EXAMINING DIFFERENCES IN MIDDLE SCHOOL STUDENT ACHIEVEMENT ON THE MATH, SCIENCE, AND SOCIAL STUDIES CRITERION-REFERENCED COMPETENCY TEST (CRCT)

by

SARAH BALLEW HICKS

(Under the Direction of Myra N. Womble)

ABSTRACT

The purpose of this exploratory, quantitative study was to determine if there is a statistically significant difference in academic achievement of students who completed a yearlong agricultural education course and students who only completed an eight-week agricultural education course in the same school, taught by the same teacher whose instruction was guided by brain-based research with regards to their scores in the math, science, and social studies portions of the Criterion-Reference Competency Test (CRCT). Existing CRCT data was used for the 2011-2012 and 2012-2013 school years for the seventh and eighth grade students who attended the researcher’s school. This static-group design study indicated that there was a statistically significant difference in the CRCT scores of yearlong students in the math, science, and social studies portions when compared to students who only completed an eight-week agricultural education course.

INDEX WORDS: Criterion-Referenced Competency Test, Agricultural Education, Math, Science, Social Studies, Integration, Academic Achievement, Brain Based Learning
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DEDICATION

This dissertation is dedicated to all the academic teachers who think their non-academic colleagues exist solely to provide them with a planning period; to the students who think all we do in agriculture class is “have fun” but learn a lot more than they meant to, and to the teachers who do not realize what a profound impact they have on students…you never know.
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If it takes a village to raise a child, it has taken an entire civilization to get this dissertation completed. First, God receives all the glory and thanks for allowing me the unique opportunity to engage in such a special journey, for putting people in my life at the right times to help guide the way, and for holding the light at the end of the tunnel, illuminating an end all this. Dr. Dennis Duncan should receive special credit for his advice, guidance, and timely feedback; what a role model and splendid example of an educator. Dr. Myra N. Womble, deserves praise for asking hard questions and giving straight-up answers, for timely email responses and countless hours of reading this dissertation. She is a proofreading savant. Although I have not had Dr. Robert Branch as a classroom professor, his insight and support as a committee member has been invaluable; when he runs for office, he has my vote. Mrs. Candi Stargell was instrumental in handling various issues that arose due to my distance from Athens and for that I am thankful, she has calmed my nerves numerous times by simply saying “I will take care of it.” Stephen Cramer also deserves thanks for helping me with my statistical insufficiencies. Like I said, God sent the right people.

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CHAPTER 1

Introduction

Congress reviewed and revised the Elementary and Secondary Act of 1965 to create the No Child Left Behind Act (NCLB) which was signed into law by President Bush in January of 2001. The law holds states accountable for students’ academic achievement and measured adequate yearly progress (AYP) for each public school (Linn, Baker, & Betebenner, 2002). In response, each state developed an assessment standard as well as proficiency standards for each core area (Reeves, 2003). Standardized testing was phased in with reading and math being the first academic areas to be tested. Science standards were to be in place by the 2005-2006 school year and standardized tests by the 2007-2008 school year. Despite science testing being a requirement, according to NCLB, science scores would not be used to calculate AYP. However, since AYP is being replaced by College and Career Ready Performance Index (CCRPI) in the 2013-2014 school year, all CRCT content area scores count towards calculating the school’s index, all subject areas are of equal importance ("College and Career Ready Performance Index", n.d.). The CCRPI’s implementation is meant to provide a more thorough examination of schools than was possible using the previous AYP system. The new system takes into account aspects of schools overlooked under AYP such as standardized testing on social studies and science, both subjects not accounted for with the AYP system.
A US Environmental Protection Agency report in 2007 indicated that 98 percent of citizens in the US do not live on a farm and that 99 percent do not engage in production agriculture. This is a very different scenario than when agricultural education was initially addressed with the Smith-Hughes Act of 1917, when production agriculture dominated the industry and the majority of the public was somehow engaged in agriculture, or at least agriculturally literate to some extent. This act endorsed and federally funded vocational agriculture in order to train individuals who worked or would enter into work on a farm (Shelby-Tolbert, Conroy, & Dailey, 2000). The gradual decline of agricultural literacy in the US is a result in this departure from farming by the populations of America. This created a deficit of knowledge or awareness in the general public about agricultural careers, issues, and general knowledge about where their food or fiber originates. Thus, a need for agricultural education exists. The first agricultural education programs in the 1830s existed to promote new methods and techniques to further agricultural production. Today, extending integration, general knowledge, appreciation, and literacy about agriculture is the goal, especially at the middle school level. Not only is agricultural education to encompass academics, but science and technology, literacy, and career preparedness are parts of the total agriculture program. Gibbs writes that traditional career exposure has occurred at the high school level, but that today, administrators and educators realize that “developing students’ interest must be addressed earlier at the middle school level” (2005, p. 1).

To meet this need, a committee for middle school improvement and the Georgia Department of Education partnered in 2005 to design a middle school curriculum with the goal of integrating academic concepts from sixth, seventh, and eighth grades as
well as develop links to careers and real-world applications of knowledge (Georgia Department of Education, 2005). Thus, the Georgia Middle School Agricultural Education Curriculum was developed to address the vast industry of agriculture for students grades six through eight. The three part model of a complete agricultural education program involves classroom and laboratory experiences, Supervised Agricultural Experience projects (SAE), and National FFA Organization activities referred to as career development events (CDE). This creates a complete agricultural education program for both middle and high school students as pictured in this image. Figure 1 illustrates this framework.

![Figure 1](image_url)

*Figure 1. Three-Ring Model of Agricultural Education*

Since the passage of NCLB, more stress is put on teachers to generate increased student academic performance and improvement of test scores. Using the three facets of an agricultural education program to reinforce academic concepts is one technique suggested to improve test scores (Martin, Fritzsche, & Ball, 2006).

One may use the Criterion-Referenced Competency Test (CRCT), as is done in Georgia, to measure academic achievement, because it creates a standardized measure of academic success. The CRCT is used in Georgia to test student skill and academic
knowledge in science, mathematics, social studies, reading and English/language arts. Each subject is tested on a separate portion of the CRCT and the assessment was designed by teachers and educational professionals directed by the Georgia Department of Education. Using CRCT scores is one way to quantify student academic success.

To address integration of academics into agricultural education, in 2007, the Agricultural Education Division of the Georgia Department of Education implemented Agricultural Education Georgia Performance Standards. In their development, academic subject standards were reviewed and identified along every agricultural education standard (Georgia Department of Education, 2011). To facilitate the state-wide curriculum, hands-on activities, problem-solving, and inquiry based techniques are utilized by agriculture educators within classroom and laboratory instruction (Parr & Edwards, 2004).

Another component of agricultural education is the Supervised Agriculture Experience (SAE). This portion of the curriculum involves extension of classroom learning and situational application of agricultural principles (Newcomb, McCracken, Warmbrod, & Whittington, 2004; Phipps, Osborne, Dyer, & Ball, 2008; Talbert, Vaughn, Croom, & Lee, 2007). There are four types of SAEs, exploratory, research, placement, and entrepreneurship, all of which are applicable to all academic subject areas. For example, the research SAE is directly related to science curriculum involving the scientific method (Roberts & Harlin, 2007). This type of SAE provides students with opportunities to apply scientific methods and concepts in meaningful, hands-on ways. This also allows students to extend their existing knowledge, reinforce concepts, and gain real-world experiences (Croom, 2008).
A 2012 study by Kronholz found that students involved in activities involving science after school had improved American College Testing (ACT) Science Reasoning scores. The idea of involving students in after school activities that directly relate to their academic learning is the foundation for involvement in the National FFA Organization. The National FFA is a nation-wide youth organization aimed at providing skill development in the areas of personal growth, career success, and leadership (Phipps, Osborn, Dyer, & Ball, 2008). This organization is dedicated to making “a positive difference in the lives of students by developing their potential for premier leadership, personal growth, and career success through agricultural education” (National FFA Organization, 2011, p. 1). The FFA is a critical component in agricultural education and sponsors student competitions called Career Development Events (CDE). The academic foundations of CDEs that students participate and compete in reflect academic concepts in a meaningful, application-based situation, thus creating opportunities for experiential learning (Gentry, 1990). For example, the Agriscience Fair CDE challenges students to use the scientific method to plan and conduct an experiment on a subject related to agriculture. Students develop their own hypothesis, carry out research by gathering, organizing, and analyzing data that was utilized to represent both conclusion and recommendations. In addition to conducting sound research practices, students must create a visual display of their activities and verbally explain the whole process to a panel of judges (National FFA Organization, 2011).

**Statement of the Problem**

Limited studies exist which offer empirical evidence of the impact that completion of a yearlong agricultural education course has on standardized academic test
scores compared to students who completed only eight weeks of agricultural education at the middle school level.

**Purpose Statement**

The purpose of this research study was to determine if there were statistically significant differences in academic achievement of students who completed a yearlong agricultural education course, being exposed to a full year of agricultural education and students who completed an eight week agricultural education course and therefore, were exposed to only eight weeks of agricultural education. The agricultural education courses were taught in the same school, by the same teacher whose instruction in both courses is guided by brain-based research. Student academic achievement was determined based on scores received on the math, science, and social studies portions of the Criterion Reference Competency Test (CRCT), a standardized test used in Georgia to test individual student performance.

**Research Questions**

1. Is there a statistically significant difference in math CRCT scores of students who completed a yearlong agricultural education course that was guided by brain-based research and math CRCT scores of students who completed an eight-week agricultural education course that was also guided by brain-based instruction, in the same agriculture program?

2. Is there a statistically significant difference in science CRCT scores of students who completed a yearlong agricultural education course that was guided by brain-based research and science CRCT scores of students who completed an eight-week
agricultural education course that was also guided by brain-based instruction, in the same agriculture program?

3. Is there a statistically significant difference in social studies CRCT scores of students who completed a yearlong agricultural education course that was guided by brain-based research and social studies CRCT scores of students who completed an eight-week agricultural education course that was also guided by brain-based instruction, in the same agriculture program?

**Theory**

Although there was no difference in the type of instruction provided to either groups being tested in this study, the amount of exposure to various topics greatly varied. Where one group only received eight weeks of instruction and topics, the yearlong group received 26 weeks and many more units of content. Because the yearlong group was exposed to more topics and received more brain-based instruction, the likelihood of them attaining content is higher. Since the state agricultural education curriculum being taught integrates academics, it is probable that their scores on academic-based standardized tests reflect the concepts that they retained due to the instruction in the agriculture classroom.

Instruction that is guided by brain-based learning theory engages techniques and methods that are guided by the brain’s development and maximizes the potential for learning. The theory holds that using a diverse array of learning experiences that match how students’ brains are developing at a given time increases the probability of learning successfully. The elements of brain-based learning theory fit the situation being studied in this research because the experiences within the agriculture classroom compliment the needs of a developing brain. There are several examples of how the agriculture
classroom at Gladden Middle School models recommendations from the brain-based theory. For example, this theory posits that activities should change within 12-15 minutes; this is the exact time-frame for activities within the researcher’s classroom. Classes utilize repetition of terms, concepts, themes, and learning daily, often restating new knowledge several different ways at various times during the duration of class. The novelty of topics and experiences are promoted to encourage contextualization and interest. For example, when teaching about animal reproduction, students have access to artificial insemination tools and mock breeding tools so they can experience what it is like to breed a cow artificially. They can examine the technology and methods rather than being limited to reading about it or watching it on a video.

**Null Hypotheses**

1. There will be no statistically significant difference at the .05 level in the science CRCT scores of yearlong agricultural education students when compared to eight-week agricultural education students.

2. There will be no statistically significant difference at the .05 level in the math CRCT scores of yearlong agricultural education students when compared to eight-week agricultural education students.

3. There will be no statistically significant at the .05 level in the social studies CRCT scores of yearlong agricultural education students when compared to eight-week agricultural education students.

**Assumptions**

1. The CRCT is considered to yield valid scores for measuring the math, science, and social studies achievement of students.
2. The agricultural education teacher at the researcher’s school teaches the agricultural education curriculum which is based on the Georgia Performance Standards.

3. Georgia Department of Education correctly reported student CRCT scores.

4. Both the yearlong and the eight-week courses were taught by the same instructor and cover the same content at a given time.

5. There are four semesters of eight-week courses taught at the researcher’s school.

6. Eight-week courses are taught using the same brain-based instruction and the same unites of instruction as the yearlong agricultural education course.

**Delimitations of the Study**

1. The scope of this study only included CRCT subjects of math, science, and social studies scores for students at the researcher’s school during the 2011-2012 and 2012-2013 school years.

2. The CRCT was the standardized instrument used to measure science, math, and social studies achievement.

3. Data set was provided by the Georgia Department of Education.

**Significance of the Study**

Georgia’s public schools have been evaluated using various measures to assess whether or not they make Adequate Yearly Progress (AYP). Those measures have been replaced by the Georgia College and Career Readiness Performance Index (CCRPI) beginning with the 2013-2014 school year. Under this new system, schools receive points for standardized testing scores, student attendance, pathway completion, and other criteria. Academic achievement on standardized tests is one major source of points under this system. Being able to show a connection between completion of a yearlong
agricultural education course and increased scores on the middle school standardized test, the Criterion-Referenced Competency Test (CRCT), lends credibility to yearlong agricultural education courses and to the potential impact agricultural education has on the entire educational experience of students. Showing that students who complete a yearlong agricultural education course score higher on the CRCT compliments the agricultural education curriculum and proves its value with regard to CCRPI scoring.

**Operational Definitions**

**Agricultural Education** – A Career and Technical Education program available to 6th through 12th grade students in public school. The whole program involves three equally important segments; FFA, SAE, and classroom/laboratory curriculum and instruction. Agricultural education may also be referred to as Vocational Education or Agriscience Education (Phipps, Osborn, Dyer, & Ball, 2008).

**Adequate Yearly Progress (AYP)** – This 2001 educational reform was signed into law and holds all US public schools accountable by measuring adequate yearly progress using standardized tests (Reeves, 2003).

**Brain-Based Learning Theory** – The engagement of strategies and teaching methods that engage the developmental stages and mechanics of how the brain works in the context of education (Hileman, 2006, p. 18).

**Career Development Event (CDE)** – One third of the total agricultural education program. These are competitive experiences which provide opportunities to utilize problem-solving, investigative, and diagnostic skills to career areas such as Animal Science, Nursery Landscape, Forestry and Natural Resources, Public Speaking, Agriculture Mechanics, and Agriscience (National FFA Organization, 2011).
Career, Technical, and Agriculture Education (CTAE) – Refers to the courses or programs that provide students with both academic and real-world experiences in order to prepare them for employment in the 21\textsuperscript{st} century (Roberson, Flowers, & Moore, 2000, p. 32).

Classroom and Laboratory Instruction (CLI) – Instruction which promotes educational experiences which utilize school classrooms as well as specialized facilities such as greenhouses, school barns, canning plants, forestry plots, and classroom laboratories (Croom, 2008).

College and Career Ready Performance Index (CCRPI) – An platform for comprehensive school accountability, improvement, and communication that is designed to prepare Georgia students for both college and careers ("College and Career Ready Performance Index", n.d.).

Criterion-Referenced Competency Test (CRCT) – Standardized test designed to assess students’ level of skills and knowledge as they relate to the Georgia Performance Standards (GPS) (Georgia Department of Education, b, 2005-2006).

Curriculum – Educational experiences which are planned and facilitated by the school (Smith, 2000).

Curriculum Integration – Act of involving or embedding academic concepts into other realms. This act encourages students to make connections between the academic and non-academic, real-world scenarios (Zirkle, 2004).

Epistemology – The study of knowledge or “way of knowing” (Imel, 2000).
Georgia Performance Standards (GPS) – Curriculum guidelines that outline objectives for students to master. These are set forth for educators by the Georgia Department of Education (Georgia Department of Education, b, 2005-2006).

Hatch Act of 1887 – This act provided federal land grants to states in order to create agricultural experiment stations. These stations worked collaboratively with the land-grant colleges and universities which were established under the Morrill Act of 1862 (The Morrell Act of 1892, 1862).

Middle School Agricultural Education Programs – Complete agricultural education programs following the Georgia Performance Standards set forth by the Georgia Department of Education for middle school agricultural education classrooms. These programs are intended to introduce agriculture, promote agricultural literacy and awareness as well as expose students to the broad career opportunities within the agricultural industries and related fields (Committee for Middle School Improvement Progress and the GA Department of Education, 2005).

Middle School Students – For the purposes of this study, middle school students are public school students in grades six through eight.

Quasi-Experimental Model of Research – A type of research model that attempts to investigate relationships between at least two variables. Method is used extensively in social science experiments (Burris and Garton, 2007).

United States Department of Agriculture (USDA) – This Federal Executive Department develops and oversees the execution of farming, agriculture, and food policy ("U.S. Department of Agriculture", n.d.)
CHAPTER 2

Review of Literature

The goal of this review of literature is to establish the foundation for the importance of this study with regards to academic achievement on the CRCT and involvement in agricultural education. The underlying topics addressed through this literature review are: (A) history of agriculture as a field of study; (B) agricultural education curriculum; (C) teaching strategies; (D) academic integration; (E) academic achievement influenced by agricultural education; (F) recommendations; and (G) summary.

**History of Agriculture as a Field of Study**

Although today the field of agricultural education is highly standardized with grade-specific state standards and end-of-course-tests, this has not always been the case. Benjamin Franklin encouraged the teaching of agriculture as early as 1749 although his vision was not commonplace at that time (Shelby-Tolbert, Conroy, & Dailey, 2000). However, the early 1800’s saw governmental encouragement to supplement the national educational system with agriculture instruction (Hillison, 1989). Despite such encouragement it was not until 1821 that the first agriculture programs were installed, the first being in Gardiner, Maine, followed by some in Maine and Massachusetts; all in secondary schools (Shelby-Tolbert, Conroy, & Dailey, 2000). Also, little was being done at this time to address agricultural education or outreach to the populations of farmers and agriculturists. To address this, Congress created the Department of Agriculture in 1862
with the goal of distributing information about agriculture to the public. That same year the Morrill Act was passed, providing the nation’s initial legislation addressing the development of schools for agricultural education at the post-secondary level. Under this legislation, every state was given 30,000 acres for each congressional seat they held on which to construct a university. These universities would teach “manual arts” such as agriculture, military studies, and mechanics (The Morrill Act of 1862). They were also charged with the task of studying and developing improved methods for animal and crop production. This landmark effort challenged for the first time traditional methods of farming and marked the initial attempts to improve them by the government on behalf of the people’s interest (Phipps et al., 2008). Farming techniques prior to this time were handed down through generations by parents to their children who became agriculturists in their footsteps; little advances had been made in techniques or equipment. This all changed, though, as land-grant colleges developed and birthed an age of investigation, research, and formalized agricultural education (National Research Council, 1988).

Continued governmental support took shape in the form of various legislation that extended the realm of agricultural education and development and set aside government funds to continue that extension and growth. This commitment to research and development took shape in the Hatch Act of 1887 which provided funds to create experiment stations at land-grant colleges in order to find solutions to problems associated with the food and fiber industries (Phipps et al., 2008). These stations worked collaboratively with the land-grant colleges and universities which were established under the Morrill Act of 1862 (The Morrell Act of 1862, 1892).
Shortly after this in 1914, the Smith-Lever Act provided a means to disseminate the new information, techniques, and research being done at the experiment stations to the public. The arm of this branch was named the Cooperative Extension Service. This service was, in essence, a vehicle to carry information from researchers to the masses, especially in rural areas (Croom et al., 2005). The Cooperative Extension Service also came along with a financial commitment from the national government to fund high school vocational agricultural education (Federal Bureau of Vocational Education, 1917). The momentum of support and the placement of agriculture development and research as a top government priority set the stage for agricultural education to take its place in high schools throughout the nation. The new techniques and technology being developed at the colleges led to the growth in farm size and scope, increasing the need for more education and development. This need was met by the Smith-Hughes act of 1917 which provided funds for high school vocational agricultural education throughout the US (Federal Bureau of Vocational Education, 1917).

As farms expanded in their reach and technology, a consolidation of governmental efforts to support agriculture in the nation was necessary. The Memorandum of Understanding Agricultural Education and Extension joined together Agricultural Education and the Cooperative Extension Service in 1928 (Jardine, W. & Davis, J., 1928). This document itemized each body’s responsibilities and outlined the ways each should cooperate with the other. It was a step in the direction of formalized agricultural education. At this time, although high school agriculture programs were becoming common, little was done to supplement middle school instruction with agricultural education. Virginia was home to the earliest reported program in 1926 which
only taught eighth grade. Seventh grade programs evolved in Virginia by 1930 and sixth grade programs began in Mississippi in 1974 (Rossetti & McCaslin, 2002). No formal curriculum or guidelines existed at this time to address this age group.

In 1963, the most significant legislation which addressed vocational education was heralded by its champion, a representative from Kentucky named Carl D. Perkins, and passed as The Vocational Education Act of 1963. This legislation provided funds to maintain and improve existing agricultural education programs, create new programs, and provide part-time jobs for students to earn money in order to finance their continued vocational-education studies full-time (Phipps et al., 2008). This act was amended in 1968 and 1977, each time extending the reach and use of funds for the advancement of vocational education. In 1984, the Carl D. Perkins Vocational Education Act was signed by Ronald Reagan, becoming Public Law 98-524, and greatly improving the outlines and promotion of vocational education. This was landmark legislation for agricultural education as it not only strengthened its place in public schools, but provided money for reinforcing math and science standards by establishing the National Council for Vocational Education (Phipps et al., 2008). This set the precedent for integration of academics and vocational education which was reiterated with the Act’s reauthorization in 2006 which again, reinforced the focus on academic standards and required states to create ways to increase state and local accountability. The reauthorizations also increased the focus on career and technical education students’ academic achievement (Phipps et al., 2008). For the first time in history, agricultural education was viewed as an arm of academia. Thus, the marriage between academics and vocational education was formalized and on its way to being standardized.
As a field of study, agricultural education experienced a major transition in scope and purpose during the subsequent years since Perkins legislation initiated a focus on academics instead of production agriculture techniques. In 1988, the National Research Council issued a report which addressed their concern for agricultural literacy and education (National Research Council, 1988). Their report recommended that agriculture be taught as a context for scientific principles, specifically biology, as use of real world scenarios in agriculture, such concepts can effectively be incorporated. Furthermore, through such integration, agricultural literacy and education can be enhanced thoroughly. This study further solidified the relationship between agricultural education and academics and increased the urge to integrate the two on both the K-12 and secondary education levels.

**Agricultural Education Curriculum**

The goal of agricultural education is to make a “positive difference in the lives of students by developing their potential for premier leadership, personal growth, and career success through agricultural education (“Who We Are”, n.d.). Agricultural education provides the training and education needed to meet the needs of the vast industry it serves. There are three components to agricultural education curriculum (see Figure 1): classroom and laboratory instruction, supervised agricultural experience programs (SAE), and FFA leadership activities referred to as career development events (CDE). Each of these three reinforces the other as well as incorporates academic concepts throughout. The illustration of this framework was seen in Figure 1.

Efforts to determine the course of development of the three branches was completed by Croom (2008). His research involved historical documents and acts of
legislation. He found that the initial component to develop was the SAE element, followed by standardized instruction, then the formation of the National FFA Organization. He also determined that all three are interconnected and equal in importance. SAE programs involve a variety of industries, skills, and hands-on experiences that reflect each student interests individually. These extra-curricular learning experiences take place out of the classroom, often in the community, and reflect classroom learning and real-world application of skills or knowledge learned through agricultural education instruction. They expose students to agriculture industries, careers paths, as well as help develop job-related skills.

Social cognitive theory teaches that learning experiences shape the academic and career-related choices of students (Carnes et al., 1995). In short, this theory posits that the social aspect of a situation has a tremendous influence on the ability of a student to learn. A Texas study found that in a group of 595 ninth graders, those who were involved in extra-curricular activities were much more prepared to make career-related choices than those who were not (Carnes et al., 1995). Research by Eccles et al. in 2003 indicated that students who were involved in “constructive, non-academic activities both at school and in the community” were more likely to be engaged in the school as well as academic achievement. They also experience more positive development throughout their adolescence (p. 883). This ideal supplements earlier research by Eccles and Barber who found that student’s choices about their activities are actually part of a larger psychological system that influences students’ self-identity and development (1999). Involving students in experiences that involve problem solving, goal setting, intentional and goal-oriented effort, as well as time management undoubtedly influence student’s
identity development in addition to exposing students to contextual learning and management of one’s self (Hansen, et al., 2003). Figure 2 provides a model depicting how the level of student involvement and the types of experiences students have relate to their knowledge retention.

**Figure 2. Activity Type-Retention Relationship**

Classroom and laboratory instruction is directed by the Georgia Performance Standards and focuses on agricultural literacy, natural resources, leadership, agriscience, and horticulture in the seventh grade. Eighth grade standards involve a wider range of concepts including those covered in seventh grade as well as the scientific method, agricultural production, environmental horticulture, and forestry (“Middle School CTAE Courses, n.d.). Yearlong students are exposed to the entire curriculum while eight-week students are exposed to only a quarter of the topics included in the curriculum; exact units covered for eight-week students depends on the time of year they are enrolled in the agriculture class. For example, while the yearlong students receive at least 23 different
units of brain-based agricultural education instruction that covers a variety of topics and academic integration opportunities (see Figure 3), the eight-week students only receive 3 to 4 units of similar instruction due to the amount of time they are enrolled in the class. The opportunities for exposure to agricultural education curriculum is severely limited for the eight-week students who only experience one quarter of the material being covered in the yearlong class.

<table>
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<tr>
<th>7th Grade Yearlong Curriculum</th>
<th>8th Grade Yearlong Curriculum</th>
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<tbody>
<tr>
<td>Agricultural Literacy</td>
<td>Agriculture and Society</td>
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<tr>
<td>Lab, Shop, Greenhouse Safety</td>
<td>Innovations and Agricultural Research</td>
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<tr>
<td>By-Products</td>
<td>National FFA Purpose and Elements</td>
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<tr>
<td>Agricultural Careers</td>
<td>Agriculture in America</td>
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<td>Agriculture in Georgia</td>
<td>Supervised Agricultural Experiences</td>
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<td>FFA Orientation</td>
<td>Career Development Events</td>
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<td>National FFA Structure and History</td>
<td>Communication</td>
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<td>Supervised Agricultural Experiences</td>
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<td>Natural Resources</td>
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<td>Conservation</td>
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<tr>
<td>Nonrenewable and Renewable Resources</td>
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<td>Livestock Industry</td>
<td>Poultry Production, Management and Evaluation</td>
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<td>Poultry Industry</td>
<td>Equine Production, Management and Evaluation</td>
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<tr>
<td>Dairy Industry</td>
<td>Livestock, Production, Management and Evaluation</td>
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<td>Equine Industry</td>
<td>Natural Resources</td>
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<tr>
<td>Plant Reproduction</td>
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<td>Wildlife Management</td>
<td>Soil Sciences</td>
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<tr>
<td>Forestry Industries</td>
<td>Greenhouse Management</td>
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*Figure 3. Curriculum Outline*
Role of Extracurricular Activities on Student Attendance and Academic Achievement

Much research has been done to identify a relationship between student academic achievement and involvement in extracurricular activities. In fact, not only does involvement in extracurricular activities influence academic success, involved students are exposed to more role models, access to more resources, opportunities to learn time management, team work and, communication skills, as well as be exposed to peer pressure that likely motivates students to perform positively academically (Kronholz, 2012). In a study by Reeves, it was seen that students who took part in three or four extracurricular activities during the year had “dramatically better grades than those who” were not involved in any (2008, p. 86). One might assume, however, that the better achieving students are the ones who would naturally be involved in various extracurricular activities and, therefore, would have good grades anyway. In a study by Kronholz it was found that efforts to recruit low-achieving students whose attendance or grades might have traditionally prevented them from participation in an after-school activity were successful in causing an increase in participants’ grades after involvement began (2012). In another study that differentiated between the types of extracurricular activities and their relationship to academic achievement it was found that students who are “involved in activities outside the school day yielded better academic performance, especially those that participated in study-related activities” (Moriana et al., 2006, p. 38).

Teaching Strategies

As an application-based industry, agricultural education employs a wide variety of teaching strategies and methods to address the state standards. Much research has
been done to investigate the CTE curriculum as well as the techniques and methods used therein, especially with regards to academic integration. Roberts (2006) conducted a philosophical study in which experiential learning theories were surveyed and templates developed to be utilized in agricultural education. The study focused on learning theories from David A. Kolb, Lloyd J. Phipps, Edward W. Osborne, Laura Joplin, and John Dewey. Roberts found that experiential learning was widespread in secondary agricultural education and that inquiry-based learning and problem-solving were also commonplace. Robert's and Ball in 2009 found that current agricultural educators taught content for employment skills as well as integrated academics using agricultural contexts. Common theories that were identified in agricultural education classrooms included curriculum theory, inquiry based, problem-solving theory, contextual learning theory, experiential learning, reasoned action and planned behavior theories, social cognitive theory, and brain-based learning theory. Theories of learning describe conceptual frameworks for how knowledge and information is absorbed, internalized, and retained. Several factors play a role in this process and how those factors interact and impact each other has a direct effect on the learning process.

Curriculum Theory

The study of curriculum has been examined by many scholars and researchers throughout the years of structuralized education. The writings of Franklin and Bobbitt in the early 1900s reflect the idea that the objectives of curriculum should be to produce in students the knowledge, skills, and abilities needed to live in the real world. The objectives, which are definite, particularized, and numerous, should prepare students to perform real-world tasks (Smith, 2000). This mirrors the ideals of scientific
management, an organizational reform trend in the early 1940s developed by R. W. Taylor which focused on teaching or training individuals on the basic, most consequential elements of something. If applied within a school, students would be taught a skill and made to practice that skill until mastered without gaining exhaustive knowledge about the job being practiced or the reason behind the technique. If applied to industry, workers would be trained in a specific task and not taught any more than they absolutely had to know in order to perform their jobs (Smith, 2000). These ideals differ from the proposed curriculum goals of John Dewey who felt that curriculum should prepare students to function in society and that knowledge should be connected with the learner’s real life (Smith, 2000). In both cases, curriculum referred to the process of deciding what should be learned and how it should be taught to students.

How does this relate to current curriculum theory? The influences of such ideas caused educators and eventually lawmakers to examine the structure of what is taught in schools. Curriculum theory emerged to guide the process of developing curriculum as it still does in the contemporary educational landscape. The theory is based on the concept that curriculum should be planned, guided, organized, and should address the following questions (Popkewitz, 2009).

- What educational goals should curriculum attempt to attain?
- What experiences should be provided to meet those goals?
- How should these experiences be organized?
- In what way can progress towards goals be measured?

Modern curriculum theory is highly subjective, being influenced by the learning theories, goals, and values of those developing the curriculum. For example, curriculum theory
calls into question the value system of educators by questioning such things as whether or not ethnic studies should be included, how much data will drive curriculum decisions, what types of career, technical, and agricultural education programs will be offered to students, or how will the school system’s goals be met.

When applied to research about academic performance on standardized tests of students who completed a yearlong agricultural course and those that completed only an eight-week course at the researcher’s school, curriculum theory offers some insight to differences in performance. Curriculum for all agriculture classes in Georgia are developed and followed by Gladden’s agriculture teacher. Both groups of students received state-approved instruction at the same level; however the yearlong students were exposed to more topics due to the length of time spent in the class. The depth of study into any given subject, however, was not quantifiably different between the two groups. Therefore, differences in academic performance cannot be said to be solely the result of curriculum.

**Similar and Different Theoretical Elements**

It may be said that curriculum theory shares similarities with each and every learning theory known to man. This is because curriculum development can reflect elements of any or all learning philosophies to some degree. Of course, should the designer of that curriculum desire, curriculum can be made to reflect one or a combination of a few learning theories. But, to assign just one as a “match” for curriculum theory is impossible without knowing the goals, methods, and techniques intended to be used within the curriculum.

**Philosophic Orientations and Epistemological Assumptions**
It is difficult to designate curriculum theory with a philosophic orientation or epistemological assumption. Curriculum theory is comparable to a paint brush and a palette of paint in that what results is in the artist’s control, the brush and paints are just the way in which the artist’s goals are expressed. Whomever is designing the curriculum is more in control of what curriculum results, and it is their beliefs about educational philosophy and epistemology that determines the shape and scope that curriculum takes. The “theory” part comes in the path that curriculum development takes, being guided by the specific goals and influenced by the unique resources available at the time.

**Inquiry-Based Learning**

Research by Thoron and Myers in 2011 involved 15 agriculture classes in seven high schools; all of which were taught by graduates of the National Agriscience Teacher Ambassador academy (NATAA). The study utilized a quasi-experimental model as well as pre- and post-tests instruments on seven units of instruction. Data was analyzed using Kuder-Richardson 20 and research proved that higher post-test scores resulted in groups of students who received inquiry-based instruction versus those who received instruction otherwise. From a qualitative standpoint, Grady, Dolan, and Glasson (2010) conducted research using one teacher and fifteen students, grades eight through ten who were involved in Partnership for Research and Education in Plants (PREP). Teacher and student comments and actions were coded and analyzed, concluding that the integration of science into their agricultural education curriculum improved student acquisition of science knowledge and skills.

The hands-on aspect of classroom and laboratory experiences within an agricultural education program has an influence on student learning. Myers and Dyer
studied Florida secondary students who took a basic agricultural education course in order to see how laboratory experiences influenced comprehension of content and science processes (2006). Three categories of instruction were used: exploratory laboratories, predetermined laboratory experiments, and no laboratory experiences. They used pre-and post-tests as instrumentation to measure science skill abilities. Data was analyzed with descriptive statistics, MANCOVA, Hotelling’s Trace, multivariate analysis of covariance, and backward regression of analysis. The researchers concluded that exploratory laboratory experiences resulted in the highest levels of science-related skills (2006).

**Problem-Solving**

Parr and Edwards confirmed the availability of experiential learning and problem-solving tasks in agricultural education in a 2004 study that reviewed a wide range of literature involving both agricultural education and teaching techniques within that realm. They reviewed national commission reports, magazine and journal articles, professional research, as well as doctoral dissertations and found that problem-solving processes were equitable to inquiry-based methods and that opportunities abound in agricultural education for both. A quasi-experimental, non-equivalent comparison group investigation by Burris and Garton (2007) also found that students involved in problem-based learning scored higher in tests of critical thinking than those who were not involved in problem-based learning. The study focused on 140 Missouri students in twelve high school agriculture programs who were enrolled in Ag Science II or a Natural Resource/Conservation class that were taught a unit about management of quail. Seventy-seven students were taught using problem-based learning while the remaining sixty three
were not. Using the Watson-Glaser Critical Thinking Appraisal as an instrument, descriptive statistics and ANCOVA were used. It is interesting to note that in this scenario, although the treatment group received higher critical thinking scores, their scores in the content area were lower than the control group’s using the content testing instrument.

**Contextual Learning Theory**

This learning theory is the result of work by John Dewey in the early 1900s. Contextual learning posits that curriculum and methodologies should mirror real world application and be linked to student interests and experiences. These experiences should be deeply rooted in situations that require students to actively engage in critical thinking and internalization of knowledge (Hudson & Whisler, 2008). This theory emphasizes problem-solving and inquiry-based approaches to learning. When applied to the research questions comparing academic success of completers of a yearlong agriculture class to students who completed only an eight-week agriculture class, contextual learning theory may account for some of the difference. However, since both classes were taught the same content in the same way, it would be more likely that this theory does not account for a variation in academic success. A more appropriate way to test if this theory had an effect on academic achievement would be to create a control group of students who were not taught a concept with contextual elements and an experiment group that was taught the same concept using contextual methods which emphasized active problem-solving. Assuring that both groups were otherwise equal, assessing each with a pre- and a post-test, then measuring gain would be a good quantitative method of studying the role contextualized learning played in their achievement. Student surveys and interviews
about the methods of instruction would be an acceptable quantitative method or, utilizing both and create a mixed-method study to give a thorough glimpse of the role contextualized learning played in achievement.

**Similar and Different Theoretical Elements**

Contextual learning theory shares elements with planned behavior theory in that for both, planned, purposeful educational experiences are vital. For example, if a student actively begins a learning experience and actively engages critical thinking (especially if the goals of that learning experience are relatable and applies to the student), they are more likely to learn. Also, experiential learning theory shares the elements of real-world experiences within the contextual learning theory, both emphasizing that students are more engaged and active in the learning process when the educational experiences mean something to them personally. In the eight week agricultural education course at the researcher’s school, students are exposed to a limited amount of such experiences when compared to the amount of topics and units covered in the yearlong class. For example, the eight-week students may receive instruction in environmentalism and water pollution, but not have time to experience outdoor investigations, labs, and Supervised Educational Experiences in these subjects. Experiential learning stresses in that the process of and reflection upon learning is the most important thing, even if the result of the experience is not what was initially intended (Northern Illinois University, 2011). Having limited time to participate in such experiential tasks in an eight week class limits the students ability to truly engage in the material.

**Philosophic Orientations**
Contextual learning is rooted in constructivism as well as pragmatism, and active learning philosophies. Constructivism holds that people learn by interacting with their environment and constructing meaning through experiences (Imel, 2000). This nicely compliments contextual learning by allowing the student to learn elements of the curriculum through experiences that are authentic to him or her. Allowing the student to think through experiences allows them to internalize information more effectively (Blanchard, n.d.). Pragmatist learning theory assumes that education should train students to think critically and become engaged in problem-solving, especially in the use of the scientific method (Imel, 2000). With emphasis on the problem-solving higher-order thinking, contextual learning fits well into the active learning philosophy. Also, a facet of active learning is the concept of putting students in real-life circumstances and allowing them to think themselves through a situation. This method has been called “learning by doing” and involves conscientious, contextual learning (Hudson & Whisler, 2008, p. 55).

Yearlong students at the researcher’s school engage in constructivist activities more frequently than eight week students due to the extended time in the class. For example, to learn plant reproduction, yearlong students set up experiments in the greenhouse and facilitate agriscience projects dealing with sexual and asexual propagation. They take plant cuttings and attempt to root them, plant seeds, and learn aspects of plant reproduction. Due to time constraints in the eight week class, students cannot engage in such activities; therefore, they must experience these concepts in an abridged version, using videos and virtual experiments that can be quickly accomplished. The eight week students do not engage in thorough Supervised Agricultural Experience
projects or Career Development Events due to the short amount of time they are in the agriculture class. This drastically alters their ability to construct projects that fit their interests and apply what is being learned in their agriculture class to real-life situations, thereby reinforcing the content and making it more meaningful.

**Epistemological Assumptions**

Contextual learning is characterized by the following epistemological assumptions (Imel, 2000).

- the process of problem solving is vital to knowledge acquisition
- self-monitoring by student in order to become self-regulated learners
- learning experiences must be anchored in diverse real-life context
- students may learn from one another
- teaching and learning should occur in many contexts
- authentic assessments are most meaningful

**Experiential Learning Theory**

Experiential learning theory evolved as part of the humanistic approach to psychology. Carl Rogers developed this theory, publishing his book *Freedom to Learn for the 80’s* in 1983. In this work, he distinguished two types of learning: cognitive and experiential. Cognitive knowledge refers to academic principles like multiplication tables and formulas while experiential knowledge includes applied concepts like how to build a barn or replace a fuel pump on a motor (Knobloch, 2003). The distinction between the two lies in the ability of the knowledge to meet the needs of the learner. Rogers posits that the experiential learning involves personal involvement of the learner, learning that is self-initiated and evaluated by the learning, and has a pervasive effect on
the learner (Roberts, 2006). Within this learning theory, experiences like internships, field work, service learning opportunities, and volunteer experiences that reflect the student’s interests are the most meaningful. This theory fits nicely with the concept of Career Development Events (CDE) and Supervised Agricultural Experiences (SAE), both facets of the National FFA (National FFA Organization, 2011). For this reason, there may be a difference in academic achievement of students to engage in SAEs and CDEs when compared to those who do not. Students who complete a yearlong agriculture class are required to have an SAE, and many choose to compete in CDEs. Students who complete an eight-week agriculture class do neither.

**Similar and Different Theoretical Elements**

Experiential learning shares similarities with contextual learning in that they both adhere to constructivist philosophies. They differ, however, because within experiential learning, focus is not on student problem solving, but how meaningful the experience is to the student (Knobock, 2003).

**Philosophic Orientations and Epistemological Assumptions**

From a philosophic standpoint, experiential learning is seen as a form of authentic learning. Epistemologically, authentic learning is similar to constructivism, both believing that students construct meanings from experiences. Under these theories, learning occurs once learners create “their” version of reality based on what they know and their experiences (Knobock, 2003).

**Reasoned Action and Planned Behavior Theory**

In 1980, Ajzen and Fishbein developed the theory of reasoned action (TRA) after attempting to estimate the difference between behavior and attitude. They determined
that intentions predict behaviors. Intension is defined as “readiness” and is determined by a person’s attitude towards the behavior, subjective norms, and their behavioral control. In short, a person’s intention to perform a behavior determines whether or not that behavior occurs. Furthermore, one’s intention is dependent on his or her attitude about the behavior and his or her subjective norms (Theory of Reasoned Action, n.d.).

Once the TRA was developed, Ajzen and Fishbein determined that additional input is required to fully understand intention and they formulated the theory of planned behavior from the foundations of TRA. Planned behavior theory says that only very specific attitudes toward a specific behavior can predict the behavior. In addition, this theory added that a person’s perception of how other people view a specific behavior has a tremendous impact on their intention to exhibit that behavior. Lastly, perceived behavioral controls also have an impact on intention. This refers to a person’s perception of whether or not they can perform the behavior.

**Similar and Different Theoretical Elements**

The main difference between TRA and the theory of planned behavior is that the latter includes self-efficacy, or a person’s beliefs about their ability to do something. Otherwise, both theories attempt to predict behaviors based on quantifiable factors. When applied to learning, these theories speculate that if one intends to learn, his or her peers believe learning to be acceptable, and he or she perceives they are able to learn, learning is more likely to take place. None of the other theories discussed here deal with the intention to learn. However, when applied to the study of academic achievement of students who completed a yearlong agriculture class compared to those that completed an eight-week course, this theory would only be applicable if the groups initially intended to
be academically successful. Meaning that the group assumed to have more academic
achievement (the yearlong group) would have had to consciously intended to learn more,
felt their peers deemed it acceptable to be more academically successful, and believed
themselves capable of being more academically successful. Since none of the students
had any control over their placement in the yearlong class, it is unlikely that they set out
at the beginning of the year with the goal of being more academically successful than
they would be otherwise.

**Philosophic Orientations Epistemological Assumptions**

The theory of reasoned action and its updated version, theory of planned behavior,
can be applied to any philosophic model. Epistemologically, the learner’s “way of
knowing” is directly influenced by his or her perceptions about what is being examined.
The learner’s intention to learn or participate in the educational experience is not
dependent on the experience, but instead on the learner’s perceptions about the
experience, subjective norms, and their perceived ability to participate in the activity.
Therefore, these theories can be applied to any learning model or philosophic school of
thought. There is a relationship between the learning experience and the quality of
learning that takes place, however. If the learning experience is favorably viewed by the
learner, his or her peers, then the learner is more likely to learn from it, regardless of the
model or philosophic orientation of the learning experience.

**Social Cognitive Theory**

Developed by Albert Bandura in the 1970s, social cognitive, or social learning
theory, stems from the work of Neal Miller and John Dollard’s social learning theory
work in 1941. Their research found that behaviors are learned through observation and
imitation. Bandura’s extension of their findings included an emphasis on observing other’s behaviors, emotional reactions and attitudes. Social cognitive theory explains behavior as a perpetual relationship between environmental, cognitive, and behavioral influences (McLeod, 2011).

Bandura classified three basic sources of observational learning. The first of these are learning from a live model, like a parent, teacher, or mentor. Secondly, verbal models of instruction come from explanations of a behavior that the learner hears. Lastly, characters or people in the media, books, and films serve as symbolic models of instruction. When applied to an examination of differences in academic success of students who completed a yearlong agriculture class compared to those that completed an eight-week course, this theory offers little significance to findings because both classes received the same model and opportunities for observation. The difference in the two groups might lie in their self-efficacy, but it would be difficult to determine if academic success was solely a result of the groups’ differences in this respect.

Utilizing the potential of social cognitive theory is one method the researcher facilitates the FFA chapter and promotes participation in agricultural education. For example, engaging “popular” or influential students in the agriculture classroom, decorating bulletin boards with pictures of such students and their Supervised Agricultural Experiences, Career Development Events, or just doing activities within the classroom helps promote the image of the agriculture program. By letting other students see that the program is not “redneck” or that is has something to offer to the band members, athletes, quiz bowl participants, as well as the student who does not yet engage
in any school-related activity helps promote the diversity of an agriculture program and make students more confident in their participation.

**Similar and Different Theoretical Elements**

The theory of social cognition stands in contrast to behaviorist theories because these theories assume that behaviors are a result of external factors. Bandura theorized that introspection and reflection of the learner about the behaviors being observed or modeled is what allows individuals to make sense of information. Instead, social cognitive theory is in unison in the humanistic views of learners, believing that learners are actively engaged and involved in their development. His theory also accounted for how individuals feel about themselves, much like TRA and theory of planned behavior (Pajares, 2002).

**Philosophic Orientations**

Bandura’s social cognitive theory has roots in behaviorism, believing that experiences cause learning, feedback promotes learning, and that punishments and rewards/reinforcements influence behavior. Difference is found in where learning occurs or can be seen. Behaviorism posits that an observable change in behavior is learning while social learning theory claims that learning occurs internally and may not be indicated by a behavioral change (Pajares, 2002).

**Epistemological Assumptions**

According to social learning theory, the learner’s “way of knowing” is a result of their perceptions of what they are observing. Their thoughts and feelings, reflections upon, and feelings about themselves all merge to have a combined influence on learning.
Academic Integration

The idea of integrating curriculum into agricultural education programs has been a popular ideal for many decades (National Commission on Excellence in Education, 1983; Roberts & Harlin, 2007, p. 48). The benefits of such integration are valued by agriculture and science teachers alike. Several government and professional organizations also support endeavors of collaboration and integration. Recently, in efforts to strengthen the relationship between academia and agricultural education, the United States Department of Agriculture sponsored a grant program which was intended to help agricultural education by incorporating agriscience into business and consumer education programs. The goal was to prepare more students to pursue agriscience and agribusiness as careers (Cooperative State Research, Education, and Extension Service, U.S. Department of Agriculture, 1999). It is thought by some researchers, that there is great need to “beef” up instruction in the science fields in order to compete “for global economic leadership” (Myers & Washburn, 2008). Roberts and Ball write that “agricultural education has dual outcomes: a skilled agricultural workforce and successful citizens that are agriculturally literate contributors in a democratic society” (2009, p. 81). To accomplish this, today’s agriculture educators teach “both agriculture content and knowledge from other domains, yielding integrated curriculum” (Roberts & Ball, 2009, p. 87).

The American Association for the Advancement of Sciences encourage educators to build connections between existing student knowledge, newly acquired skills and information, and real-world scenarios or the world of work (American Association for the Advancement of Science, 1993). “From a theoretical perspective, education with the
purpose of acquiring knowledge and skills in preparation for a job aligns with
behaviorism, in that learning leads to an observable change” (Roberts & Ball, 2009, p. 83). Even from the earliest agriculture curricula, agricultural education held specific skill acquisition as a high priority. The shift in the current educational paradigm lies in the idea that the agriculture classroom is a valid context for cross-curricular skill as well as knowledge acquisition. Under this idea, agriculture is the context for constructivist learning in which learning occurs in “authentic settings” which are relevant to learners (Roberts & Ball, 2009).

Integration is not a new phenomenon or ideal urged by academia. “The call to integrate academic education with career and technical education has been made by educators, supported by business and industry, as well as by professional and academic organizations, and articulated by policy makers in the 1990 Carl Perkins Amendments” (Warnick & Thompson, 2007). Within this piece of legislation, educational reforms encouraged vocational and academic teachers to collaborate on pedagogy, multidisciplinary integration, and to create realistic learning experiences (Stephenson & Warnick, 2008). Research has thus far been conducted by various institutions on numerous topics dealing with science integration in the agriculture classroom setting. Much of this research has been done using the reasoned action theory. Within this theory, behaviors and intentions of individuals are studied extensively. Focus is given to predicting behavior of an individual, the roles of attitudes, norms, and efficacy as they relate to one another and become factors influencing the individual’s intention to perform a specific behavior (Bleakely & Hennessy, 2012). According to this research model, deciding, and following through with incorporating science curriculum into an agriculture
classroom would be studied and a degree of teacher intention to integrate curriculum would be determined. This correlates well with the reasoned action learning theory that indicates if the teachers intend to integrate, they are more likely to do so and be more successful with doing so. The factors that exist within the reality of “participators” would be correlated and predictability of such individuals would be determined. This model compliments Ajzen and Madden’s theory of planned behavior (Myers and Washburn, 2008). According to this theory, one’s behavior/decisions are determined by their intention to perform the behavior or decision. In turn, intensions are influenced by attitude, subjective to social norms, and perceived as behavioral control (2008).

**Historical Background and Legislation Regarding Integration**

The integration of academic curriculum into agricultural education programs has been the topic of much interest and discussion for many years (Thompson & Warnick, 2001). In fact, the integration of science into agriculture program instruction has been discussed and supported by teachers, business and industry, professional organizations, as well as policy makers for over a decade (Balschweid, Thompson, et al., 2000; Warnick & Thompson, 2007). The 1988 release of a report by the National Research Council caused increased research in agricultural education, especially regarding the profession’s capacity and willingness to integrate science concepts into agriculture classrooms (Myers, Washburn, & Dyer, 2004). Policy makers in the Carl Perkins Amendments echoed the call for science integration in 1990, realizing the need to “beef” up instruction of the sciences in order to compete for “global economic leadership” (Warnick & Thompson, 2007, p. 75; Myers & Washburn, 2008, p. 27; Wilson & Curry, 2011). The re-authorization of the Carl D. Perkins Career and Technical Education Improvement Act
of 2007 further encouraged science integration into agricultural education. This act shaped the future of the curricular focus of Career and Technical programs, requiring student attainment or achievement of academic content standards be measured by the state. This legislation also outlined an expectation that agriculture teachers share the responsibility of preparing students to meet the science standards (Washburn & Myers, 2010).

Integration into Agriculture: Logical and Practical

In addition to the government, private entities have also recommended using interdisciplinary links, real-world and workforce connections to bridge what students are learning in school to something applicable and meaningful. The American Association for the Advancement of Sciences encourages such activities, supporting the idea that the mind seeks meaning in context, allowing meaningful relationships to be formed with new knowledge (Balschweid & Thompson, 2000; Myers & Washburn, 2008). One state that has followed this advice is North Carolina. There, high school agricultural education programs are able to offer a state-approved integrated biotechnology curriculum that teaches applied science through an agricultural context (Wilson, Kirby, & Flowers, 2002). The availability of such a course lends merit to the theory of Myers, Dyer, and Breja (2009). They suggest that students see more value in agricultural education courses when science is incorporated into the curriculum (2003). Myers and Washburn (2010) write that as agriculture programs have natural ties to the sciences, such integration is essential, they even claim it to be an “essential practice” (p. 89). This mirrors research by Rich, Duncan, Navarro, and Ricketts in a study of Georgia middle schools. This study found that the mean percentage of students who met or exceeded standards in the
Criterion Referenced Competency Test where agriculture programs existed was higher than in schools where agriculture was not taught (2009).

Tangible differences in standardized test scores are evidence of the impact of an agriculture program’s influence on the academic success of students as witnessed in a study conducted by Foutz, Navarro, Hill, and Thompson (2011), which examined how math and science Criterion Referenced Competency Tests (CRCT) were increased as a result of integration. The CRCT scores in 7th and 8th grade science were below the state average the year before integration efforts were incorporated into the agriculture classroom. The five years after integration efforts were initiated CRCT scores were well above the state average. Qualitative results also indicated that students and teachers felt their integration efforts were not in vain and instruction most often incorporated project-based learning in order to vertically and horizontally align the math and science curricula.

**Pressure for Agriculture Programs to Contribute**

In addition, as budget deficits put targets on non-academic programs within schools, pressure to perform or justify the existence of an agriculture program is evident. Myers and Washburn (2008) write that career and technical education programs are expected to “justify their curricular contribution to student academic achievement” (p. 27). They confirm that using agriculture as a contextual framework to support science knowledge acquisition would increase student learning as well as the meaning students apply to their learning. The Georgia Rural Development Council published a study in 2009 that verified that involvement in agricultural education could increase student interest in math and science. This study confirmed the value of middle school agriculture programs specifically, stating that the middle school agricultural education/agriscience
curriculum in Georgia provides students with “basic science concepts for applied learning” by covering the three topics in Georgia’s middle school science standards (earth, life, and physical science). They argue that this makes agriculture and science classrooms comparable “according to the science standards in the state” (Dunn et al., 2009, p. 16-17).

**Brain-Based Learning Theory**

Unlike most learning theories, brain-based theory states that learning is “innately linked to the biological and chemical forces that control the brain” (Hileman, 2006, p. 18). This theory is a comprehensive approach to instruction utilizing what is known about how the brain functions and learns. It utilizes an eclectic combination of learning theories and models to help teachers connect learning styles and educational experiences.

When applied to the concept of increased academic success due to completion of a yearlong agriculture class at the researcher’s school, brain-based ideology makes sense.

The elements of brain-based learning theory fit the situation being studied in this research because the experiences within the agriculture classroom compliment the needs of a developing brain. There are several examples of how the agriculture classroom at the researcher’s school models recommendations from brain-based theory. For example, this theory posits that activities should change within 12-15 minutes; this is the exact time-frame for activities within the researcher’s classroom. Classes utilize repetition of terms, concepts, themes, and learning daily, often restating new knowledge several different ways at various times during the duration of class. Figure 4 presents the original brain-based teaching strategies developed by Sarah Hileman (2006). Figure 5 is an
adaptation of Hileman’s work, showing how each strategy is implemented in the researcher’s classroom.

![Brain-Based Teaching Strategies](image)

*Figure 4. Brain-Based Teaching Strategies*
Very important for a developing brain are images and active learning. Since students often lack background knowledge about what they are learning, visuals in the form of pictures, actual items or animals, videos, or demonstrations are provided daily. Also, students are put in situations where cognitive thought must be applied to do more than memorize and regurgitate information, but to use it and create a product, argument, or idea about the topic (Bellah et al., 2008). For example, students create agriscience projects in which they identify an agricultural problem, develop a hypothesis, follow the steps of the scientific method to test their hypothesis, and present their findings publically, emphasizing the relevance of their results to the broader agricultural industry.

**Figure 5. Brain-Based Methods Utilized in the Researcher’s Classroom**

| B | Brain’s Time Clock - Variation of instructional activities and experiences. |
| R | Repetition - Students experience information repetitively through varied methods. |
| A | Active Learning - Students are physically and mentally active throughout the classroom, SAE and CDE experiences. |
| I | Images - Use of images, video, projects, computers, bulletin boards, etc. |
| N | Novelty - Variations in classroom settings, field trips, guest speakers, seating changes, etc. |
| B | Beauty - Classroom environment is colorful, inviting. Colors and color coding are used in assignments, handouts, posters, and instruction. |
| A | Automatic Learning - All forms of communication are utilized in a physically and emotionally safe environment. |
| S | Social - Cooperative learning, group and individual accountability, meta-processing skills are all employed. |
| E | Emotions - Purposefully creating learning activities that elicit emotions to make experiences more meaningful and engaging. |
| D | Develop Thinking Skills - Incorporation of real-world scenarios to stimulate thinking skills to generate solutions, findings/results are publicly presented. |
Another aspect of the researcher’s classroom that stimulates brain activity according to brain-based research is pleasing aesthetics. Without gaudy posters and white walls, the researcher’s classroom is full of awards hung on colorful walls, student work (exemplars), and thought-provoking quotes. The research also used colored handouts, various fonts, and color coded assignments, all of which help the brain organize information (Hileman, 2006). Brain-based research also stresses the importance of modeling, verbally, socially, professionally, and emotionally, something the researcher took very seriously. Not only is the researcher a facilitator of student learning, but also a walking example to the students and should strive to be a positive role model at all times (Knoblock, 2006).

One of the most important aspects of the researcher’s agriculture classroom is the social activity that takes place inside. Brain-based theory holds that humans are social and learning that involves social interaction should be very structured and feature face-to-face interaction as well as individual student accountability. Hileman wrote that allowing students to “gather information, conceptualize their problem, generate possibilities” and publicly present their findings or thoughts is a vital process in developing thinking skills (2006). Almost every learning experience in the researcher’s agriculture classroom functions as such, utilizing technology, various learning modes, and cooperative learning to develop not only learning, but thinking skills. One example of this would be use of the school greenhouse to test which type of fertilizer grows tomatoes the fastest. Conducting the experiment and presenting their findings to the class, students engage in various learning modes that compliment various learning styles. The entire brain-based theory of
learning syncs well with agriculture classroom and curriculum, no variances exist between the theory and practice within agricultural education.

Incorporating novelty into instruction is another recommendation of the brain-based learning model. Curriculum within agricultural education fits nicely with this facet of the theory because classes delve into interesting subjects not covered in academic classes. Hence, because they are usually more comfortable in the agriculture classroom, they ask questions they normally might not. For example, artificial insemination is a method of manual sexual reproduction for various livestock animals. Although the concept is foreign to students, once introduced to it, they are so interested in how it works and how it relates to our food prices, research methods, even human reproduction, they become engaged in the conversation thoroughly. Such an experience is not commonplace in an academic classroom setting, but since it is in agriculture curriculum, it can be openly discussed. Another novelty within the agriculture classroom is the ability to move the learning to different locations. The ability of the class to utilize a greenhouse, forestry plots, or even the grass in the school’s lawn creates opportunities for learning. Any change in the learner’s normal schedule creates opportunities for novelty, therefore, increasing the opportunity for learning to occur.

**Similar and Different Theoretical Elements**

Brain-based learning theory is different from any theories mentioned in this survey because it calls into question the actual development, from a physiological standpoint, of the brain and how learning experiences can utilize what is known about the developmental process to maximize learning. Elements from every theory may be incorporated into instruction using the brain-based theory, but the foundations of this
theory are not grounded in philosophical orientations. One might say they are grounded, instead, in neuroscience (Hileman, 2008).

**Philosophic Orientations and Epistemological Assumptions**

Given the existing philosophies in education, brain-based theory does not fit nicely into a category. On the contrary, it does not have a social goal, an assumption about what one thinks or feels about a subject, subjective norms, or themselves. The framework of this theory rests on the science of brain development and how the brain sense, process, and utilizes knowledge. More importantly, it guides educators in developing experiences that compliment various stages of development and abilities. Therefore, finding a singular or even a combination of philosophic orientations for brain-based theory is difficult.

The ability to connect what students learn in the agriculture classroom with science application both “increases student agricultural literacy and creates interesting contextual science learning opportunities” (Duncan et al., 2009, p. 15). According to the research from Farley and Taylor (2004), teaching skills in isolation reinforces the idea that skills are separated by task and cannot be transferred to different areas. The research of Thompson and Warnick (2007) found that integration of science into agriculture curriculum is a “more effective way to teach science” (p. 1). This concurs with Caine and Caine’s theory of brain-based learning as cited in the research (Caine & Caine, 1994; Duncan et al., 2009; Balschweid & Thompson, 2000). According to this theory, science and agriculture share a relationship that, when taught together, allows students to synthesize information so their brains can recognize relationships and organize the information (Balschweid & Thompson, 2000).
Theoretical Framework for Existing Research on Integration

Much of the existing research regarding the integration of science in agricultural education is focused on the perceptions of agriculture teachers regarding integration, the problems with integration, and the barriers to integration (Warnick & Thompson, 2007; Boone et al., 2006; Balschweid & Thompson, 2000; Wilson et al., 2002; Myers & Washburn, 2008; Myers et al., 2004; Balschweid & Thompson, 2002; Washburn & Myers, 2010; Duncan et al., 2009). The theoretical framework utilized by these studies is drawn from theories of planned behavior from researchers Madden (1992), Fishbein (1980), and Ajzen (1988, 1991). According to these theories, one’s behavior is “determined directly by one’s intention to perform the behavior” and one’s intentions are influenced by attitude, subjective norms, and perceived behavioral controls (Ajzen, 1985). This relates to curriculum integration in that if academic and agriculture teachers hold a positive perception of integration, they are more likely to utilize integration in their classrooms (Thompson & Warnick, 2007). Many studies that gauge agriculture teachers’ intent to integrate science concepts use Thompson’s Integrating Science Survey. In a study by Thompson and Warnick, 100% of the agriculture teachers surveyed agreed that agriculture is an applied science. Such agreement and subsequent integration will help agriculture programs “align with educational standards” and be better prepared for standardized tests (2007, p. 6-9).

According to existing research, there is a common understanding that incorporating academic subjects into vocational education strengthens student understanding and engagement. Myers and Washburn (2008) write that the mind seeks meaning in context by searching for relationships that make sense and appear
meaningful. They continue to assert that using agriculture curriculum as the contextual framework for supporting science knowledge acquisition would increase student learning and the application of learning. Career and technical education programs are encouraged, and to some degree expected, “to justify their curricular contribution to student academic achievement in science, reading, and mathematics” (Myers & Washburn, 2008, p. 26). Given that agricultural education was originally thought of and taught as a science, the potential for collaboration between agriculture and science teachers is tremendous, with a collaborative relationship being vital (Warnick & Thompson, 2007; Stephenson, Warnick, & Tarpley, 2008). Research has already shown that “students taught by integrating agriculture and scientific principles demonstrated equivalent or higher academic achievement” than students taught in a traditional manner (Warnick & Thompson, 2007). According to the contextual learning theory, learning only takes place when a student processes new information in a way that makes sense within their frame of reference.

**Academic Achievement Influenced by Agricultural Education**

Specific research has been conducted to determine the impact of middle school agricultural education curriculum on students’ science achievement. One study in Georgia examined 51 middle schools with agriculture programs and 51 schools without agriculture programs that consisted of similar student population demographics. Both groups’ mean scores on the science Criterion-Referenced Competency Tests were compared using data from the Georgia Department of Education. The researchers found that the percentages of students meeting or exceeding standards in the CRCT test were higher in the schools with agricultural education programs than in the schools without
agricultural education programs. This middle school study lends further credit to the growing numbers of studies that indicate that “participation in an agricultural education program can improve student achievement in science” (Duncan et al., 2009, p. 21). A study by Myers, Dyer, and Breja (2003) concluded that in addition to increasing test scores in science, schools with strong agriscience programs or increased science integration see increased enrollment compared with schools lacking agriscience instruction (p. 101).

Increased enrollment allows for more students to have contact with the applied scientific instruction and, therefore, benefit from integration (Warnick & Thompson, 2007). This is not only true for middle school students, but secondary students who are taught agriculture via integration of scientific principles also demonstrate higher academic achievement compared to those taught without integration (Duncan & Ricketts, 2008). Their research found that most science and agriculture teachers hold a positive attitude or perception of integration of scientific principles into the agriculture program. Despite their willingness, thorough integration is sometimes limited by the lack of supplies and necessary equipment to do justice to a true science course (Balschweid & Huerta, 2008). Agriculture programs which incorporate academic and technical principles are often influenced heavily by a supportive administrator. This is likely so because it is understood that qualitative and quantitative data both support the increased positive perception and perceived learning wherever integration is implemented (Castallano, Sundell, Overman, & Aliag, 2012).

There are several factors influencing teachers’ likelihood to integrate curriculums according to existing research. Most commonly, agriculture teachers report that lack of
planning time holds them back from integrating science curriculum into the agriculture lessons (Myers & Washburn, 2008; Stephenson, Warnick, & Tarpley, 2008). In addition to the lack of preparation time, lack of funding for needed scientific equipment and materials, large class sizes, and personal lack of experience in scientific integration proved to be barriers to successful integration of science curriculum.

Warnick and Thompson suggest that to successfully implement integration, stakeholders must be identified and taught about agricultural education programs. Stakeholders include administration, parents, community supporters, teachers, and students (2007). These researchers attest that the science teacher is extremely important to the success of the integration of science and agriculture (Warnick & Thompson, 2007). According to another study, most agriculture and science teachers share equipment more than collaborative ideas. Therefore, it is suggested that administrators schedule adequate time for planning and collaboration on integration (Stephenson, Warnick, & Tarpley, 2008). This same study found that the most important factor in integration is the existence of administrator support. Without integration being priority of the administration, teachers are left with little control regarding their resources and most importantly, their available spare time while at school.

Specific pathways or subjects within the agricultural field lend themselves specifically to contributing to academic knowledge application and success (Math in CTE, 2012). Aquaculture, for example, is a subject that lends itself nicely to integration. The research of Conroy and Walker indicates that environmental issues are easily incorporated into science and vice versa. Students interviewed in this study reported that they believed aquaculture enhanced their math and science success because it made those
subjects more “relevant” to them (2000, p. 54). Success in academic subjects like science, math, and social studies, however, are not the only areas shown to benefit from agriculture programs. Duncan, Ricketts, and Shultz report that seniors who had been involved in an Agriscience program at a high school had the highest percentage in the highest percentile of the Language Arts portion of the Georgia High School Graduation Test (2011). Reinforcing various other studies, their report also indicated that agriscience students were more likely to pass the science and social studies portions of the GHSGT (Georgia High School Graduation Test).

**Findings of Existing Research on Perceptions Toward Integration**

Rauma, Himanen, and Vaisanen examined integration practices within Home Economics classes. They found that the majority of teachers surveyed reported integrating to some extent but that their competence to fully integrate was not sufficient; these teachers reported being limited by inadequate knowledge about the scientific principles (2006). A similar study used Okey and Dillashaw’s Test of Integrated Process Skills to measure agriculture teachers’ knowledge of scientific concepts in order to determine their capacity for teaching scientific principles. This study found that regardless of learning style, teaching experience, gender, or area of certification, agriculture teachers possessed the knowledge necessary to deliver effective science instruction (Myers et al., 2004).

Additional findings of such research found that most educators perceived integration as a means to increase program enrollment and stakeholder views of agriculture programs, “pressure to address state standards and administrator pressure” often encourages agriculture educators to integrate (Washburn & Myers, 2010, p. 91-92).
In a Balschweid and Thompson study, it was found that most agriculture teachers are favorable to integrating science into agriculture classes. In fact, many already teach agriculture courses for which students may earn science credit (Balschweid & Thompson, 2002). Several reported already teaching agriculture as an applied science because it “just makes sense to” teach it as such (Washburn & Myers, 2010, p. 95). In addition, although many studies indicate that science teachers are generally willing to collaborate on integration, their cooperation was not a necessity (Balschweid & Thompson, 2002; Washburn & Myers, 2010). Boone, et al. (2006) found that agriculture teachers felt responsible for teaching elements of biotechnology and agreed the subject should be taught, but that they had more knowledge on biotechnology topics traditionally associated with traditional agriculture like animal reproduction and hybridization and less knowledge on how biotechnology applies to other fields (human genomics, environmental biotechnology).

Although most agriculture educators feel comfortable teaching academic curriculum in their classrooms, many are not. Research by Myers and Washburn (2008) found that teachers feel their personal lack of experience is a barrier to them integrating in their classroom. The study by Wilson, Kirby, and Flowers (2002) found agriculture teachers who echo this concern. The majority of the participants in their study reported never participating in training related to biotechnology and felt “ill-prepared” to teach the subject even though they recognize the benefits of “integrated curriculum in agricultural education” (p. 77). In addition, exterior factors such as a lack of funding for equipment, large class size, and school climate or norms are seen as barriers to integration. However, studies find overwhelming evidence that the number one factor influencing integration is
the availability of preparation time (Balschweid & Thompson, 2000; Warnick & Thompson, 2007; Myers & Washburn, 2008). One study even reported that among agriculture teachers who integrate, all indicated that due to their practice of integration, they had less time to prepare for classes and less personal time within their teaching day (Balschweid & Thompson, 2000; Roberson, Flowers, & Moore, 2000). Some research suggests that integration of academic concepts into CTAE courses is limited. However, much evidence supports the claim that when it is done, it is beneficial (Parr, Edwards, Leising, 2006).

When the actual collaboration is examined, it is evident that although attitudes toward integration are mostly positive, there are several factors preventing actual collaboration and integration to occur. Although agriculture teachers do not necessarily need to collaborate with science teachers in order to integrate curriculums, collaboration has “potential to foster decision making skills, cognitive skills, and critical thinking skills” along with enhanced student comprehension of scientific principles (Stephenson, Warnick, & Tarpley, 2008). Studies also show that collectively, agriculture and science teachers agree that collaboration broadens school curriculum, reduces separation between teachers, enhances student comprehension of scientific concepts, and allows students to understand the relationship between science and agriculture and their importance to society. Barriers to collaboration may prevent thorough integration and is often caused by social divides, territorial issues, physical distance, and overwhelmingly, lack of a common planning time in which to plan integration. In addition to these obstacles, social stigma of the agriculture teacher is that of inferior or nonacademic, less important than
the major academic subject traditionally taught in schools (Stephenson, Warnick, & Tarpley, 2008).

**Recommendations to Encourage Integration**

The resources surveyed in this literature review generated several recommendations to ensure or promote integration within the agriculture classroom setting. Administrative support is foremost in their recommendations, followed closely by the implementation of preservice science teacher workshops where agriscience is taught, explained, and integration can be planned. The lack of funds for materials can be fixed with participation in various grant programs. However, grant writing is time consuming and often requires multiple parties to be involved and can be a tedious task. Here, administrative support and dedicated time to accomplish the tasks involved would be helpful. In addition to targeting preservice teachers, offering agriscience workshops to existing science and agriculture teachers will serve to promote integration, collaboration, and strengthen the commitment to integrate. Encouragement from administrators to try integration without fears of failure or reprimand is also a useful tool that will give teachers the confidence needed to try science-specific curriculum.

In order to promote integration and remove perceived barriers to integration, several studies have resulted in common recommendations. Increased support in the form of professional development opportunities is critical in order for teachers to make curricular adjustments (Myers & Washburn, 2008). Perceptions of all stakeholders should be taken into account and education of the councilors, science teachers, students, parents, and administrators regarding the importance of integration should occur (Thompson & Warnick, 2007). In addition, “preservice and current teachers of
agriculture must receive in-depth instruction on how to properly interact with potential students and parents as well as how to integrate science into the agricultural education curriculum” (Myers et al., 2003, p. 102). Also, utilize available funds for equipment and allow a planning period with science teachers to promote integration. Wilson, Kirby, and Flowers (2002) found that newer teachers are more likely to adopt integrated curriculum, especially if they had already attended relevant training and perceived the content to be useful. Warnick and Thompson’s (2007) study produced recommendations from teachers surveyed for the State Departments of Education to provide in-service and summer opportunities for teachers to gain more knowledge.

For pre-service teachers, additional training and instruction is seen as beneficial by many teachers surveyed in the studies mentioned within this review (Myers et al., 2003; Washburn & Myers, 2010; Thompson & Warnick, 2007; Balschweid & Thompson, 2002). Washburn & Myers (2010) found that eighty percent of the teachers they surveyed suggested that cooperating teachers (supervising student teachers) should model integration for student teachers. While still in teacher programs, future-teachers should also receive instruction on how to integrate science into their agriculture curriculums (Balschweid & Thompson, 2002; Thompson & Warnick, 2007).

**Summary**

There is great potential for integration and student success within the agricultural education framework. Nicely complementing the science curriculum in the middle school, agriculture state standards should be utilized to promote science knowledge acquisition. Given the great potential for student learning in the agriculture classroom, integration of academic curriculum will have a positive influence on student learning and
encourage acquisition of content knowledge in an engaging, useful manner. Despite this, obstacles exist that prevent teachers from integrating curriculums unless coerced to do so by administrators or necessity. To overcome obstacles to integration, more research should be done to determine definite causes for perceived barriers. It is clear that without distinct, purposeful planning for integration, it is not likely to happen naturally.
CHAPTER 3

Methods

This chapter provides details of the methods were employed in conducting this study. The design, participants, procedure, data analysis, and instrumentation for the study are provided within this chapter.

Educational research is traditionally characterized by three categories of research, qualitative, quantitative, or mixed method which involves elements of both qualitative and quantitative methods (Harwell, 2011). The category of research utilized for this study was quantitative. The quantitative design attempts to discover relationships between variables, often using numeric values for topics being studied. This method is characterized by use of instruments such as surveys to collect data that is usually analyzed using statistical tests. The typical goal of quantitative research is to predict or describe a relationship between variables (Harwell, 2011). This type of research includes experimental designs with variables and treatments (factorial designs as well as repeated measure designs) (Creswell, 2014). Data relevant to academic success as it relates to involvement in an agricultural education program most commonly involves scores from standardized tests, with variables including involvement in extra-curricular activities, completion of an agriscience program, and participation in an agriculture program that integrated academics into the curriculum. Figure 6 provides details about the quantitative method used for this study.
Design

Research design refers to the underlying framework and key features within a research study. More importantly, it characterizes how data is collected, the types of instruments used, and how the data may be utilized (Harwell, 2011). This qualitative, descriptive study utilized a static-group comparison design. This design features two groups, one of which receives a treatment while the other does not. A posttest is administered to both groups at the end of the experiment and the differences in test scores between the two groups are compared. The post-test used was the CRCT. This research was conducted by comparing mean math, science, and social studies CRCT scores from groups of seventh and eighth grade students who attended the researcher’s school during the 2011-2012 and 2012-2013 school years. Static-group comparison design was used because it allowed the researcher to gather data from a large number of subjects at one time, provided the opportunity for a snap-shot of variable relationships, and served the researcher’s goals by providing an exploratory tool to gather lots of data at one time. The

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CRCT scores of special education students and those with Individualized Education Plans who took the CRCT with modifications such as extended time or having it read aloud were included in this study. By retaining the scores of these two student groups a true snapshot of actual student knowledge was attained. It also made the testing groups more authentic as it included all students, not excluding special needs students which are usually a subgroup and are pulled out of the general education testing groups. These scores remained a part of the two groups that were established because there was no reason to identify them as special needs because they are not identified as such while in either the yearlong or eight-week agricultural education course. They are not accompanied by a special education teacher who accommodates their learning needs and receive no special treatment that a regular education student does not receive. Also, research already exists which addresses the academic impact of agricultural education on students with special needs and the purpose of this study was not to replicate previous research (Rich, Duncan, Navarro, & Ricketts, 2009; Clark, 2012).

Two groups were established, one group being a population of students who completed the yearlong agriculture class (N = 260) and another group of students who completed only one eight-week agriculture class (n = 260). During one school year, two yearlong agriculture classes are taught to 7th graders and two are taught to 8th graders. This combines for a total of four classes of students who complete a yearlong agriculture class each year. There are, however, four eight-week agriculture classes every eight weeks and there are four eight week terms within each year. Therefore, a total of 16 eight-week agriculture classes are taught each year (two each eight weeks to 7th graders, and two to 8th graders) while only four yearlong classes are taught. The target
population for this study was students who completed the yearlong agricultural education course (N = 260). The eight-week agriculture class completers were chosen to create a sample (n = 260) by the researcher’s colleague who randomly selected students from the population group.

Using existing CRCT data, group comparisons were made. The data collection (CRCT examination) were administered and collected uniformly. Therefore, consistency in data collection and analysis was very probable. The data were de-identified by school personnel other than the researcher and provided to the researcher grouped according to completion of the yearlong or eight-week agriculture class. The school’s CRCT data is provided to the school in Excel format by the Georgia Department of Education. The data set exists in this format with student names, scores, and other identifiable information. To ensure anonymity of data, the researcher was provided only with the scores, already sorted into their respective groups, so the researcher had no access to other identifiable student information.

The CRCT is administered only in Georgia, with other states using their own standardized tests to study student achievement. The CRCT is proven to be a reliable and valid instrument in determining student knowledge and application of academic concepts. The CRCT is developed based on the Georgia Performance Standards and the content validity of the CRCT is high. The test uses scaled scores, a common scoring system for vast assessments similar to the CRCT. The scaled scoring system bases scores on the raw score, the number of items students answer correctly. All sections of the CRCT feature around 70 multiple choice questions. The State Department of Education sets the score standards for meeting or exceeding the standard. For example, scores below the state’s
designated level of proficiency of 800 do not meet the standard and therefore, fail that portion of the CRCT. Such a score may indicate the student requires additional academic support. Scores above 850 are considered exceeding the standard and those between 800 and 849 indicate that the student met the standard for that portion of the test. These levels are considered the same for every CRCT subject and grade in school being tested. So, students who score below 800, no matter what grade they are in, are considered below standard while those scoring above 850 are always considered exceeding the standard. Student test scores are reported for individual content areas (math, social studies, science, language arts, and reading) and is computed by converting the number of correct answers (or raw score) to the CRCT scale which are equivalent to all the other content-specific test portions. This allows comparisons from grade to grade in the same content area in order to show trends or growth for each student. The Georgia DOE Testing and Assessment Division oversees the reliability and validity of testing items and scoring for the CRCT. Teachers and educational professionals develop testing items which are revised by additional committees of teachers and approved by the Georgia DOE before tests are finalized and administered to students. This assessment is used state-wide to evaluate students’ academic performance. Scores on this test are used to determine student progression to subsequent grades and class placements. It is graded by the Georgia Department of Education electronically using a scantron sheet and computer. Students do not write in answers to be graded manually; therefore human error and bias in grading are not issues of concern.

Potential threats to design validity exist where the final results of data analysis cannot be generalized to the larger population of middle school aged students in Georgia
and in the United States. To alleviate the threats to design validity the scores were not applied to suggest similar findings in different situations. They were used to describe the findings in this specific scenario for this given time-frame.

The potential disadvantages were limited by the researcher by analyzing and inferring results based on the Department of Education data sets. Furthermore, data sets were further analyzed statically to explain their relevance to the research questions. Similar studies have examined student performance on both the CRCT and the Georgia High School Graduation Test and the relationship between student involvement in agricultural education and test scores on such standardized tests. Delimitations of the study refer to the data set provided by the Georgia Department of Education. In addition, results may not be generalized or applied to other situations since on-site demographic and qualitative data may be dissimilar to the school detailed in this study.

The researcher utilized existing data sets provided by the Georgia Department of Education. No additional data from a visit to school campus was collected. Therefore, discussion points and recommendations for this study were based solely on the data sets and analysis thereof. The alpha level for the study was set at the .05 level because this is a good compromise between the likelihoods of making Type I and Type II errors. Setting too stringent an alpha level, such as .01 or .001 increases the probability of not rejecting a false null hypothesis while setting too generous an alpha level, such as .1 or higher, thus increasing the likelihood of making a Type I error. The general Null Hypothesis is: There will be no statistically significant differences in scores on the CRCT of agriculture students who completed a yearlong agriculture class and students who completed only an eight-week long agriculture class.
Participants

The participants for this study were students who were enrolled in a yearlong agriculture class during the 2011-2012 and 2012-2013 school years and an equal, similar sample of students who completed an eight-week long agriculture class during those same school years. The rural, public school was located in the Southeast United States. The group of yearlong agriculture class completers consisted of approximately 260 students, N = 260, and took the course of the entire school year, consisting of 32 weeks. The group of eight-week agricultural course completers was randomly selected by the researchers colleague to equal 260 students also and took the class for only 8 weeks. Since school year lasts 32 weeks, yearlong students took the agricultural education course for 24 more weeks than the eight-week course student. It is possible that 8th graders in the 2012-2013 school year were repeating the yearlong course from the 2011-2012 school year. Student CRCT scores are provided to each Georgia school in Microsoft Excel program by the Georgia Department of Education.

Procedure

The University of Georgia Institutional Review Board deemed this study not in need of IRB approval since it involved no human subjects or threat to participant privacy. The rights of subjects were followed according to Creswell (2008). Confidentiality of subjects is not an issue within this study as students are not individually identified, but instead maintain anonymity throughout the research process. Students’ scores are compiled as part of their whole-school group’s math, science, and social studies CRCT scores as well as attendance rates. Data used in the study will be retained for three years.
at which point, as instructed by APA guidelines on maintaining research data, it will be destroyed.

To complete this study, CRCT data for every student who attended the researcher’s school during the 2011-2012 and 2012-2013 school years was utilized. This data is available from the school’s data resource and counseling office. The data is available for any teacher to review upon request. The spreadsheet was emailed to the individual who de-identified it for the researcher. From the master Excel document, another Excel spreadsheet featuring only math, science, and social studies scores were compiled. Students’ scores were grouped according to student completion of a yearlong agriculture class or an eight-week agriculture class. Approximately 65 seventh graders and 65 eighth graders each year take an agriculture class which lasts all year long while the remaining student population filters through an eight-week long agriculture class. Mean scores for the entire population of yearlong 7th and 8th grade agriculture students, for each of the two school years, were determined (N= 260). Since the number of students enrolled in the eight-week agriculture classes is higher than the number enrolled in the yearlong classes, a random sampling of the 7th and 8th grade students who were enrolled in the eight-week classes, equal to the number of students in the yearlong classes (n = 260), was selected and mean scores determined. The two groups’ mean scores were compared, percentage increase in group means, F and p values were determined along with the degrees of freedom and standard deviations. Data compilation was completed in the spring and summer of 2014. Data were analyzed during the summer of 2014.
Data Analysis

Microsoft Excel was used to determine descriptive statistics for the two sample groups and to create graphs that illustrate data comparisons. Two-way ANOVA was used to account for both grade in school and school year, ensuring a consistent effect. The data set of CRCT scores is provided to each Georgia school in Microsoft Excel program by the Georgia Department of Education. No additional statistical software was required to perform mean comparisons between the groups being compared using greater than comparison operators. Results were displayed on a column graph and a line graph to compare the two sample means. Research questions were answered by comparing the mean score of yearlong agriculture students to the mean score of students who complete an eight-week long agriculture class to determine if a statistically significant difference exists. In addition to means scores, standards deviations, F and p values were found as well.

Instrumentation

States are required to individually develop and administer criterion-based assessments according to the No Child Left Behind Act (NCLB) of 2001. The state of Georgia chose to administer the Criterion Referenced Competency Test (CRCT) which is aligned to the state’s academic standards (Cox, 2007). In addition, Georgia law, amended by the A+ Education Reform Act in 2000, requires that students in first grade through eighth be administered the CRCT in the reading, English/language arts, and mathematics content areas (McLeod, 2013). Science and social studies CRCT are also administered to students in grades three through eight. This assessment measures students’ skill levels and knowledge of academic subjects and is constructed of selected-
response items (McLeod, 2013). The CRCT’s design is intended to measure or quantify skill and knowledge level of students over the curriculum in a multiple-choice format. For this study, only math, science, and social studies test scores for the 7th and 8th graders were considered. Students’ individual scores were not identified and no direct contact with students was made (CRCT statewide scores, 2013).

The curriculum for seventh and eighth grade science includes overarching concepts such as inferencing, writing clearly, organizing data into models, charts, and graphs, as well as using safety equipment and the scientific method. These are concepts to be reinforced within daily lessons while focusing on specific grade standards. The seventh grade science curriculum specifically focuses on natural selection, heredity, and animal-based science concepts while the eighth grade curriculum is based on cell structures, nature and matter, conceptual acids, bases and phase changes, along with electrical and magnetic forces ("GPS by Grade Level, K-8").

Standards for seventh grade social studies involve concepts associated with Southwest Asia and the Middle East. Not only are economic concepts studied, but also entrepreneurship and natural resources, government structures, and history of these regions as well. In contrast, Georgia studies dominate the eighth grade social studies standards. Included in the study of Georgia are Native Americans, the colonial period, the Civil War and reconstruction, and the impact of agriculture on Georgia’s development. The state’s geographic regions and their effect on development are also studied within this curriculum ("GPS by Grade Level, K-8").

Within the seventh grade math standards, several complex concepts are outlined. Many requirements involve the student using mathematical concepts to solve real-world
problems and utilize diagrams, charges, and other means to organize information.

Rations, fractions, area, circumference, angles, probability, and statistical concepts are also part of the seventh grade math curriculum. The eighth grade curriculum focuses on functions, proportions, scales, linear equations, geometry, the Pythagorean Theorem, and volume of various shapes and sizes ("GPS by Grade Level, K-8").

The Georgia Department of Education determined that the purpose of the CRCT is to “measure student acquisition of the knowledge, concepts, and skills set forth in the state curriculum” (Cox, 2007, p. 3). The state-wide test was intended to serve two purposes in that it should identify individual student strengths and weaknesses as they relate to the state curriculum as well as create a bar or standard upon which all schools can be compared (Cox, 2007). Given these goals, the Georgia Department of Education designated a committee of Georgia educators to aid in the development of the assessment after thoroughly reviewing the existing curriculum. This committee created documentation identifying and detailing recommendations for item formatting, scope and limits of content and cognitive difficulty. This documentation was given to professional assessment contractors hired by the Georgia Department of Education who developed the drafts of the CRCT for all grade levels. Once finished, the draft was provided to the committee of Georgia educators who reviewed them for suitability, potential bias, and alignment to Georgia curriculum (Cox, 2007). Upon resolution of discrepancies and accommodation of suggestions from the committee, the CRCT was adopted in the spring of 2000 and used as the state-wide standardized test for the first time in spring of 2001 (Georgia Department of Education, 2005-2007).
Georgia law requires all students, grades one through eight to take the CRCT in English/language arts, mathematics, and reading and students in grades three through eight take science and social studies portions of the CRCT. The test is a constant and does not change throughout the state. Also, because every student took the same test, per grade and school and academic subject student scores may be compared to one another.

In addition, the procedures for administering the CRCT were written and all teachers who administer the test receive the same state-mandated training to ensure homogeneity in student testing experience. Manuals for test administration include scripts to be read to students as well as specific instructions for test administrators and are used by every teacher administering the test (Georgia Department of Education, 2005-2007).

The CRCT data for the groups of students in the math, social studies, and science portions of the test were gathered from the Excel document provided by the Georgia Department of Education for the 2011-2012 and 2012-2013 school years. The researcher determined the mean score of the science, math and social studies CRCT scores from both groups. These means were compared without identification of student-specific data. Yearlong agricultural education students were identified using the rosters from each yearlong class. Their names were removed once identified by a school employee other than the researcher and no other identifiable information was present on the data provided to the researcher.
CHAPTER 4

Results

The purpose of this research study was to determine if there were statistically significant differences in academic achievement of students who completed the yearlong agricultural education course and students who completed the eight week agricultural education course. Both groups were in the same school and taught by the same teacher, and received the same instructional treatments that were guided by brain-based learning theory. The only difference between the two groups was the amount of instruction each group received and the number of instructional units covered while in these agriculture classes. The scores examined for this study were the math, science, and social studies portions of the Criterion Reference Competency Test (CRCT), a test designed to measure how well students acquire the skills and knowledge described in state mandated content standards.

Research Questions

1. Is there a statistically significant difference in math CRCT scores of students who completed a yearlong agricultural education course that was guided by brain-based research and math CRCT scores of students who completed an eight-week agricultural education course that was also guided by brain-based instruction, in the same agriculture program?

2. Is there a statistically significant difference in math CRCT scores of students who completed a yearlong agricultural education course that was guided by brain-
based research and science CRCT scores of students who completed an eight-week agricultural education course that was also guided by brain-based instruction, in the same agriculture program?

3. Is there a statistically significant difference in math CRCT scores of students who completed a yearlong agricultural education course that was guided by brain-based research and social studies CRCT scores of students who completed an eight-week agricultural education course that was also guided by brain-based instruction, in the same agriculture program?

A total of 260 7th grade and 260 8th grade student scores were taken into consideration for this study. For the yearlong student group, \( n = 130 \) and \( n = 130 \) for the eight-week 7th grade student group, resulting in a total of \( N = 260 \) students. For the 8th grade yearlong student group, \( n = 130 \) and \( n = 130 \) for the eight-week 7th grade student group, resulting in a total of \( N = 260 \) students. Results indicate that for both 7th and 8th grade levels, the yearlong students’ mean scores were higher on the math, science, and social studies portions of the CRCT than the eight-week students (see Table 4-1).
Table 4-1. Total Group Comparisons

<table>
<thead>
<tr>
<th></th>
<th>7th Grade Mean Scores</th>
<th>8th Grade Mean Scores</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Math</td>
<td>Science</td>
</tr>
<tr>
<td>Yearlong (n=130)</td>
<td>850.13</td>
<td>866.23</td>
</tr>
<tr>
<td>SD</td>
<td>30.36</td>
<td>34.02</td>
</tr>
<tr>
<td>Eight-Week (n=130)</td>
<td>823.11</td>
<td>823.03</td>
</tr>
<tr>
<td>SD</td>
<td>28.69</td>
<td>40.20</td>
</tr>
</tbody>
</table>

Note: Yearlong students took the course for 32 weeks versus only 8 weeks.

As seen in the Table 1, 7th grade yearlong mean scores for every subject fell in the “exceeded” category because they were all above 850 while none of the eight-week mean scores were even close to exceeding, all ranging from 823 to 827. Again, scores 799 and below are considered failing or substandard, 800 or higher are considered passing, and 850 and higher are considered exceeding. Regarding the 8th grade scores, although none of the yearlong mean scores were exceeding, they were all above 830 while the eight-week group mean scores ranged dangerously close to 800, the minimum score for passing the CRCT, ranging from 812 to 815.

Seventh Grade Results

On the math portion of the 7th grade CRCT, the mean score for the students who completed a yearlong brain-based agricultural education ($M = 850.13$) was 27.02 higher than the eight-week student group’s ($M = 823.11$). Also, for the Math portion, $F(1, 129) = 55.03$ and $p < 0.0001$ (see Table 4-4). Yearlong students’ mean score ($M = 832.68$) was 43.20 points higher than the eight-week students ($M = 823.03$) on the science portion.
of the CRCT (see Table 4-2 and 4-3). In addition, on this portion \( F(1, 129) = 89.53 \) and \( p < 0.0001 \) (see Table 4-4). Similar results were also seen in the social studies portion of the CRCT where a difference in the mean of 34.65 was seen in yearlong students’ scores \((M = 861.81)\) while the eight-week means score was 827.16 (see Table 4-2).

Comparisons within the Social Studies portion indicated that \( F(1, 129) = 53.58 \) and \( p < 0.0001 \) (see Table 4-4). In each subject area, the \( F \) values were high, while the \( p \) values were < 0.0001, indicating a statistically significant difference between the mean scores of the two groups and no side complications related to grade (see Table 4-4).

Table 4-2. Seventh Grade CRCT Mean Score Comparisons
Table 4-3. Seventh Grade Mean Score Differences and Percent Increase

<table>
<thead>
<tr>
<th></th>
<th>Math</th>
<th>Science</th>
<th>Social Studies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yearlong (n=130)</td>
<td>850.13</td>
<td>866.23</td>
<td>861.81</td>
</tr>
<tr>
<td>Eight-Week (n=130)</td>
<td>823.11</td>
<td>823.03</td>
<td>827.16</td>
</tr>
<tr>
<td>Difference</td>
<td>27.02</td>
<td>43.2</td>
<td>34.65</td>
</tr>
<tr>
<td>Percent Increase</td>
<td>3.28</td>
<td>4.99</td>
<td>4.02</td>
</tr>
</tbody>
</table>

Table 4-4. Seventh Grade Descriptive Statistics

<table>
<thead>
<tr>
<th></th>
<th>F Value</th>
<th>P Value</th>
<th>DF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Math</td>
<td>55.03</td>
<td>&lt;.0001</td>
<td>1, 129</td>
</tr>
<tr>
<td>Science</td>
<td>89.53</td>
<td>&lt;.0001</td>
<td>1, 129</td>
</tr>
<tr>
<td>Social Studies</td>
<td>53.58</td>
<td>&lt;.0001</td>
<td>1, 129</td>
</tr>
</tbody>
</table>

**Eighth Grade Results**

In this study, it was found that 8th grade students who completed a yearlong brain-based agricultural education course had higher mean scores than students who only completed an eight-week brain-based agricultural education course (see Table 4-1). Specifically, on the math portion, the mean score for yearlong students was 17.93 points higher at $M = 830.88$ than the mean score of the eight-week students ($M = 812.95$) (see Table 4-6). For the math portion, $F(1, 129) = 29.84$ while $p < 0.0001$ (see Table 4-9).

On the science portion of the CRCT, yearlong students’ mean score ($M = 832.68$) was 17.02 higher than the eight-week students’ mean score ($M = 815.66$) and $F(1, 129) = 35.26$ and $p < 0.0001$ (see Table 4-10). Social Studies scores had the greatest differences with the yearlong students’ mean score of 842.45 being 29.34 points higher than the eight-week students’ mean ($M = 813.11$) and $F(1, 129) = 56.07$ and $p < 0.0001$ (see Table 4-11). As was seen in the 7th grade comparisons, for all three subject areas, 8th
grade score comparisons indicate a statistically significant relationship between the yearlong and eight-week groups’ mean scores (see Table 4-3 and Table 4-7). In all cases, F values were high while p values were < 0.0001 indicating that the differences in mean scores between the yearlong and eight-week groups were statistically significant.

Table 4-5. Eighth Grade CRCT Mean Score Comparisons

Table 4-6. Eighth Grade Mean Score Differences and Percent Increase

<table>
<thead>
<tr>
<th>Yearlong (n=130)</th>
<th>Math</th>
<th>Science</th>
<th>Social Studies</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>830.88</td>
<td>832.68</td>
<td>842.45</td>
</tr>
<tr>
<td>Eight-Week (n=130)</td>
<td>812.95</td>
<td>815.66</td>
<td>813.11</td>
</tr>
<tr>
<td>Difference</td>
<td>17.93</td>
<td>17.02</td>
<td>29.34</td>
</tr>
<tr>
<td>Percent Increase</td>
<td>2.16</td>
<td>2.04</td>
<td>3.48</td>
</tr>
</tbody>
</table>
Table 4-7. Eighth Grade Descriptive Statistics

<table>
<thead>
<tr>
<th></th>
<th>F Value</th>
<th>Value</th>
<th>DF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Math</td>
<td>29.84</td>
<td>&lt;.0001</td>
<td>1, 129</td>
</tr>
<tr>
<td>Science</td>
<td>35.26</td>
<td>&lt;.0001</td>
<td>1, 129</td>
</tr>
<tr>
<td>Social Studies</td>
<td>56.07</td>
<td>&lt;.0001</td>
<td>1, 129</td>
</tr>
</tbody>
</table>

**Summary**

Results of this study show that students who completed a yearlong brain-based agricultural education course had higher mean scores than students who completed only an eight-week brain-based agricultural education course on the math, science, and social studies portions of the CRCT. Overall, the 7th grade yearlong students’ mean scores were 3.28% higher on the math portion, 4.99% higher on the science portion, and 4.02% higher on the social studies portion of the CRCT (see Table 4-3). Eighth grade yearlong students scored 2.16% higher on the math, 2.04% higher on the science, and 3.48% higher on the social studies portion of the CRCT (see Table 4-6). Yearlong mean scores on all three portions of the CRCT exceeded the standard in the 7th grade. This is likely due to the nature of the 7th grade standards being more easily incorporated into the agricultural course than 8th grade standards. For example, 7th grade science standards feature animal-based science concepts such as natural selection, and heredity, all of which flow nicely into agricultural education, especially within units on animal science. Math standards in 7th grade utilize charts, graphs, fractions, and statistical concepts which can seamlessly be integrated into any agricultural unit. Seventh grade social studies standards feature economic concepts, entrepreneurship, and elements of trade throughout the world. These conceptions are taught within agricultural education in units featuring
world economies, small business, entrepreneurship concepts, and globalization. A stark contrast occurs in the 8th grade where standards are more abstract in math and science but more relatable to agriculture in social studies. Eighth grade math standards feature concepts not as easily incorporated into agricultural education such as linear equations, geometry, volume of shapes, and the Pythagorean Theorem. Science standards focus on cellular science, chemical changes, and electricity. Social studies standards focus on Georgia studies, topics that can very easily be incorporated in agricultural education courses in Georgia which perhaps accounts for 8th grade yearlong social studies scores to nearly reach the exceeding mark of 850 with an 842.45, a full 29.34 points above the eight-week group’s mean score of 813.11.

The F values in each comparison were high while the $p < .0001$, much smaller than the standard set at $\alpha = .05$, indicating a statistically significant difference in the means scores of the eight-week and yearlong student groups. High F values indicate that in each subject area, the variance between the yearlong and eight-week group scores exceed the variance within each of the two groups independently. There were no complications related to grade or year. Results from each comparison were stable across each of the three content areas.
CHAPTER 5

Conclusions, Implications, and Recommendations

This chapter begins with a restatement of the purpose and limitations. The chapter continues with a restatement of the research questions, and a summary of the methods and findings. Finally, the conclusions drawn from the findings of this study, implications of these findings, recommendations for practice, and recommendations for research that would add to the body of knowledge related to student achievement and instruction guided by brain-based research are presented.

Purpose

The purpose of this research study was to determine if there were statistically significant differences in academic achievement of students who completed a yearlong agricultural education course and students who completed an eight week agricultural education course. Students who completed the yearlong agricultural education course were exposed to a full year (32 weeks) of agricultural education. Those who completed an eight week agriculture education course were exposed to only eight weeks of agricultural education. Both groups were in the same school, taught by the same teacher whose instruction is guided by brain-based research. Academic achievement was compared using the groups’ scores on the math, science, and social studies portions of the Criterion-Reference Competency Test (CRCT).
Limitations

Results may not be generalized or applied to other situations since on-site demographic and qualitative data would likely be dissimilar to the school detailed in this study. The researcher was limited to the acquired data sets and cannot make inferences beyond the scope of the CRCT or to enrollment in other agriculture programs.

Research Questions

1. Is there a statistically significant difference in math CRCT scores of students who completed a yearlong agricultural education course that was guided by brain-based research and math CRCT scores of students who completed an eight-week agricultural education course that was also guided by brain-based instruction, in the same agriculture program?

2. Is there a statistically significant difference in science CRCT scores of students who completed a yearlong agricultural education course that was guided by brain-based research and science CRCT scores of students who completed an eight-week agricultural education course that was also guided by brain-based instruction, in the same agriculture program?

3. Is there a statistically significant difference in social studies CRCT scores of students who completed a yearlong agricultural education course that was guided by brain-based research and social studies CRCT scores of students who completed an eight-week agricultural education course that was also guided by brain-based instruction, in the same agriculture program?
Summary of Methods

A total of 260 yearlong students’ scores and 260 eight-week students’ scores were examined in this quantitative study. Students were in 7th or 8th grade during the 2011-2012 or 2012-2013 school years and were enrolled in agricultural education courses at the researcher’s school. The static-group comparison method with two-way ANOVA and existing data on the math, science, and social studies portions of the CRCT were utilized to compare scores of students who completed a yearlong agricultural education course featuring brain-based instruction and students who completed an eight week agricultural education course featuring the same instruction.

Summary of Findings

This study found a statistically significant relationship between yearlong agricultural education students’ academic performance on the math, science, and social studies portions of the CRCT when compared to students who only completed an eight week agricultural education course. Results from each comparison were stable across each of the three content areas; therefore, all three null hypotheses are rejected, as well as the general null hypothesis. It was found that 7th grade yearlong students’ mean scores were 3.28% higher than the eight-week students’ mean scores on the math portion, 4.99% higher on the science portion, and 4.02% higher on the social studies portion of the CRCT. Eighth grade yearlong students’ mean scores were 2.16% higher on the math, 2.04% higher on the science, and 3.48% higher on the social studies portion of the CRCT than were the eight-week students’ scores. Similarly, these higher means scores were reflected in the findings when a two-way ANOVA was performed. Consequently, findings of this study identified a practical and statistical relationship between yearlong
exposure to brain-based agricultural education instruction that integrates academic concepts and emphasizes academic achievement.

Conclusions

Although the manner in which agricultural education is delivered and viewed has changed since its inception, it is seen through this study that exposure to yearlong brain-based agricultural education was academically beneficial for students at the researcher’s school. As Caine and Caine (1994) suggested, teaching academic subjects through agricultural education lends itself to utilization of the brain’s functions to benefit content acquisition. This study found that students who engaged in brain-based experiences in the yearlong agricultural education course had higher CRCT scores than students who completed the eight week agricultural education course in the same school, taught by the same teacher. Because the standards for each grade are vastly different, 7th and 8th grade scores cannot be compared within subject areas, but must be examined independent of grade in school. Despite the fact that 7th grade yearlong scores were higher than 8th grade yearlong scores, such a comparison should not be made to examine achievement. Only subject and grade-specific comparisons may be made. Myers and Washburn (2008) reason that the mind naturally seeks relationships between new knowledge and the brain’s existing knowledge, therefore, integrating brain-based learning theory techniques in the classroom increases the likelihood of students retaining academic concepts when taught within the agricultural education setting. As previous studies have found, integration of academics into agricultural education is not only practical, but promotes students’ engagement with knowledge (Balschweid & Thompson, 2000; Dunn et al., 2009; Wilson, Kirby, & Flowers, 2002).
Exposure to yearlong brain-based agricultural education had an effect on student standardized test scores (CRCT) at the researcher’s school. The findings showed a statistically significant relationship between the completion of the yearlong agricultural education course and math, science, and social studies scores on the CRCT. Therefore, it can be concluded that a positive effect was seen for students who completed the yearlong agriculture course. Likewise, it can be concluded that if this trend continues to the 2013-2014 school year when CCRPI will officially “grade” Georgia’s public schools, the possibility of a positive effect on the school’s CCRPI is likely.

**Implications**

Under Georgia’s new College and Career Readiness Index (CCRPI), all standardized test scores count as part of the school’s total score. This is different than the previous AYP system that only counted reading and math CRCT scores. Because of this, now, more than ever, non-academic teachers are pressured to contribute positively to their students’ total academic success. Considerable research has shown the positive relationship between academic integration into vocational settings and academic achievement, therefore, this study corroborates earlier findings, but adds that utilization of brain-based methods of instruction influenced student academic achievement on standardized tests such as the CRCT. Findings from this study suggest that accounting for student’s brain development within instructional strategies used increases the likelihood of students internalizing the information being presented. Thus, when academic integration occurs in the vocational setting which allows for hands-on and tangible experiences, or brain-based instruction, academic success is more probable. Much like the fore-fathers of vocational education, John Dewey and Charles Prosser
positied, students learn better when what is being taught is meaningful and tangible. The findings of this study indicate that academic integration into agricultural education has a tremendous potential effect on student academic success. As previous studies have shown (Duncan, Navarro, & Ricketts, 2009; Imel, 2000) integrating academic principles into a real-world, hands-on setting, a strategy used in brain-based instruction, is highly effective. This study’s results add that not only is this effective, but continued exposure and experience with brain-based instruction is more academically beneficial than limited exposure.

Another aspect of this study that relates to CCRPI is the benefits of a yearlong agricultural education course over an eight-week course. Under the new CCRPI system, students must complete a pathway in high school. A pathway consists of three different courses within a vocational area such as health care science, metals, early childhood education, horticulture, or agriculture mechanics. Students are required to pass three area-specific courses to graduate. Percentages concerning pathway retention and completion are indicators that the CCRPI system includes in the school’s total score. Therefore, high percentages of students who not only stay in the pathway, but complete all three classes are desired. The goal of having high percentages of pathway completers applies to the current study because the academic system allows eighth graders who complete a yearlong agricultural education course to take the Basic Agriculture end of course test and if passed, receive credit for the first class in any agriculture pathway. Being able to receive credit for the first class in any agriculture pathway would allow any eighth grader who passed the Basic Agriculture end of course test to enter high school with one pathway class credit, thus increasing their likelihood of completing the other
two classes within the pathway, and ultimately, completing the pathway. Individual pathway classes are taken over the entire year, one per year, and are often replaced by developmental academic classes if needed by the student. Therefore, hurdles often exist that prevent students from completing their pathways in the four years available for pathway completion. Having the pathway credit as they enter high school gives such students a considerable advantage over their peers who enter high school with no pathway credits and must complete all three within the next four years of high school.

**Recommendations for Practice**

As more is learned about brain development, strategies that incorporate and test new information should be used, and perhaps even combined with existing knowledge about how the brain learns at given stages of growth. Further education on brain-based methods should be included in teacher education preparation programs and professional development for existing teachers. Training on how to implement brain-based methods while integrating academic concepts and collaborating with academic teachers also should be emphasized by student-teacher supervisors and professional development planners. In addition, given the results of this study, the yearlong agricultural education course appears to have a positive influence on student academic achievement, and therefore guidance counselors and student schedulers should encourage students to enroll in the yearlong course.

Academic teachers should also seek opportunities and resources available within the agricultural education setting to supplement and reinforce academic content. Examples of this include using the greenhouse to teach global warming or reproduction or, if available, a barn could house chickens and afford opportunities to incubate eggs,
reinforcing life science concepts and allowing real-world examples of otherwise abstract concepts. Language Arts or Literature teachers should link their material to the agricultural education courses being taught at their school, affording opportunities for collaborative units where all academic subject areas utilize the same material to teach related standards. An example of this in the sixth grade includes having the agriculture teacher guide students through a lab experience in which they plant green beans and learn about the care of a garden, pests, fertilizers, and so on. The science teacher could then teach about soils and elements within the Earth and atmosphere that allow plants to live and life to sustain while the social studies teacher highlights the area’s topography and uses a map to outline gardens or graph the rows of green beans the students planted, teach map skills, as well as how to use a scale and cardinal directions. The social studies teacher can collaborate and teach graphing concepts, determine germination rate, estimate a harvest date, and chart plant growth. Language arts and reading teachers can assign reading or writing assignments that complement the experience of gardening or the history thereof. Narratives about historical agriculture crises such as the Dust Bowl would be appropriate, generating discussion about how investments in agriculture research and subsequent advancements in farming methods have improved access to food across the world and averted natural disasters such as the Dust Bowl. Opportunities for collaboration between subjects and integration are only limited to the imagination of the teachers involved.

**Recommendations for Further Research**

The topic of yearlong agriculture classes is a prime area for additional research. Recommended areas of research include qualitative studies of teachers, administrators,
and students focused on the benefits, implementation, and barriers to providing yearlong agricultural education courses. Gaining teacher, administrator, and student perceptions on this topic through qualitative study will provide a means to guide further school schedule development as well as pathway planning.

It also would be constructive to determine how many students, who begin their pathway enrolled in the yearlong agriculture class, actually finish an agriculture pathway in high school. Gaining this type of information, along with perceptions of administrators, teachers, and students about the malleable factors that they believe contributed to completion will provide more information for planning and improving the pathway completion rates. Such longitudinal studies would also help researchers gain insight on the process of pathway completion. In addition, further research should seek to determine if the completion of a yearlong pathway class at the middle school level increases the odds of completing the entire pathway once in high school. This type of information could lend itself easily to legitimizing additional yearlong classes at the middle school level.

Given the positive relationship between yearlong brain-based agricultural education instruction and standardized test scores, more research is recommended to further explore their connection. Further research concerning brain-based methods, using both qualitative and quantitative methods to determine the most prevalently used brain-based methods in instruction, teacher preparedness to utilize such methods, and teacher perceptions of their use is needed. Mounds of research already exist concerning the barriers to, benefits of, and ways to integrate academic concepts into agricultural
education. Little is known, however, about how brain-based instruction is utilized to integrate academics into non-academic settings.
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