5-1-2016

A Comparison of Direct Instruction and Experiential Learning Techniques to Assess Agricultural Knowledge and Agricultural Literacy Gains in Private School Students

Timothy Bradford Jr.

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By

Timothy Bradford Jr.

A Dissertation
Submitted to the Faculty of
Mississippi State University
in Partial Fulfillment of the Requirements
for the Degree of Doctor of Philosophy
in Agricultural Sciences
in the School of Human Sciences

Mississippi State, Mississippi

May 2016

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By

Timothy Bradford Jr.

Approved:

Gaea A. Hock
(Major Professor)

Christopher Ryan Akers
(Committee Member)

Marina D'Abreau Denny
(Committee Member)

Laura L. Lemons
(Committee Member)

William L. Kingery
(Committee Member)

Michael E. Newman
(Graduate Coordinator)

George M. Hopper
Dean
College of Agriculture and Life Sciences

Name: Timothy Bradford Jr.

Date of Degree: May 6, 2016

Institution: Mississippi State University

Major Field: Agricultural Sciences

Major Professor: Dr. Gaea A. Hock

Title of Study: A comparison of direct instruction and experiential learning techniques to assess agricultural knowledge and agricultural literacy gains in private school students

Pages in Study: 156

Candidate for Degree of Doctor of Philosophy

The United States has shifted from a once agrarian, to a predominantly urban society (Riedel, 2006). Currently, less than 2% of the U.S. population live on farms. Coupled with urbanization, this has contributed to the decline of an agriculturally literate population (EPA, 2013; Kovar & Ball, 2013). One strategy to alter the public's perception of agriculture and increase agricultural literacy is implementing an educational environment that promotes agricultural activities via experience (Blair, 2009). Experiential learning has been championed by prominent educational theorists John Dewey and David Kolb. Experiential learning is conceptualized as a process where relevant experiences are the foundation of learning and which allow for deeper connections between the learner and the subject. This study was a mixed methods design conducted at three private schools in Northeast Mississippi during the Spring of 2015. Tenth grade biology students were taught six (6) lessons contextualized in agriculture, with one group serving as a control group (no teaching), one group receiving direct

instruction, and one group being provided with relevant experiences to agricultural topics.

Results showed that distribution of post-test knowledge scores changed drastically by intervention groups. There were significant differences in post-test scores based on students' involvement with experiential learning ($p < .001$). Further analysis of the data displayed that 67% of the variance in scores can be attributed to method of instruction received. In addition, focus groups were conducted to assess student knowledge gain and perceptions of agricultural production. Focus group responses were analyzed and grouped into the following themes:

1. The interesting and dynamic nature of agriculture and the lessons
2. Stereotypical preconceived notions of agriculture
3. Desire to learn more about agricultural topics
4. The role of experiential learning (and lack thereof)
5. Increase in knowledge, awareness, and appreciation of agriculture

Results revealed that the participants who experienced the hands-on approach to the lessons had a more lasting and richer learning experience than those who did not participate in a hands-on approach. The results also indicated not only an increase in knowledge among students, but a willingness for future agricultural education opportunities and a deeper appreciation for agriculture.

DEDICATION

To all those lost souls who have forgotten to believe in the immensity of love and to those who are making their dash count.

ACKNOWLEDGEMENTS

First, I want to give honor to my Lord and Savior, Jesus Christ. It is in Him, that defines my very existence, and for Him I do all things for; for without Him I am nothing. Next I would like to thank my chair, Dr. Hock, for never micromanaging my tasks and trusting me throughout this process. To my committee members who have continually challenged me to do more and to keep pushing and for serving on my committee. To Dr. Newman for always being willing to help me with whatever I needed for my project.

To my parents for always taking the time to tell me how proud they are of me and for telling me at an early age that I did not have to be a product of my environment. To my brothers for always pushing me to do more and encouraging me in my endeavors and my nephews for providing me with a tangible goal to show them the importance of hard work and dedication. To my pastors, Jody and CJ Andrews, whom I dearly love, for providing guidance and prayers throughout this process. To my church family for their continued prayers and support, there are so many that I cannot name specifically. To my friends Brian, Kristy, Tito, & Damaris whom I love dearly and share more than a common bond, for praying and encouraging me and my family in this journey. To my grandmother for her unchanging love for her grandson, and who encouraged me that if it is worth having, it is worth fighting for. To all of my aunts, uncles, and cousins, thank you for providing a family unit that supports one another.

To my friend Carley, who always entertained my silly ideas with a straight face, no matter how outlandish they were and was my sounding board for statistical questions. I want to thank my fellow grad students and friends, Alayna, Shawn, Michael, Bear, and many others who assisted me in gathering thoughts and effort for this project. To the administrators, teachers, and students who allowed me to come into their schools to perform this project, I could not have done this without you. To my in-laws for their continued support and encouragement.

And last, but not least, I acknowledge my beautiful wife and my best friend, Joy. You are truly a gift from God. Thank you for pulling me from my lowest point with love and encouragement. For believing in me when I didn't believe in myself, for being my anchor, for not letting me quit, for loving me when I was unlovable, for continually letting me know that I'm worth the sacrifice, and for being perfect for me. Thank you for making me feel relevant when I felt irrelevant. Thank you for letting me know that I am worth it and for being part of my present and future when my past was full of loss and pain. I could not have done this without you.

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CHAPTER I

INTRODUCTION

Agriculture's significance can be argued as being unrivaled in comparison to other disciplines; however, agriculture's role is not viewed as important by most of society. Today, agricultural literacy is an area that is often invisible and rarely discussed outside of specific agricultural disciplines (Doerfert, 2011). Agricultural production practices (e.g., pesticides, confined animal feeding, fertilizers, etc.) and environmental issues, such as erosion and non-point source pollution, have come under intense scrutiny (Horrigan, Lawrence, & Walker, 2002). Issues regarding animal safety and antibiotic use in animals, combined with the never-ending debate of genetically modified organisms (GMOs) and their effects, are usually misrepresented in the media by special interest groups. Therefore, it is important that society is properly educated on these issues and how they impact the world around them (Kovar & Ball, 2013).

Once a dominantly agrarian society, the United States has drastically shifted to the other end of the spectrum (Riedel, 2006). This is confirmed by the United States Environmental Protection Agency (EPA). The EPA reported that less than 3% of the U.S. population currently live on farms (EPA, 2013). This trend, along with more people moving from rural to urban areas, otherwise known as urbanization, has also led to the decline of an agriculturally literate population (Kovar & Ball, 2013). Increases in technology related to agricultural production systems are more efficient today than they have ever been before, which further distances the population away from the farm (Birkenholz, Harris, & Pry, 1994). Bauman and Capper (2011) stated one farmer in the United States can feed 155 people, while the American Farm Bureau Federation (2014) reports a 262% increase in food production by farmers using 2% fewer inputs than those in the 1950s. However, even with these statistics, the outlook for agriculture can seem bleak and this trend should be alarming.

According to the 2012 Census of Agriculture, the United States Department of Agriculture (USDA) figures show the average age of the American farmer is 58 years. This number is up 1.3 years since 2007 (National Sustainable Agriculture Coalition, 2014). The 2012 Census of Agriculture also reports the number of total farmers is decreasing at an increasing rate. These trends indicate that fewer people are choosing agriculture as a career choice. Taking into account the human population increases geometrically and food production increase linearly, one can infer there is a desperate need for an agriculturally & scientifically literate population (Pimentel & Pimentel, 2008).

With the decline of an agriculturally literate population, the perceptions of agriculture itself have changed in society as well. Many people tend to associate the term “agriculture” with either farming or ranching (Terry, Herring, & Larke, 1992). Unless the masses are agriculturally literate, they will be unable to fend off the onslaught of emotional negativity produced through various media outlets (Kovar & Ball, 2013).

One strategy for altering agricultural perceptions and agricultural literacy is implementing agricultural education opportunities such as introductory agriculture curriculums or school gardens (Fisher-Maltese, 2014). Fisher-Maltese (2014) reported that school gardens have a significant impact on traditional academic subjects. Combined with experiential learning, school gardens provide opportunities to learn additional topics such as diet and nutrition, fruit and vegetable consumption, agricultural topics, and environmental stewardship (Graham, Beall, Lussier, McLaughlin, & Zidenberg-Cherr, 2005; Ratcliffe Merrigan, Roger, & Goldberg, 2011). Balschweid (2002) further discussed the role that agriculture can play when utilized within a high school curriculum. The author contended that agriculture curriculums often benefit the learner in increasing their scientific literacy by connecting agriculture to science and real world applications while increasing overall achievement. Private schools offer an avenue for agriculture based curriculums. Private schools offer the freedom and flexibility to incorporate additional approaches in the learning environment due to the nature of the educational landscape (Carbonaro & Covay, 2010).

Whether it is a concern for food production and consumption, food security, or conserving natural resources, everyone has a vested interest in agriculture (Frick, Birkenholz, Gardner, & Machtmes, 1995). School gardens have been shown as effective in improving agricultural literacy and many other disciplines as well. By creating an educated and informed public regarding agricultural issues, citizens are equipped to positively affect changes in agriculture and work to secure the future of agriculture.

Statement of the Problem

Agricultural literacy is a topic that is extremely important, especially as the world population approaches nine billion people by 2050 (Doerfert, 2011). The combination of technological advances in agriculture and urbanization have resulted in many generations moving further away from the farm (Leising, Pense, & Igo, 2001). This has led to a large portion of society that is unaware of agricultural and conservation practices, food production, and other agricultural aspects (Birkenholz et al., 1994). The uninformed public can potentially have dire consequences when it comes to electing political figures who have a significant impact on agriculture and policy (Birkenholz et al., 1994). A recent example is that of genetically engineered foods, of which there is fear, uncertainty, but most importantly, misconceptions in regard to it (Doerfert, 2011).

There has been a large and sporadic gap in agricultural literacy research. Kovar and Ball (2013) report that only 49 studies have been published regarding agricultural literacy since 1988. The authors also report the commonly investigated participants throughout these studies are elementary and pre-service teachers, students, and non-educator adults (Kovar & Ball, 2013). Additionally, no agricultural literacy research has been assessed among private school populations in the country nor in Mississippi at all.

Since the implementation of "No Child Left Behind," many public school teachers and administrators are concerned with test scores and teaching for performance and have difficulty fostering creativity and flexibility in their lessons (Eason, Guannangelo, & Francheschini, 2009). Private schools however, offer the freedom and flexibility to incorporate agriculture into their curriculum more so than public schools (Eason et al., 2009).

A link in the literature exists between school gardens and agricultural knowledge (Blair, 2009). A school garden or similar program is one way agricultural literacy can be incorporated into existing curriculums while teaching a variety of other subject matters (Blair, 2009; Graham et al., 2005). There has been no research conducted in Mississippi identifying the current state of school gardens or the use of school gardens in private schools as well as the effectiveness of school garden or similar programs on agricultural literacy.

Background

Agriculture in itself is a broad, wide-ranging discipline that includes many areas of expertise. The National Research Council's (NRC) (1988) publication *Understanding Agriculture – New Directions of Agriculture* stated "agriculture encompasses the study of economics, technology, politics, sociology, international relations and trade, and environmental problems, in addition to biology" (p. 8). The authors also stated "agriculture is too important a topic to be taught only to the relatively small percentage of students considering careers in agriculture and pursuing vocational agricultural studies" (p. 8).

The National Research Council claimed, traditionally, vocational education high school students are usually the only students who are exposed to a systematic agricultural curriculum. Today, there are more avenues available for secondary students with regard to increasing knowledge of agriculture in formal settings (Mercier, 2015). Mercier (2015) reported approximately 800,000 – 1 million high school students are currently receiving food and agricultural education in the United States. While this number is promising, the National Center for Education Statistics (2015) reported 15 million students are enrolled in secondary education and the current students being offered formal agricultural education opportunities represent a small portion of the population. Braverman and Rilla (1991) reported that non-formal, school-based agricultural programs, such as 'Ag in the Classroom' are rare, and in most cases are ineffective due to limited funds.

Furthermore, the National Research Council (1988) provided a basis for how important agriculture and agricultural literacy is to society and stated:

> Students should come to appreciate that the species providing our food and fiber are part of a vast web of life that functions as an integrated whole. Every species of plant and animal depends not only on its physical environment but on the biological component of the environment as well. All living creatures are part of the same cycles of matter and energy. Thus, education will be in-complete unless students learn what is essential for the lives of our crops, animals, and plants (National Research Council, 1988, p. 8).

From the National Research Council's statement citing the importance of agriculture, the authors believe education is not complete until one has an understanding of the interaction between various concepts and aspects that agriculture encompasses.

Kovar & Ball (2013) reported that much of agricultural literacy research, past and present, has spurred from the publication of *Understanding of Agriculture – New Directions of Education*. From the National Research Council's publication, we can conclude that agriculture is an extremely important topic that is seldom talked about outside of the agricultural discipline. Agricultural literacy provides the framework for the general public to make well-informed decisions about the many facets of agriculture and how it impacts their immediate world; however, there are not many proper educational outlets to disseminate this information (National Research Council, 1988).

This publication outlined the importance of agriculture in our society and the need to teach agriculture to children starting in pre-K (National Research Council, 1988). The authors identified the current focus and identified many various aspects of which agricultural education and agricultural literacy needed to be improved upon in the United States.

Purpose Statement

Researchers have documented the need to increase agricultural knowledge within society. With regard to agricultural literacy, research has shown there have been approximately 50 studies conducted since 1986 on this topic. A lack of agricultural literacy can lead to a bevy of misinformed decisions and unsubstantiated opinions in regard to agricultural related practices as it pertains to the consumer. One example is the increasing attention resulting from genetically modified products and animal growth and safety. These topics have taken a hold on mainstream media and have dominated scientific and political discussions. As a result, much of society's knowledge base is potentially being influenced by information that could be biased. As a result, future economic decisions as well as governmental policies can be influenced and determined by public perception.

However, in order to form a knowledge base and opinion of agriculture, a systematic approach should be conducted to investigate: reasonable approaches to assess agricultural knowledge and literacy, identify underrepresented populations, and assess the best way to disseminate information. The purpose of this study was to investigate the knowledge and perceptions of agriculture among private school biology students in Northeast Mississippi. Most agricultural literacy efforts have been conducted in public primary and secondary school settings; however in Mississippi, there has been no agricultural literacy research conducted with any population. Also, this study investigated student perceptions and effectiveness of particular intervention methods (direct instruction vs. experiential learning) on agricultural knowledge. The interventions also determined the recommendations for other researchers and schools who would like to implement similar teaching at their institution and/or school.

Research Objectives

The study aimed to determine the current knowledge and perceptions, as well as the change in knowledge and perceptions, of agriculture among biology students at three private schools in Northeast Mississippi. This study also aimed to compare direct instruction and experiential learning and their impact on the change in knowledge and perceptions of agriculture. The specific research objectives were:

Objective 1: Describe the demographics of students who participated in the study.

Objective 2: Assess the agricultural knowledge (plant, soil, and water relationships) among private school students in Mississippi prior to and after treatment.

Objective 3: Assess agricultural literacy (knowledge and perceptions of agricultural practices and policies) among private school students in Mississippi prior to and after treatment.

Objective 4: Measure and compare the impact of direct instruction and experiential learning on the change in student knowledge of plant, soil, and water relationships, agricultural literacy, and perceptions of agriculture.

Objective 5: Investigate the perceptions of the agricultural lessons and method of intervention among students (experiential learning, direct instruction, no intervention).

Significance of the Study

This research study could provide initial information regarding the state of agricultural literacy among certain populations in Mississippi. With Mississippi being a predominantly agrarian state, this study could provide further information regarding agricultural literacy trends, and if there is any correlation between agricultural literacy and geographical location. By infiltrating private schools with agriculture, the study can shed light on populations that have been traditionally unexposed to agricultural education and solutions to alleviate agricultural illiteracy. Furthermore, this study will be beneficial to private schools in Mississippi who would like to incorporate agriculture into their lessons without causing major disruptions to their existing curriculum by utilizing an already established curriculum. This study could potentially serve as a starting point for others who want to assess agricultural literacy within the state or among private schools.

Definition of Terms

Agricultural literacy – having knowledge and understanding of agriculture and being able to communicate, analyze, synthesize, that knowledge including but not limited to: plant and animal production, agricultural policy and economic significance, global and domestic significance of agricultural production, and agriculture's relationship with natural resources and the environment (Frick et al., 1991).

Agricultural literacy framework – a systematic, multi-disciplinary, educational approach that promotes, fosters, and disseminates agricultural knowledge (Powell, Agnew, & Trexler, 2008).

Direct Instruction – a scripted form of instruction where the teacher facilitates student development by controlling materials, pace of instruction, and objectives (Dean & Kuhn, 2007).

Ecoliteracy – a term that denotes familiarity with how the environment and nature connects students to the world around them (Government of Manitoba, 2011).

Experiential learning – the philosophy in which educators purposely provide pupils with direct experiences and reflection on the subject matter to facilitate knowledge gain, learning by doing (Northern Illinois University, 2011).

Future Farmers of America (FFA) – is a student organization designed for students who are interested in agriculture and leadership (FFA, 2015)

Golden Triangle Region – The golden triangle is the geographical region of Mississippi that is formed by the cities of Starkville, West Point, and Columbus.

High tunnel – high tunnels are greenhouse-like structures covered with polyethylene that do not contain a heating or cooling system that is used for growing crops/plants (University of Kentucky Cooperative Extension Service, 2012).

Private schools – schools that are funded by private sources and do not receive tax revenue (Eason et al., 2009).

Supervised Agricultural Experiences (SAE) – SAE is a component within the three part agricultural curriculum. SAE's provide a basis for students to apply classroom knowledge to real-world situations including, internships, service learning projects, and school-based enterprises (FFA, 2015).

CHAPTER II

LITERATURE REVIEW

Introduction

Since the turn of the 20th century, our country has shifted from a dominantly agrarian society to a society that has become urbanized and technologically advanced (Birkenholz et al., 1994). The result of that shift is more and more of society gaining their income away from the farm (Birkenholz et al., 1994). Because of this, it has led to a large proportion of the general population being ill-equipped to make adequate decisions regarding food production, among the many other vast arrays of disciplines that agriculture encompasses (Elliot, 1999). Birkenholz et al. (1994) stated "although involvement in production agriculture has declined over the past century; the public has become more vocal with regard to issues related to agriculture, food, and the environment" (p. 63).

Agricultural policy and potential career choices also have a place within the agricultural literacy framework. Agricultural policy affects how policymakers implement economic decisions in regard to marketing and consumption of food (Riedel, 2006). Traditionally in the United States, a large portion of legislation and newly enacted governmental policies are centered on strengthening the agricultural sector of the economy (Keeney & Kemp, 2002). The role agricultural legislation plays in society can potentially lead to the increase or reduction in commodity prices, GMO labeling, or a precursor to who holds political offices, which in turn can have a direct effect on the consumer (Karsten & O'Connor, 2002).

Recent evidence suggests the demand for agriculture and related career fields are expected to rise in the future (Esters & Bowen, 2005; Mercier, 2015). According to the National Science and Technology Council's report (2013), an estimated 750,000 jobs will be created between 2008 and 2018 in order to meet the demand of a growing population. However, with much of the population moving farther away from agriculturally dominated lifestyles, trends indicate a lack of qualified professionals to meet these needs (National Science and Technology Council, 2013). Zoldoske (1996) reported agriculture students who are pursing agricultural careers have been on the steady decline since the 1970s. Agreeing with the National Research Council (1988), Esters and Bowen (2005) stated "all schools need to provide opportunities for students to prepare for agricultural careers so that the predicted shortage of trained professional in agriculture may be alleviated" (p. 24).

The aforementioned factors, combined with the constant flow of potentially incorrect information from the media, can lead to misconceptions regarding agriculture and its wide array of constructs. More directly, food prices, surplus and shortages in agricultural career fields, and other economic and environmental policies can be directly contributed to the lack of agricultural literacy in society (Birkenholz et al., 1994). In order for society to make sound decisions in regard to agriculture that significantly affect future generations, it is important for the population to have opportunities to become agriculturally literate (Kovar & Ball, 2013). Together, the literature review and conceptual framework served as a guide for the research design and in order to investigate the research objectives.

Agricultural Literacy

Previous studies regarding agricultural literacy have frequently cited the National Research Council's (1988) publication, *Understanding Agriculture: New Directions for Education*. This study was initially published in response to the declining profitability of American farms and decreasing agricultural education enrollment (Kovar & Ball, 2013). The Council's report was aimed at assessing agricultural education in regard to improving agricultural productivity and providing recommendations for long-term goals of agricultural instruction, subject-based curricula and skills that needed to be further stressed, and the policy changes that needed to be implemented in order to effectively administer agricultural programs in secondary schools. Their publication began what Kovar and Ball (2013) described as the constructs of agricultural literacy.

The National Research Council developed and proposed the idea of agricultural literacy. The authors not only identified the struggles of current agricultural education within the United States, but suggested a stronger push for "education about agriculture" (National Research Council, 1988; p. 8). With this in mind, the council developed a three-part definition of what competencies an agriculturally literate person possesses. First, they asserted that an agriculturally literate person's knowledge should include "[agriculture's] history and [agriculture's] current economic, social, and environmental significance to all Americans" (National Research Council, 1988; p. 8-9). The second part of the author's definition is that an agriculturally literate person has "enough knowledge of nutrition to make informed personal choices about diet and health" (p. 9).

The third component of the National Research Council's definition of agricultural literacy was "[for society to] have practical knowledge needed to care for their outdoor environments, which include lawns, gardens, recreational areas, and parks" (p. 9).

One of the council's principal findings was the lack of an agriculturally literate society. They contend agriculture "is too important a topic to be taught only to the relatively small percentage of students considering careers in agriculture and pursuing vocational agriculture studies" (National Research Council, 1988; p. 1) and:

> All students should receive at least some systematic instruction about agriculture beginning in kindergarten or first grade and continuing through twelfth grade. Much of the material could be incorporated into existing courses and would not have to be taught separately (p. 10-11).

Another disturbing trend the authors noted are the few and small efforts that are made to educate the public on such a topic (National Research Council, 1988). The authors stated:

> Few systematic educational efforts are made to teach or otherwise develop agricultural literacy in students of any age. Although children are taught something about agriculture, the material tends to be fragmented, frequently outdated, usually only farm oriented, and often negative or condescending in tone (National Research Council, 1988; p. 9).

They further stressed the need to reach a more diverse audience while straying away from traditional agricultural educational approaches by broadening agricultural curriculums to reach urban and suburban settings (National Research Council, 1988). They argued that teaching agricultural literacy does not require an overhaul of a current curriculum, but the inclusion of agricultural examples and experiments within the current subject lessons. Many innovative teaching approaches can be created and utilized by developing learning modules and slowly integrating agriculture into classroom instruction and by providing teachers with education and training to teach agricultural topics (National Research Council, 1988).

In the past 30 years, there have been three accepted definitions of agricultural literacy. Prior to the definition furnished by the National Research Council in 1988, Douglass provided the first definition for agricultural literacy in 1984 (as cited in Frick, Kahler, & Miller, 1991). The objectives of Frick et al. (1991) were to provide a consensus definition of agricultural literacy, to identify subject areas that classified within the agricultural literacy framework, and agricultural concepts U.S. citizens should be able to commonly identify. The authors employed the Delphi technique consisting of 63 panelists who represented various states and interests. Then, the authors developed two questionnaires; the first determined the operational definition of agricultural literacy, and after a consensus was reached, a second questionnaire determined the subject areas that agricultural literacy encompassed. The results of their study provided the following definition of agricultural literacy:

> Agricultural literacy can be defined as possessing knowledge and understanding of our food and fiber system. An individual possessing such knowledge would be able to synthesize, analyze, and communicate basic information about agriculture. Basic agricultural information includes: the production of plant and animal products, the economic impact of agriculture, its societal significance, agriculture's important relationship with natural resources and the environment,

> the marketing of agricultural products, the processing of agricultural products, public agricultural policies, the global significance of agriculture, and the distribution of agricultural products (Frick et al., 1991, p. 52)

The authors also provided 11 subject areas that agriculture literacy should encompass:

> 1) agriculture's important relationship with the environment, 2) processing of agricultural products, 3) public agricultural policies, 4) agriculture's important relationship with natural resources, 5) production of animal products, 6) societal significance of agriculture, 7) production of plant products, 8) economic impact of agriculture, 9) marketing of agricultural products, 10) distribution of agricultural products, and 11) global significance of agriculture (Frick et al., 1991, p. 54).

Since the furnishing of the definition of agricultural literacy, many assessments have been conducted to assess knowledge of agriculture among teachers and students, with much of the aim being targeted at elementary-aged students (Kovar & Ball, 2013). Prior to the National Research Council's report in 1988, Horn and Vining's 1986 study was the only study that had been conducted to assess student knowledge of agriculture (as cited in Frick et al., 1991). Horn and Vining's assessment, in which they surveyed 2,000 students in Kansas, revealed less than 30% of the students provided correct answers to basic agricultural questions (as cited in Frick et al., 1991). Birkenholz et al. (1994) surveyed agricultural literacy among college students during the fall semester of 1992. The survey instrument the authors developed consisted of three sections: the first consisted of true false questions assessing knowledge of agriculture, the second utilized a Likert-type scale (1-Strongly Agree, 2-Agree, 3-Neutral, 4-Disagree, 5-Strongly

Disagree) assessing perceptions of agriculture, and the third consisted of demographic data. Birkenholz et al. (1994) reported the mean knowledge score among participants was 68.1%, indicating participants were somewhat knowledgeable of agriculture. The perception score was 2.17, which closely correlated with the agree category, indicating participants had a favorable opinion of agriculture and agricultural practices. The author's report concluded that respondents who lived on farms had more knowledge of agriculture than those who lived in more populated areas.

Pense and Leising (2004) performed a similar study, but with a population of 12th graders in Oklahoma. The authors sought to determine the knowledge of the food and fiber systems based on the Food and Fiber Systems Literacy Framework benchmarks for grades 9-12. Their ex-post facto research design, coupled with purposive sampling, assessed 330 general education and agricultural students from five different high schools. Their study also encompassed students in urban, rural, and suburban schools. Their results revealed that, overall, the students exhibited similar levels of knowledge, but were not agriculturally literate based on the fact that no school received higher than a 49% mean score. Their results also indicated agricultural education students did not differ in knowledge from general education students in their overall knowledge of agriculture.

Frick et al. (1995) further examined agricultural knowledge and perceptions by assessing rural and urban inner-city students in the Midwest. Their study totaled 1,121 respondents with 668 being from rural Indiana and 453 respondents from urban Michigan. Their results showed that rural students answered 65% of the knowledge items correctly and achieved a mean score of 22.7 from a possible 35. The urban students answered approximately 48% of the knowledge questions correctly and achieved a mean score of 16.9 from a possible 35. Their numbers indicated both rural and urban student groups were not very knowledgeable of agricultural practices, but rural students had more knowledge of agricultural practices than urban students.

Furthermore, Frick et al. (1995) investigated both rural and urban students' perceptions of agriculture. The authors utilized a numerical scale that ranged from 35-100. The scale was reverse coded to indicate low numerical values indicated a positive perception of agriculture. The authors reported the urban student population achieved a mean score of 85.79 while the rural student population achieved a mean score of 83.90. The lower perception score in rural students indicated they possessed a more positive perception of agriculture than urban students; however, not significantly.

In regard to assessing agricultural literacy, it has not been limited to surveying only student populations. Kovar and Ball (2013) reported that numerous studies have been conducted in assessing and determining the need for agricultural literacy and among educators. Braverman and Rilla (1991) surveyed three populations of adult educators: county superintendents, district superintendents, and Extension personnel in California regarding agricultural literacy's significance and priority. The authors developed two, 2-page questionnaires, and their results indicated the respondents in rural districts placed a higher importance on agricultural literacy than urban districts. The respondents also suggested that agriculture be taught in fourth through sixth grade or seventh through ninth grade. Their research showed a discrepancy in priority of teaching agriculture between district superintendents and Extension personnel and identified the need to develop learning objectives for the age groups delineated in their study.

Several studies have been conducted assessing agricultural literacy and agricultural awareness among teacher populations (Elliot, 1999; Knobloch & Martin, 2000; Terry et al., 1992). Terry et al. (1992) surveyed 510 elementary teachers in Texas whose teaching experience ranged from one to 44 years. They reported 89% of teachers who were surveyed scored in the minimal knowledge of agriculture range, (i.e., less than 70%), regarding U.S. agricultural production practices. Humphrey, Stewart, & Linhardt (1994) performed a similar study on elementary education majors at the university level. Humphrey et al. (1994) utilized purposive sampling and assessed 82 elementary education majors at the University of Missouri. Their study revealed a majority of the respondents had a positive perception of agriculture, but only 20% felt confident enough to teach agricultural topics. The authors reported students who had prior experiences with agriculture were more confident in teaching agricultural topics and the students who did not have prior agricultural experiences were less confident in teaching agricultural topics. Humphrey et al. (1994) concluded the lack of students with prior agricultural experiences' as a grave concern and also a limitation in incorporating agriculture curriculum in elementary school environments.

Knoblock and Martin (2000) surveyed 311 elementary school teachers' perceptions of agriculture and agriculture in their classroom. Their results showed 97% of elementary teachers favored integration of agriculture into their current curriculum and 84% of teachers thought agriculture would enhance elementary education. They also reported that they usually had little to no time to incorporate agriculture into their lessons and agreed that elementary teachers are not trained to teach agriculture.

Of the studies that have been conducted, results indicated a lack of teacher willingness and lack of knowledge as reasons for not implementing more agriculture into their lessons (Elliot, 1999; Knobloch & Martin, 2000; Terry et al., 1992). Elliot (1999) stated there being a need for teacher training and education in agricultural concepts in order to change perceptions within agriculture. Research conducted by the National Research Council (1988) and corroborated by Elliot (1999) proposed a framework that illustrated how agricultural perceptions are developed and formed (Figure 1). Furthermore, many researchers indicated from their studies, that systematic instruction should be developed and implemented in order to ensure students can make sound decisions in the future and at an early age.

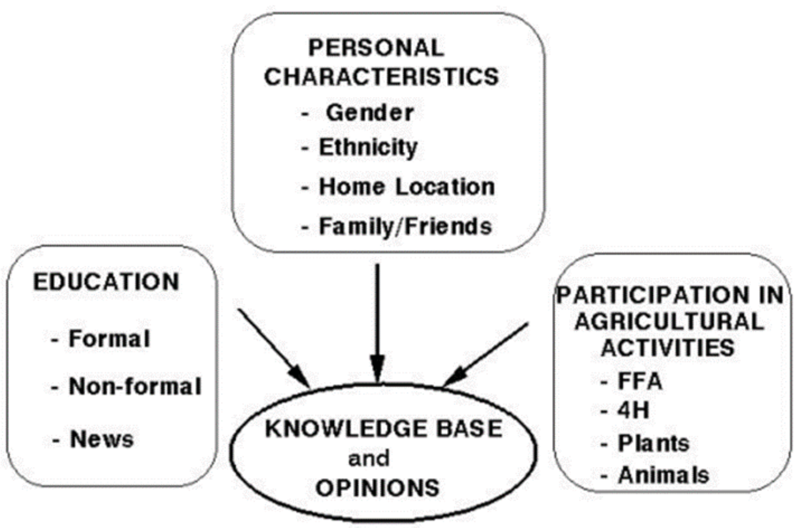

Figure 1 Agricultural Literacy Framework (Elliot, 1999).

Experiential Learning

Experiential learning is not a new theory regarding learning. It was built on a foundation provided by Dewey, Piaget, and many other notable theorists (Kolb, 1984). The theory of experiential learning is based on the process of learning whereby experience is the main component in the learning process. Many advocates of experiential learning agree that students learn through relevant, real-life experiences. Those relevant experiences should provide the foundation and influence how students learn and should guide their perception for future learning experiences (Knobloch, 2003).

John Dewey is most famously known for his progressive nature regarding educational reform and his belief in experiential learning. In his publication *Experience & Education* (1938), Dewey believed that experience is the foundation of all learning and knowledge acquisition. Dewey also assumed that in order for the pupil to develop a more intimate connection with the subject matter, one must have relevant experiences associated with the subject at hand (Dewey, 1938). Furthermore, Dewey (1938) stated textbooks, which were based on an experience from the author's perspective, do not grant the pupil justice in creating their own knowledge from experience. Dewey argued "that education in order to accomplish its ends both for the individual learner and for society must be based upon experience, which is always the actual life-experience of some individual" (Dewey, 1938, p. 39). Dewey maintained the perspective that true learning is based on experience and experience should be incorporated into every educational objective if possible.

Dewey's views are similar to those provided earlier by Stimson (1919). Stimson stated "neither skill nor business ability can be learned from books alone, nor merely from observation of the work and management of others. Both require active participation, during the learning period [in farming and other disciplines]" (p. 32). Stimson believed that learning requires more than a passive association in a learning environment, but the deliberate act of being involved is crucial to the learning process. As further elaborated by Dewey (1938), Stimson argued there is too heavy a reliance on books and observations as opposed to utilizing experiences that will directly benefit the student (1919). In addition to Stimson and Dewey, Carl Rogers also believed learning required intimate connections which are only connected through experiences (Northern Illinois University, 2011).

David Kolb is perhaps one of the most cited theorists regarding experiential learning. He and others have provided irreplaceable understanding on the topic of experiential learning (Northern Illinois University, 2011). Kolb (1984) believed "learning is the process whereby knowledge is created through the transformation of experience. Knowledge results from the combination of grasping and transforming experience" (p. 38).

Kolb presented an experiential learning model (1984) (Figure 2) which illustrated learning as a cyclical process that conceptualized learning from using experience in four components: concrete experience, reflective observation, abstract conceptualization, and active experimentation (Dunlap, Dobrovolny, & Young, 2008). Kolb contended this learning process can occur at any stage, as represented by its cyclical nature. Concrete experience begins with the learner experiencing a situation. During this stage, the learner comprehends the experience via their senses (Roberts, 2006). Following concrete experiences in the reflective observation stage, the learner examines and internalizes the experience in order to conceptualize a variety of perspectives to place meaning with the experience (Roberts, 2006). In the abstract conceptualization stage, the learner builds on their reflective experiences to examine and infer logical conclusions from the experience. Roberts (2006) reported this stage is founded upon the ability of the learner to "grasp the information through comprehension by forming rules, generalizations, or hypotheses about the phenomenon being studied" (p. 22). Finally, active experimentation propels the learner to make decisions and apply concepts to new and future experiences (Dunlap et al., 2008). This stage prompts the learner to apply and test the rules and generalizaions that were previously concluded in the prior stage (Roberts, 2006). Kolb further elaborated that within this process, its foundation is built on six concepts: (1) learning is a process, not a set of outcomes, (2) all learning is ultimately re-learning, (3) learning involves the resolution of conflicts, (4) learning is a holistic process, (5) as the learner interacts with their environment, learning occurs, and (6) learning involves the process of creating knowledge (Baker, Robinson, & Terry, 2015).

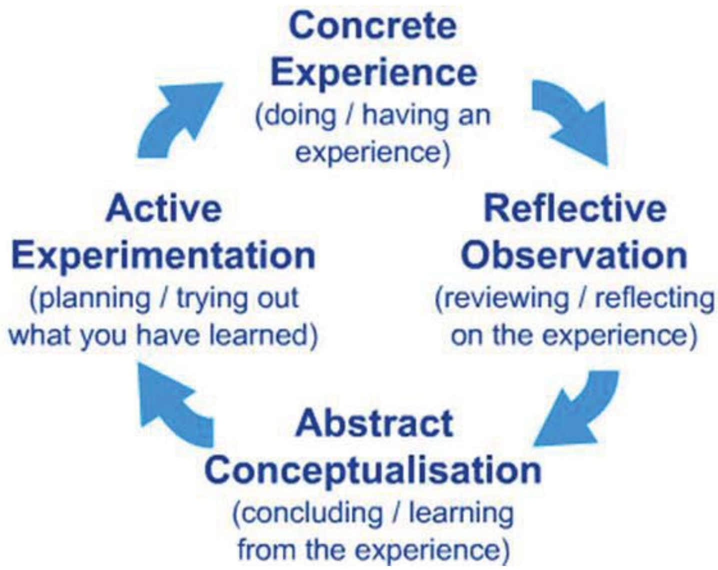

Figure 2 David Kolb's experiential learning model (Kolb, 1984).

Experiential learning is widely accepted because of its challenging nature. Additionally, experiential learning encompasses various aspects and complexity in regard to learning by doing via reflection (Penny, Frankel, & Mothersill, 2012). Experiential learning makes the case for critical thinking and problem solving by being heavily centered on student involvement rather than memorization (Northern Illinois University, 2011). These benefits associated with experiential learning are corroborated by Wozencroft, Pate, and Griffiths (2014). The authors stated experiential learning "[promotes] student engagement, [promotes] an improved atmosphere for making ethical decisions, and the promotion of critical-thinking and problem-solving skills" (Wozencroft et al., 2014; p. 4). There are many definitions and observational objectives for experiential learning, but Penny et al. (2012) gave a very appropriate definition:

> The objective of experiential learning is to provide an education that attends in some balanced manner to the student's need to advance knowledge acquisition

> and critical judgment, thinking and acting, reflection and engagement, career development and informed citizenship, growth as an individual, and greater connectivity with the larger community (p. 2).

Penny et al. (2012) further elaborated their stance by stating:

> (…) lecture format for transmitting knowledge can no longer be the only pedagogical approach used in academic settings. Experiential learning opportunities that promote use of cognitive, affective, psychomotor (…) ways of knowing are more reflective of learners in the new millennium (p. 7).

The basis of experiential learning is the notion that learning can begin at any of the four stages and is an ongoing process. The emphasis in the experiential learning process is placed on the learner experiencing a particular phenomenon. Through the experience, the learner reflects, internalizes, and gathers perspectives that involve generating hypotheses via the transformation of thought. Due to these principles, experiential learning fosters critical thinking which can be effective in regard to teaching within many disciplines.

Experiential Learning within Agriculture

Within the context of agriculture, experiential learning is dominant in secondary and post-secondary educational programs (Knobloch, 2003). Since the earliest days of inception regarding formal and non-formal agricultural education, experiential learning has been the foundation of the learning process (Knobloch, 2003). From Seman Knapp's non-formal methods of teaching via field agents, field demonstrations by the Cooperative Extension Service, and Supervised Agricultural Experiences (SAE) commonly utilized in formal agricultural programs, experiential learning provides a basis for learners to conceptualize and experience the abstractness of agriculture (Blair, 2009; Knobloch, 2003; & Roberts, 2006). Experiential learning in agriculture has been shown to provide the learners with relevant, concrete experiences within a discipline whose nature is unpredictable because it's "practical, applied, and hands-on" (Knobloch, 2003, p. 25).

Cheek, Arrington, Carter, and Randell (1994) investigated the relationship between SAE's and student achievement in agricultural education. The authors attempted to show there was a positive relationship between student achievement scores and participation in experiential learning activities in 10th through 12th graders at 21 Florida high schools. Students' level of involvement in SAE's were identified by assessing the income generated by the student, SAE activities, and the size and scope of the student's SAE. Teachers received a questionnaire that attempted to validate the students' responses by asking teachers to provide a score of zero (no or inappropriate SAE) to 50 (appropriate SAE, good records, etc.). Student achievement score was based on student's final exam score in their agriculture course. The Pearson Product Correlation revealed a significant correlation between student achievement and SAE's (.33). The authors concluded that participation in SAE's had a positive relationship with student achievement in their agriculture course.

Arnold, Warner, and Osborne (2006) sought to examine the use of experiential learning in secondary agricultural education classrooms. Their qualitative study investigated secondary agriculture teachers' familiarity with and implementation of Kolb's Experiential Learning Model (1984). Their study revealed teachers lacked formal knowledge regarding experiential learning and the particular process, but recognized the benefits of experiential learning. Some benefits the participants identified were students retained subject matter better, students were more engaged, and students performed better academically (Arnold et al., 2008). This also holds true in regard to the delivery of international implications of teaching agriculture (Jones & Bjelland, 2004). Jones and Bjelland (2004) stated due to barriers such as language and culture, traditionally, international agricultural teachings are heavily emphasized within the experiential learning framework.

The School Garden as an Avenue for Experiential Learning

School gardens are not new to the educational landscape. The use of school gardens can be traced back as far as the 18^{th} and 19^{th} centuries (Fisher-Maltese, 2014). The philosopher Jean-Jacques Rousseau and the father of modern-day kindergarten Friedrich Froebel both viewed nature as a way of enhancing education in youth (Fisher-Maltese, 2014). This is further corroborated by evidence of the first kindergarten being centered around gardening activities and Friedrich Frobel's belief that youth would be best suited by studying in "the garden, the farm, the meadow, the forest, [and] the plain" (Fisher-Maltese, 2014, p. 92).

Based on historical evidence, the implementation and effectiveness of school gardens have slowly started to become more common in the past 20 years, most notably in California, Texas, New York, and Vermont (Blair, 2009; Graham & Zidenberg-Cherr, 2005; Ozer, 2007). Recently, California's initiative "A Garden in Every School" has been wildly successful (Ozer, 2007). This initiative was designed to encourage school districts to establish school gardens to use as an aid to academic instruction and set aside funds to accomplish that task (Graham & Zidenberg-Cherr, 2005). This garden initiative assists in helping students develop and investigate concepts based on real-world problems, develop a knowledge base for agricultural literacy, and cultivates excitement for vegetable consumption (Ozer, 2007). As a result of this legislative act, more than 2,000 schools in California now have school gardens. Graham et al. (2005) reported that garden-based learning increased student performance on standardized tests and was beneficial to the student in regard to the learning environment.

Due to the notoriety of obesity and other health related issues, more emphasis has been placed on "greening" (Ozer, 2007, p. 846) many school yards in an attempt to promote better eating habits among children (Graham & Zidenberg-Cherr, 2005; McAleese & Rankin, 2007; Parmer, Salisbury-Glennon, Shannon, & Struempler, 2009; Ratcliffe et al., 2011). Graham & Zidenberg-Cherr (2005) attempted to investigate whether school gardens had a positive effect on nutrition education and promoting fruit and vegetable consumption in children. The authors surveyed 592 fourth-grade teachers in California and were asked a series of theme related questions regarding their school garden. Teachers were asked their attitudes, current practices, and barriers concerning the school garden at their current facility. Their findings indicated a majority of the teachers grew a variety of plants, vegetables, and herbs in their gardens. Additionally, many teachers felt the garden to be moderately to very effective in teaching science and social skills and somewhat effective in enhancing academic performance, language arts, and healthy eating.

McAleese & Rankin (2007), Parmer et al., (2009), and Ratcliffe et al., (2011) have all performed similar studies to Graham & Zidenberg-Cherr (2005) investigating the effectiveness of school gardens on fruit and vegetable consumption; however, the aforementioned authors investigated this in school-aged children. McAleese and Rankin

(2007) surveyed 122 sixth-grade students in southeast Idaho from two different schooling groups; two schools that had a school garden and one school that did not. Both schools that received the treatment had to complete three, 24-hour food-recall workbooks that recalled intake of food for the selected time period before and after a 12-week nutrition workshop was administered. Additionally the one treatment school received hands-on training and exercises that involved the school garden such as watering, weeding, and harvesting. The authors found a significant increase in fruit and vegetable servings, fiber, and vitamin A & C intake in students who were involved with garden activities than the other two groups.

Similar results were observed by Parmer et al. (2009). The authors surveyed 115 second grade students by utilizing questionnaires, interviews, taste tests, and lunchroom observations. Three different treatments were administered among children groups, nutritional education with gardening (NE+G), nutritional education only (NE), & a control group (CG). Their results showed NE+G treatment groups identified vegetables better and improved vegetable preference and consumption significantly more than other treatment groups. Their results presented the argument that gardening is effective in increasing fruit and vegetable knowledge and preference in young children. Ratcliffe et al., (2011) also found similar results in middle school-aged students in San Francisco. The authors found that instruction combined with gardening, students were able to correctly identify vegetables, had higher preference for vegetables, and were more willing to taste vegetables than the control group.

A considerable amount of literature has been published investigating the relationship between the effects of school gardens and academic instruction (Blair, 2009;

Graham et al., 2005; Graham & Zidenberg-Cherr, 2005; McAleese & Rankin, 2007; Ozer, 2007). Ratcliffe, et al. (2011) reported that school gardens where students plant, manage, and harvest within a designed production system, "promote academic achievement, fruit and vegetable consumption, physical activity, ecoliteracy, and positive youth development" (p. 37). Graham et al. (2005) surveyed 4,194 California principals by mail and internet questionnaires. Of the principals surveyed, approximately 60% of the administrators indicated they had a garden at their school. Administrators also indicated the purpose of the garden was to enhance academic instruction. Furthermore, the school garden was used to frequently teach science, environmental studies, and nutrition which the administrators stated as an effective component in doing so.

School gardens also promote concepts such as ecoliteracy; a term coined by Dr. David Orr and Fritjof Capra in the late 1990's (Government of Manitoba, 2011). This term is the understanding of how nature and society interact (Government of Manitoba, 2011). Blair (2009) reported that being environmentally literate is critical in helping youth create sustainable communities and stated, "gardens can improve the ecological complexity of the schoolyard in ways that promote effective experiential learning in many subject areas, particularly the areas of science, environmental education, and food education" (p. 35).

Although school gardens have been deemed effective by research, many studies have cited barriers for effective implementation and sustainability for school gardens (Graham et al., 2005; Hazzard, Moreno, Beall, & Zidenberg-Cherr., 2011; Parmer et al., 2009). Many studies cited the lack of teacher training and knowledge associated with gardening and its techniques as a vital reason why school gardens fail (Graham et al., 2005; Graham & Zidenberg-Cherr, 2005). Many authors suggested training for teachers in the area of basic gardening knowledge as a component to effectively teach students. Terry et al. (1992) contended "efforts should be made to improve teachers' perceptions and increase their technical knowledge of agriculture, to enhance their teaching of agricultural concepts" (p. 58).

Another large barrier to effective school gardens is time and functionality (Graham et al., 2005; Hazzard et al., 2011). Hazzard et al. (2011) reported that attempting to incorporate additional demands on teacher's already busy schedule is unrealistic. The framework provided by Hazzard et al. (2011) lays out proven characteristics in which the author points out that having a systematic flow of cooperation between administrators, teachers, parents, and outside parties contributes to successful implementation and longevity of school gardens. Volunteers such as university personnel, assistance from master gardeners, and parents will help ensure the school garden is successful for many years to come.

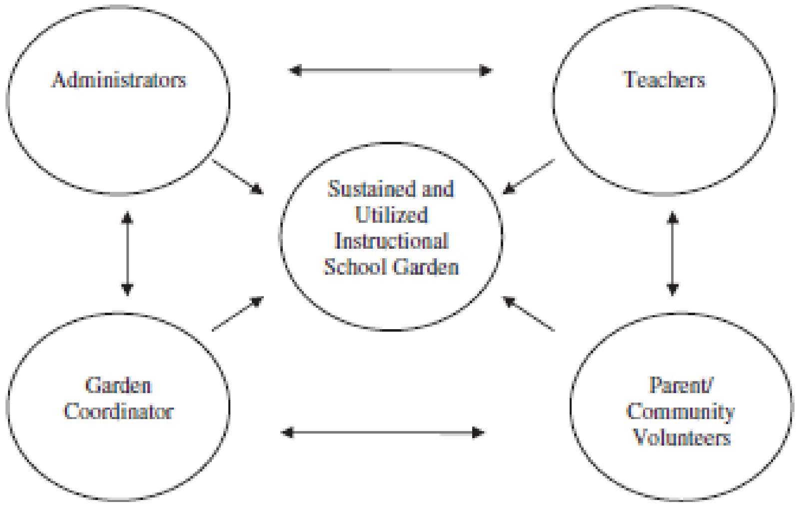

Figure 3 Key components of a successful and sustainable school garden (Hazzard et al., 2011)

Direct Instruction

Direct instruction (DI) is often considered one of the most utilized ways of disseminating information in educational settings (Baker, 2012). Direct instruction is a teacher-centered instructional technique that focuses on the skills of the teacher to facilitate learning in the classroom (Moore, 2015). Moore (2015) explained direct instruction is often accomplished through lectures that allow opportunities for practice and reaction. Moore (2015) stated the "(direct instruction) teaching strategy works best with teaching skill subjects such as reading, writing, mathematics, grammar, computer literacy, and factual parts of science and history" (p. 317). Baker (2012) expressed similar sentiments and reported why direct instruction is so prevalent in classrooms today. Due to the increase in classroom diversity and the need to meet standardized test criteria in schools, direct instruction is often the best alternative to other teaching methods (Baker, 2012).

Watkins and Slocum (2003) reported there were many groups of people who benefit from direct instruction, including those with diverse learning needs, learners who have various language barriers, and learners of different ages. Learners with diverse learning needs often benefit from carefully planned and well implemented lessons. Direct instruction has shown to benefit students with varying IQ ranges as well as in students with diverse language backgrounds and learning styles (Watkins & Slocum, 2003). They claimed direct instruction allows for "structured immersion" (Watkins & Slocum, 2003, p. 101) of material which assists in matching the instruction to the individual needs of the learner.

The purpose of direct instruction is to "teach (the) subject matter efficiently so that all the students learn all the material in the minimum amount of time" (Watkins & Slocum, 2003, p. 75). Baker (2012) and Moore (2015) outlined the idealistic five-phase process of direct instruction: orientation, presentation, structured practice, guided practice, and independent practice. In the orientation phase, the teacher is responsible for gauging students' prior knowledge on the subject and to provide the learners with an outline or overview of the learning goals and objectives. In the presentation phase, the teacher decides the best way to present or teach the information while providing variability and checking for understanding. In the structured practice phase, the instructor provides and guides the students with particular tasks to master a particular objective. The fourth phase of guided practice allows the teacher to shift the students toward independence performance after teaching a new concept to the learners. This phase often requires teachers to ask questions and use various response techniques to ensure students are correctly learning or applying information. The final phase is independent practice where teachers monitor learners, but allows the student to perform on their own.

Private Schools

The history of the separation of schools in the United States has been long documented (Lee, Chow-Hoy, Burkam, Geverdt, & Smerdon, 1998). Furthermore, it has also been well documented and debated by researchers the stark differences between public and private school education and the variety of school curricula each type of school offers (Carbonaro & Covay, 2010; Coleman, Hoffer, & Kilgore, 1982; Eason et al., 2009). Difficulties arise; however, when attempting to identify which academic setting is the most beneficial in regard to academic achievement. Carbonaro and Covay (2010) suggested because of factors such as sampling methods, methodology, statistical inferences, and external factors such as family background and socioeconomic status/factors, evidence has been largely inconclusive. However, when assessing characteristics of private schools, many studies have presented valid arguments in favor of private schools over the alternative (Carbonaro & Covay, 2010; Coleman et al., 1982; Eason et al., 2009; Lee et al., 1998).

Private schools are defined by Eason et al. (2009) as schools that do not receive and are not funded by tax revenue. Public schools are politically motivated and governed by publically elected officials such as school boards and are required to admit all students. Furthermore, public schools are confined by strict state guidelines and curriculums (Eason et al., 2009). Due to the fact that private schools are not funded by the state, they possess the freedom to incorporate a variety of instructional materials within their curriculum (Eason et al., 2009). Eason et al. (2009) further contended that private schools offer a "risk-free environment [where student's] thoughts will be accepted and tested" (p. 133). Their study assessed 48 teachers, 24 each from private and public schools in Tennessee, and sought to investigate teachers' perception of creativity within their particular school. Their results indicated that private school teachers valued creativity higher than public school teachers and observed public school teachers seemed burdened with testing, leaving small amounts of time for creativity within the classroom.

Lee et al. (1998) along with Coleman et al. (1982) suggested that private schools better prepare students for college. Carbonaro and Convay (2010) contended that public schools do not advocate students enrolling in advanced courses as private schools do due to the fact that private schools are more likely to force students to take more advanced classes. Carbonaro and Convay (2010) found that private school students performed significantly higher in advanced math courses which is an important predictor in college enrollment and completion. The same was found in previous studies conducted by Coleman et al. (1982) and Lee et al. (1998).

In Mississippi specifically, there are approximately 282 public high schools that service over 134,000 students (Education Bug, 2016; Mississippi Department of Education, 2015). Additionally, there are over 230 private schools in Mississippi that service over 11,000 high schoolers (Education Bug, 2016). Of those 282 public high schools, approximately half offer an agricultural related curriculum while in private schools that number is minimal due to the fact there is not much incentive for private schools to offer such a curriculum (Mississippi Department of Education, 2010). By observing the aforementioned numbers presented, agriculture is vastly underrepresented via agriculture curriculum in the Mississippi school systems.

Conceptual Framework

The conceptual framework for this study was based on the agricultural literacy framework model presented by Elliot (1999) and the experiential learning model presented by Kolb (1984). Elliot (1999) professed that the knowledge base and opinions of agriculture by the public are developed and shaped through: 1) education, 2) involvement in agricultural activities, and 3) personal characteristics (Figure 1). The author believed education could be received through a variety of avenues; both formal and non-formal settings, as well as through media and news sources. Involvement in agricultural activities consisted of having experience growing plants and/or raising animals or being part of structured agricultural organizations such as FFA or 4-H. Personal characteristics include race or ethnicity, if the participant lived on a farm, or if one had immediate family or relatives that lived on a farm.

This study also utilized Kolb's theory of experiential learning (Figure 2). Kolb (1984) believed learning was a process that is rooted in how the learner grasps the information. The author's experiential learning cycles consisted of four (4) phases: concrete experience, reflective observation, abstract conceptualization, and active experimentation. Baker (2012) wrote "this process is cyclical in nature where, ideally, learners are exposed to each of the leaning modes – experiencing, reflecting, thinking, and acting – in a recursive process that is dependent on the unique experiences and elements to be learned" (p. 30).

Direct instruction is widely utilized because of its effectiveness in teaching many topics in a small amount of time (Moore, 2015). Direct instruction is championed due to the value it has in teaching a wide range of learners while providing continuous praise and feedback to the learners (Baker, 2012).

Based on the model offered by Elliot (1999), the theory presented by Kolb (1984), and the literature on direct instruction, has provided a framework for investigating how the knowledge base and opinions of agriculture are impacted through systematic education. This study provided two approaches of systematic, agricultural instruction to different groups of private school students and compared the results of agricultural knowledge and perceptions after instruction.

Summary

Agricultural literacy is an extremely important topic that much of society is unaware of and an area where many people lack fundamental understanding. Being knowledgeable of agricultural practices can lead to better informed decisions regarding environmental issues, food safety and security, and agricultural policy. Since the first introduction of agricultural literacy inside the agricultural discipline, very few studies have been conducted to further assess this issue. Of the studies that have been conducted, populations consisted of various teacher and student populations; with the majority being elementary school teachers and elementary aged students. Kovar & Ball's (2013) synthesized research of agriculture reported agriculture as a constantly evolving discipline and stressed the need to assess agricultural literacy with up to date information. Kovar & Ball (2013) stated:

> The change in technology alone warrants a new framework in which to examine agricultural literacy. Other changes include organic farming, ethanol production, international trade, buying local, environmental stewardship and climate, genetically modified organisms, as well as many other trends in agriculture (p. 168).

By assessing agricultural literacy, researchers gain a perspective of what aspects of agriculture need to be addressed. By assessing agriculture awareness of teachers, Elliot (1999) believed researchers gained an edge in incorporating instruction by investigating effective ways of dispensing and implementing systematic agricultural education. An approach to effectively promote and affect agricultural literacy would be to introduce systematic agricultural instruction to underrepresented populations, such as private schools. No agricultural literacy research studies have been conducted in Mississippi or its relation to private school education. Due to the fact that private schools are not funded like public schools, they offer the flexibility to tailor their curriculum and incorporate other aspects of academic instruction as they please. Direct instruction can be a key tool to incorporate agricultural lessons due to the careful nature of planning and guidance that is provided by the teacher (Baker, 2012). Direct instruction is often the most utilized teaching strategy in schools today and provides many opportunities for successful student learning because of teacher involvement (Baker, 2012), and can be beneficial in teaching agriculture topics. Teachings that are coupled with the experiential learning process provided by Kolb (1984) and based on the agricultural literacy framework provided by Elliot (1999), have the potential of increasing not only traditional academic topics such as nutrition, math, and science, but agricultural literacy and changing agricultural perceptions as well.

CHAPTER III

METHODOLOGY

Introduction

Agricultural literacy is a topic that is extremely important and has implications beyond the agricultural sector. Birkenholz et al. (1994) stated an agriculturally literate person is one who is able to make sound agricultural decisions due to . Being agriculturally literate will enable an individual to make sound decisions regarding agricultural policy, production, and accurately disseminate information pertaining to agricultural issues (Kovar & Ball, 2013). Much of today's society is agriculturally illiterate due to urbanization and the advancement of technologies in agriculture (Leising et al., 2000).

The purpose of this study was to investigate the knowledge and perceptions of agriculture among private school biology students in Mississippi. Also, this study was intended to investigate student perceptions and effectiveness of particular intervention methods (i.e., teaching from *Nourishing the Planet in the 21st Century* accompanied with a high-tunnel/school garden, teaching of lessons from *Nourishing the Planet in the 21st Century* only, and no intervention) on agricultural knowledge. The interventions will also determine the recommendations for other researchers and schools that would like to implement similar teaching at their institution and/or school. This chapter describes the methods and procedures used in order to carry out this research.

Research Objectives

The study aimed to determine the current knowledge and perceptions, as well as the change in knowledge and perceptions, of agriculture among biology students at three private schools in Northeast Mississippi. This study also aimed to compare direct instruction and experiential learning and their impact on the change in knowledge and perceptions of agriculture. The specific research objectives were:

Objective 1: Describe the demographics of students who participated in the study.

Objective 2: Assess the agricultural knowledge (plant, soil, and water relationships) among private school students in Mississippi prior to and after treatment.

Objective 3: Assess agricultural literacy (knowledge and perceptions of agricultural practices and policies) among private school students in Mississippi prior to and after treatment.

Objective 4: Measure and compare the impact of direct instruction and experiential learning on the change in student knowledge of plant, soil, and water relationships, agricultural literacy, and perceptions of agriculture.

Objective 5: Investigate the perceptions of the agricultural lessons and method of intervention among students (experiential learning, direct instruction, no intervention).

Research Design

The research design was a mixed method, quasi-experimental study using descriptive statistics (Figure 4). A nonrandomized control group was used as a comparison for treatment groups, pre and post-test design, accompanied with various teaching interventions, cross-sectional surveys, and focus groups were also conducted.

Quasi-experimental research designs are designs where non-randomization of treatment groups are allowed (Ary, Jacobs, & Sorensen, 2010). These designs are widely used in educational research settings where pre-existing groups (i.e. classrooms) are not left up to the researcher for random assignment (Ary et al., 2010). Mixed methods research designs employ both quantitative and qualitative methodologies. Johnson and Onwuegbuzie (2004) stated “the goal of mixed methods research is not to replace either of these approaches but rather to draw from the strengths and minimize the weaknesses of both in single research studies and across studies” (p. 14-15). A mixed methods research design blends two or more different elements of a study using various perspectives and philosophies of quantitative and qualitative methods, based on the nature of the study (Ary et al., 2010).

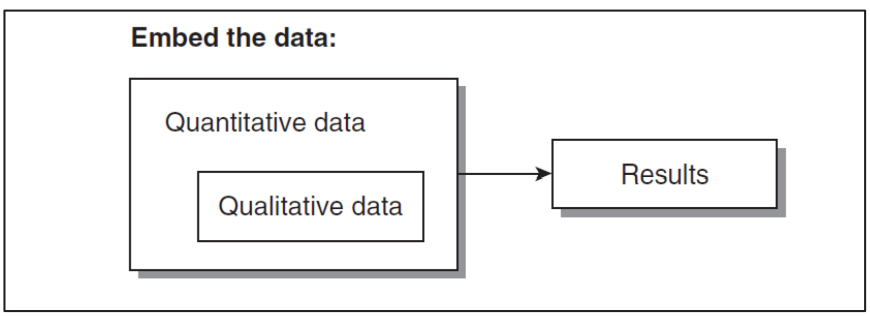

Figure 4 Ways of mixing quantitative and qualitative data in mixed-methods research (Creswell & Plano-Clark, 2011).

Ary et al. (2010) stated that utilizing the nonrandomized control group pre and post-test design decreases selection bias that could threaten the internal validity of the research design. Ary et al. (2010) stated “[the pre-test] enables you to check on the equivalence of the groups on the dependent variable before the experiment begins” (p.

317). Given the fact that in this design, each group receives the same pre-test, other threats such as regression, maturation, and instrumentation are not serious threats to internal validity (Ary et al., 2010). Also in this design, the non-randomization contributes to the generalizability of the findings because the subjects are unaware the experiment is being conducted with other groups (Ary et al., 2010).

Descriptive statistics were used when administering and assessing the agricultural knowledge and perception survey instrument developed by Birkenholz et al. (1994). Ridel (2006) stated descriptive statistics "(are) suitable for research that wishes to systematically depict a real situation factually (…) data that is acquired [from research] is then used to make generalizations about a population from the sampling that occurred" (p. 30).

Throughout the course of the study, treatment groups were assigned based on the teaching method. For each school that received a treatment, the researcher taught a series of six (6), 45-minute lessons that were contextualized in agriculture by way of The Biological Sciences Curriculum Study (2014) publication, *Nourishing the Planet in the 21st Century.* Before the teachings began, each group received a pre-test. After the pre-tests, the lessons were taught and post-tests were given. In addition to the classroom lessons, one group received a fully functional high-tunnel. For this treatment group, the high-tunnel served as the experiential learning component (Table 1). At the conclusion of the lessons, focus groups were conducted to assess the participants' attitudes and perceptions of the agricultural lessons and on the intervention method they were assigned.

The treatment groups were as followed:

- Control (Group 1)– pre and post-test; pre and post-agricultural literacy survey
- Treatment Group I (Group 2) – pre and post-test; pre and post-agricultural literacy survey; focus group
- Treatment Group II (Group 3) – pre and post-test; pre and post-agricultural literacy survey; focus group

Table 1 Overview of Instructional Plan for Two Conditions of Instruction

Experiential Learning Instructional Approach	Direct Instruction Instructional Approach
Students received six (6) lessons that were conducted outside, utilizing hands on principles that coincided with school garden activities and outlined within the curriculum.	Students received six (6) agricultural lessons targeting specific learning goals as outlined within the curriculum.
After each experience, students were asked to reflect on the experience. ('What do you think happened?' and 'Why did it happen the way it happened?' were used as guiding questions). The instructor facilitated the discussion and provided feedback based on subject expertise.	Instruction was based on scripted lesson plans that were developed with the curriculum according to specific learning objectives.
Students were coached and instructed to utilize their reflections within the abstract conceptualization stage to investigate comprehension of experience	Instructor provided critical information followed by opportunities for students to apply knowledge in groups (large, small, and then alone).
Students were allowed to actively experiment with other materials and ask questions to the instructor.	Instructor provided positive reinforcement based on student performance.

Note: Nourishing the Planet in the 21st Century was used as curriculum.

Population and Sample

Private schools in Mississippi have the flexibility to incorporate as much or as little outside subjects and curriculums into their institution as they desire (Eason et al., 2009). Homogeneous purposive sampling was used to identify appropriate private schools based on geographic region, similar social/economic characteristics, and school size similar to the control group. Tongco (2007) reported purposive sampling gives the researcher the ability to identify what information is important and who is best suited to provide answers for that information. By selecting private schools in the same region of Mississippi and participants at those particular private schools, purposive sampling is a valuable tool for this study because it attempted to identify appropriate participants who are best suited to fulfill the research questions (Tongco, 2007). In relation to purposive sampling, Erlandson, Harris, Skipper, and Allen (1993) further stated it "increases the range of data exposed and maximizes the researcher's ability to identify emerging themes that take adequate account of contextual conditions and cultural norms" (p. 82). However, a major limitation of purposive sampling is that of researcher bias (Ary, et al., 2010).

The target population for this study consisted of tenth grade biology students at private schools in the Golden Triangle region. Students were surveyed based on the following criteria:

a. Administrators willing to participate in the study,
b. Similar private educational institutions (size),
c. Teachers who were willing to allow for interruptions into their classroom to provide agricultural lessons, and

d. Private schools that weren't currently utilizing *Nourishing the Planet in the 21st Century* as a teaching curriculum.

The rationale for the willingness of the administrator of the school is critical to this study. A willingness to participate by the school administrator conveyed the importance of this research to the school's teacher. The second criteria was in reference to private schools in the study area. Similar private schools based on size and curriculum allowed the researcher to assess agricultural knowledge at a consistent level based on current curriculum. The third criterion for school selection was based on teacher willingness. Teachers had to consent for the researcher to come into their classroom to convey specific information. The last criterion indicated schools who weren't currently using *Nourishing the Planet in the 21st Century* as a teaching curriculum. Schools who weren't (currently using the *Nourishing the Planet in the 21st Century*) allowed the researcher to decrease biases from the data, observations, and measurement variables when surveying students.

Instrumentation

Knowledge of Plant, Soil, & Water Relationships (Curriculum Pre & Post-Tests)

Each of the three schools were given identical pre and post-tests at the beginning and the end of the study provided by the *Nourishing the Planet in the 21st Century curriculum*. The pre and post-tests consisted of 15 multiple choice questions that assessed basic knowledge of plant, soil, and water relationships. The pre and post-test directions prompted the student to indicate if they are sure, have guessed, or don't have enough knowledge to answer the question correctly. Prior to administering the pre and post-tests, students were informed that both unanswered and/or guessed answers would be marked as incorrect, but were made to feel at ease that incorrect answers held no penalty. At the end of the teachings, each group received a post-test with different questions from the pre-test, but likewise measured knowledge gained over the course of the teachings in relation to plant, soil, water, and agricultural production and relationships. As with the pre-test, post-test answers that were unanswered or where the student indicated they guessed were counted as incorrect. After collection of the pre and post-tests, the researcher scored each by hand and recorded grades as a percentage out of 100 points. Pre and post-tests can be found in Appendix L and Appendix M, respectively.

Agricultural Literacy Survey

In addition to the pre and post-tests, students were also given agricultural literacy surveys after completion of the pre and post-test. The agricultural literacy survey instrument that was used in this study was utilized by Frick et al. (1995). The authors utilized this instrument when they assessed the knowledge and perceptions of agriculture in rural and urban inner-city youths. According to Fraenkel and Wallen (2009), survey research is important when attempting to describe certain characteristics of a population. Surveys allow for the researcher to assess a smaller sample of a population and "make inferences about the population" (Ary et al., 2010, p. 372).

The agricultural literacy survey instrument consisted of three sections. The first section consisted of 35 general knowledge statements where respondents were asked to identify if each statement is true, false, or if they didn't know. The general knowledge section of the instrument tested several concept areas including, plant and animal science, agriculture's relationship with the environment and natural resources, and agriculture's global and societal significance. Overall, the statements were categorized into four broad categories: Agricultural Career Literacy (5 of 35 questions), Environmental & Natural Resources Literacy (7 of 35 questions), General Agricultural Knowledge (13 of 35 questions), and Agricultural Policy (10 of 35 questions).

The second section contains 35 attitude and perception questions in which respondents were asked to respond based on a Likert-type response scale with responses indicating their feelings toward agriculture. The third section of the data collection instrument asked a series of demographic questions (APPENDIX E).

The survey instrument had been analyzed in previous studies for reliability and validity by the authors (Frick, et al., 1995). Using the Kuder-Richardson 20 (KR-20) coefficient, Frick et al. (1995) determined the reliability of the instrument to be .85, which indicates the instruments are reliable. The attitude and perception section of the survey instrument was also analyzed. The authors achieved this by using the Cronbach's alpha coefficient (Frick et al., 1995). The perception as determined by Frick et al. (1995) revealed the Cronbach's alpha coefficient to be .90. Additionally, validity was examined (Birkenholz, et al., 1994).

The initial instrument was based on agricultural literacy concept areas. A national panel of experts in agricultural literacy reviewed the questions to determine validity (Birkenholz et al., 1994). After panel review, the experts deemed the instrument valid and it was then pilot tested by Birkenholz et al. (1994). For the purposes of this study and because of the age of the instrument, the survey instrument was reviewed by experts in Agricultural Economics, Agronomy, and Animal & Dairy Sciences to ensure validity concerning statements included in the instrument regarding agricultural practices.

After collection of the pre and post-agricultural literacy surveys, the researcher scored each by hand and recorded grades as a percentage out of 100 points. Responses were coded into dichotomous data where a correct student response (i.e. True or False) received a score of "1" and each incorrect answer, including students that selected "Don't Know," received a score of "0." After participants complete the pre-test and the agricultural literacy survey, the teaching intervention began during the next scheduled class meeting as agreed upon by the researcher and teacher.

Focus Groups

At the end of the teachings, the researcher administered the curriculum post-tests, agricultural literacy surveys, and conducted focus groups. Focus groups were conducted by an additional researcher who was familiar with the project without the principal investigator present. The principal investigator was not present in order to minimize forced, acceptable responses from participants. Focus groups were conducted with students in order to gauge their perceptions and attitudes of the treatment they received. Furthermore, focus groups gained an in-depth viewpoint and a deeper perspective of students' perceptions of agriculture based on the treatments they received.

Trustworthiness for the qualitative portion of this study was established by assuring credibility, transferability, dependability, and confirmability of the data (Erlandson et al., 1993; Shenton, 2004). Transferability was achieved by using thick descriptions and purposive sampling of the students who most frequently utilized the school garden and participated in the teachings. Credibility was achieved by persistently observing participants over a series of several months, teacher input, and developing relationships with teachers and students. The prolonged interaction allowed for a clearer picture of the effects based on the treatment each group received and ensure thoughtfulness and truthfulness throughout the study. Dependability was achieved by repeatedly asking participants to further elaborate when asked questions to gauge their perceptions and feelings accurately. Confirmability was achieved by detailed documentation of the research procedures which can be referenced in an attempt to reconstruct this study for confirmation of by future researchers and investigation of researcher bias. Additionally, triangulation was accomplished by eliciting the different viewpoints of students and their respective treatment groups and comparing them with one another.

Focus groups were conducted at the conclusion of the agricultural lessons for the treatment groups. Focus groups for the treatment groups lasted approximately 50 minutes. The focus groups for Group 2 and Group 3 were conducted at their respective institutions. Group 1 received no treatment; therefore, did not warrant use of a focus group.

Focus group responses were digitally recorded and transcribed verbatim in Microsoft Word® via the transcription software Express Dictate and pseudonyms were assigned to protect participants. The transcripts were then analyzed and themes developed based on responses from the participants. Themes were generated based on approaches that are outlined from the constant comparative method (Boeije, 2002). After coding the responses to questions from individuals in a particular group, data were then compared to other pieces of relevant data within the group's responses to develop themes. After development of themes in both treatment groups, data were then compared as a whole to deepen insight that was given within the groups.

Description of Variables and Measurements

The investigated variables in this study were knowledge of plant, soil, and atmospheric interaction and agricultural literacy (knowledge of agricultural policy, perceptions of agriculture and agricultural production). This study also investigated perceptions of the method of intervention and teaching (i.e., experiential learning, direct instruction, no intervention), and the effect each instructional technique influenced the change in knowledge and perceptions of agriculture (Table 2).

Table 2 Table of Study Variables

Independent Variables	Dependent Variables
A). Type of teaching/instruction 1. Those who received no form of instruction 2. Those who received direct instruction from the curriculum 3. Those who received experiential learning	A). The mean scores of: 1. Curriculum Pre & Post-tests (Plant, soil, & atmospheric relationships) 2. Section I – Agricultural Literacy Survey (Agricultural Knowledge; pre & post) 3. Section II – Agricultural Literacy Survey (Perceptions of Agriculture; pre & post B). Perceptions of method of instruction

Knowledge of agricultural practices and policy was assessed in section one of the agricultural literacy survey instrument. Participants' perception of agriculture were in section two of the agricultural literacy survey instrument. Focus groups of participating students assessed the attitudes and perceptions of the instructional method they received from *Nourishing the Planet in the 21st Century* curriculum. Comparisons of instructional groups were then conducted to determine the change in knowledge and perceptions of agriculture. This was assessed by the scores on the curriculum and agricultural literacy pre and post-test. Scores were then compared across treatments to see if any differences were observed.

Data Collection

Prior to the study, the Office of Research Compliance granted IRB approval for research to be conducted with human subjects and approval of all instruments included in the study. Each private school principal was initially contacted by phone in early January 2015 to express the desire to meet with them and discuss the nature of the study, its objectives, and procedures. Once the principal agreed to participate in the study, the principal investigator (PI) traveled to each private school in January 2015 to gain permission from the appropriate teachers. This was done to determine the willingness to allow interruptions in classes where the lessons would be taught. After permission had been granted from the administrators and teachers, the researcher traveled to each school to administer the pre-tests and survey instruments in late January 2015.

Prior to administering any materials, the principal investigator solicited student participation at each of the three schools. Solicitation was conducted by verbal communication within Biology classrooms. Students were given parental consent forms that outlined the nature and essence of the research project (APPENDIX A-B). After students returned signed parental consent forms, students were given assent forms to agree to participate in the study (APPENDIX C-D). After both forms were returned by each student, pre-tests were administered to each group by the principal investigator.

After pre-tests and agricultural literacy surveys were distributed, each student was given a unique identification number to serve as identification purposes for examination of scores. Starting in February 2015, lessons were taught as outlined in *Nourishing the Planet in the 21st Century* curriculum at the two treatment schools.

Group 1

Group 1 was the designated control group and received no experimental treatment. This group consisted of 10th grade Advanced Biology private school students. The Advanced Biology students were assessed due to the principal's recommendation. This group was given the curriculum pre-test and pre-agricultural literacy survey on February 24, 2015 and was given the curriculum post-test and post-agricultural literacy survey on May 4, 2015. Pre-tests, post-tests, and both agricultural literacy surveys were all conducted during the regularly scheduled class time. A total of 14 students were included in this group.

Group 2

Group 2 was designated as a treatment group that received agricultural lessons via direct instruction. This group consisted of all 10th grade Biology students. Lessons were conducted with pre-existing classroom populations. Each classroom session/lesson lasted one (1) hour, which was the allotted time by the school for biology instruction. Curriculum pre-tests, pre-agricultural literacy surveys, and the first lesson was taught on February 9, 2015. Nine (9) students were given pre-test and agricultural literacy surveys on February 10, 2015 because of pre-scheduled school activities and/or general absences. The remaining lessons were taught on February 10, 11, 12, 18, and 19. Due to school schedules, holidays, and severe winter weather, post-tests and agricultural literacy surveys were administered on March 16, 2015. Focus groups were also conducted on

March 16, 2015 and responses were audio recorded. A total of 21 students were included in this group.

Group 3

Group 3 was also designated as a treatment group. For this treatment group, i students received the agricultural lessons via experiential learning (high-tunnel and school gardening exercises). This group consisted of all enrolled 10th grade biology students present at the school. Lessons were conducted with pre-existing classroom populations. Each classroom session/lesson lasted 55 minutes, which was the allotted time for biology instruction by the school. Pre-tests, agricultural literacy surveys, and the first lesson was taught on February 9, 2015. Three (3) students were given pre-test and agricultural literacy surveys on February 10 because of absences on the first day of the study. Due to weather restrictions, school holidays, and school activity scheduling, the remaining lessons were taught February 16, March 3, March 24, April 8, and April 20, 2015. Post-test and agricultural literacy surveys were administered on April 20, 2015, with the exception of nine (9) students due to pre-scheduled school athletic activities. The remaining nine (9) students were assessed the following day. Focus groups were conducted on May 6, 2015 during regularly scheduled class time and responses were audio recorded. A total of 22 students were included in this group.

Data Analysis

Microsoft Excel® spreadsheets were used for entering data to be transferred into SPSS (Version 23.0) where further analysis were conducted. Demographic and questions located in section two of the agricultural literacy survey where participants chose not to respond were coded as missing data. Due to missing values, an independent samples test was conducted for equality of means and variances to determine if data were systematically missing or if data were missing completely at random (MCAR) in order to be further analyzed. Univariate tests for normality were also conducted for the group of scores to determine if scores were normally distributed based on Shapiro-Wilk's test of normality statistic at the 0.05 alpha-level. This was done to determine if the means could be further analyzed and compared between groups. True knowledge and questions in section one of the agricultural literacy survey where participants did not or chose not to respond were coded as incorrect.

Objective one collected demographic data from the participants. Frequencies and percentages were calculated for gender, age, whether or not participants were raised on a farm, whether or not students had relatives that lived on a farm, if participants had received any type of agricultural instruction previously, participants involved with FFA, and participants who had experience raising farm animals and crops/gardens.

Objective two of this study assessed agricultural knowledge (plant, soil, and atmospheric relationships) gain as determined by questions posed by the curriculum based on the pre and post-tests. Scores were calculated by dividing correct answers with the total number of questions answered and recorded as a percentage out of 100. Means and standard deviations were calculated for the overall pre and post-tests. A paired t-test compared means between pre and post-test scores of each group and the mean difference was reported. Frequency distributions were also reported for treatment groups.

Objective three assessed agricultural literacy (knowledge and perceptions of agricultural practices and policies) gain among participants prior to and after treatment based on results of pre and post-test assessments. Scores were calculated by diving the number of correct answers with total questions attempted using the agricultural literacy survey developed by Birkenholz et al. (1994). The survey was divided into two parts: knowledge of agriculture (35 questions) and perceptions of agriculture (35 questions). Means of the scores were calculated at the beginning and end of the study to serve as pre and post assessments. Paired t-tests were conducted to observe differences from the beginning to the end of the study. Within the agricultural knowledge section, content was further broken down into knowledge categories: agricultural careers, environmental & natural resources literacy, general agricultural knowledge, and agricultural policy. Paired t-test were conducted to further analyze each category within agricultural knowledge and the mean difference was reported.

Objective four measured and compared the impact of direct instruction and experiential learning on the change in student knowledge of plant, soil, and water relationships, agricultural literacy, and perceptions of agriculture. Specifically, objective four attempted to determine if there was a difference in experiential learning and direct instruction as it related to change in knowledge of plant, soil, and atmospheric relationships, agricultural literacy, and agricultural perceptions. Multivariate tests were conducted to determine the effect of more than one independent variable (intervention: direct instruction, experiential learning) has on more than one dependent variable (post-test scores, agricultural literacy post-test scores). A multivariate analysis of variance was performed (MANOVA) in SPSS to investigate if any significant differences were observed in the treatment groups as well as linear regressions in an attempt to model the relationship between true knowledge and agricultural literacy scores on intervention treatment.

Objective five was to investigate the perceptions of the agricultural lessons and method of intervention among participants in treatment groups (experiential learning, direct instruction) via focus groups. Focus groups were conducted by an additional researcher who was familiar with the overall aspect of the study. Focus groups were digitally recorded and transcribed verbatim in Microsoft Word® via the transcription software Express Dictate. After coding the responses to questions from a particular group, data were then compared to other pieces of relevant data within the group's responses to develop themes. Themes were developed based on approaches from the constant comparative method (Boeije, 2002). Theme development occurred by triangulation of verbatim responses to questions, prolonged interaction with participants, open-ended survey responses, and the moderator's extensive reflective notes taken during the focus group sessions and techniques guided by the constant comparative method. After development of themes in both treatment groups, data were then compared as a whole within groups to deepen any insight that was given (Boeije, 2002). By doing this, the researcher was able to delineate and connect categories and make interpretations and conclusions for the qualitative portion of the study.

Limitations

This study was conducted with a small sample size ($N = 57$). Due to time and high-tunnel resource availability, this study could not be replicated with other schools. With both pre and post-tests, it was difficult to determine if participants answered questions according to instructions (i.e., not guessing on questions). Also, randomization in this study was not possible because of the impractical expectation of separating participants based on treatment received. Because classrooms within schools were already intact, randomization and placing students in separate groups other than their already assigned classroom was not possible.

In an attempt to investigate increased agricultural literacy among students, student knowledge gain according to the survey instrument was not directly attributed to the agricultural curriculum that was taught. The agricultural content contained in the curriculum that was taught, did not closely align with the questions presented within the agricultural literacy survey instrument as it did with the pre and post-tests as provided by the curriculum.

CHAPTER IV

RESULTS & DISCUSSION

Objective One Results

Objective was to describe the demographics of students who participated in the study. Demographics were collected in Section III of the agricultural literacy survey instrument. Also, Section III sought to investigate more intimate details and background information from students regarding past and current agricultural experiences.

Group 1

Of the students assessed in group 1 (N = 14), 36% were female (n = 5) and 64% were male (n = 9) and were an average age of 15 (M = 14.9, SD = 0.46). Of the students in group 1, less than eight percent (7.14%) self-identified as currently living on a farm, but almost half of the students indicated they had relatives who lived on farms (42.86%). No students identified as having taken any agricultural courses before or being knowledgeable of FFA and only a few students had been involved in raising animals (n = 9, 28.57%), but had more experience raising crops and plants (n = 11, 78.57%) (Table 3).

Table 3 Demographics of Participants in Group 1

Variable	Category	Count
Gender	Female	5
	Male	9
Age	14	2
	15	11
	16	1
Ethnicity	Caucasian	13
	African-American	1
	Hispanic	-
	Other	-

Group 2

Of the students assessed in group 2 (*N* = 21), 57% were female (*n* = 12) and 43% were male (*n* = 9) and had an average age of approximately 15 (*M* = 14.7 *SD* = 0.47). Of the population of students in group 2, less than five percent (4.76%) self-identified as currently living on a farm, but more than half of the students indicated they had relatives who lived on farms (61.9%). Only a small percentage of students indicated they had taken agricultural classes before (*n* = 2, 9.52%), and no students identified as being knowledgeable of FFA. Few students had been involved in raising animals (*n* = 4, 19.05%), but group 2 had more experience raising crops and plants (*n* = 16, 80.95%) (Table 4).

Table 4 Demographics of Participants in Group 2

Variable	Category	Count
Gender	Female	12
	Male	9
Age	14	7
	15	14
	16	-
Ethnicity	Caucasian	19
	African-American	-
	Hispanic	-
	Other	2

Group 3

Group 3 included a total of 22 students. Of the students assessed in group 3, 55% were female (*n* = 12) and 45% were male (*n* = 10), and had an average age of 16 (*M* = 15.6, *SD* = 0.49). Of the students in group 3, only 10% self-identified as living on a farm. In group 3, more than half of the students indicated they had relatives who lived on farms (63.16%) and a small percentage of students in group 3 indicated they had taken agricultural classes before (5.26%). No students identified as being knowledgeable of FFA. A small portion of the student population indicated had been involved in raising animals (26.32%) and approximately half of the students had experience raising crops and plants (47.37%) (Table 5).

Table 5 Demographics of Participants in Group 3

Variable	Category	Count
Gender	Female	10
	Male	12
Age*	14	-
	15	8
	16	11
Ethnicity	Caucasian	19
	African-American	2
	Hispanic	-
	Other	1

**Two students did not provide information regarding age.*

Prior to analyzing data, an independent samples t-test was conducted for equality of means and variances due to missing values. It was determined that data were not systematically missing and data was missing completely at random (MCAR) and was further analyzed (Table 6). Univariate tests for normality were also conducted for the group of scores to determine if scores were normally distributed. Based on Shapiro-Wilk's test of normality statistic, it was determined that scores were normally distributed at the 0.05 alpha-level and the means could be further analyzed and compared between groups with the exception of group 2 perception scores after intervention (Table 7). Agricultural literacy perceptions of group 2 cannot be generalized beyond this study due to the fact scores did not meet normality assumptions.

Table 6 Levene's Test for Equality of Variances

			T-Test for Equality of Means	
	F	Sig	df	Sig.
Pre Test Score	.716	.716	55	.781
Post Test Score	.000	.000*	54	.186
Ag Literacy Pre Test	.810	.810	52	.087
Ag Literacy Post Test	.015	.015*	53	.542
Ag Literacy Perceptions (Before)	.817	.817	51	.923
Ag Literacy Perceptions (After)	.959	.959	53	.513

** Indicates significance at the 0.05 alpha-level.*

Table 7 Shapiro-Wilk Test of Normality

	Group	Shapiro-Wilk		
		Statistic	df	Sig.
Pre-Test Score	1	.88	14	.067
	2	.96	19	.568
	3	.96	19	.535
Post-Test Score	1	.97	14	.812
	2	.90	19	.050
	3	.92	19	.123
Ag Literacy Pre-Test	1	.96	14	.690
	2	.94	19	.259
	3	.98	19	.879
Ag Literacy Post-Test	1	.96	14	.782
	2	.96	19	.602
	3	.97	19	.802
Ag Literacy Perceptions (Before)	1	.89	14	.091
	2	.94	19	.266
	3	.99	19	.997
Ag Literacy Perceptions (After)	1	.93	14	.350
	2	.85	19	.008*
	3	.90	19	.051

** Indicates significance at the 0.05 alpha-level.*

For all groups, scores were classified on a ten-point grading scale that was used by Terry et al. (1992). This scale is typically used in many academic settings and the range of scores were attributed to the student's level of knowledge (Table 8).

Table 8 Classification of Knowledge Based on Range of Scores

Score	Classification
90-100	Superior Knowledge
80-89	Acceptable Knowledge
70-79	Moderate Knowledge
60-69	Minimal Knowledge
< 60	Unacceptably low knowledge

Objective Two Results - Pre & Post-Test Scores (Plants, Soil, & Water Relationships)

Objective two of this study was to assess the agricultural knowledge (plant, soil, and water relationships) among private school students in Mississippi prior to and after treatment.

Group 1

Group 1 student's scores on the pre-test ranged from 20% (3/15 correct) to 67% (10/15 correct). A large majority (86%, n = 12) of the students scored in the 'Unacceptably low knowledge' while the remaining 14% (n = 2) scored in the 'Minimal Knowledge' portion (Figure 5). On average, group 1 displayed an unacceptably low knowledge of agriculture (M = 36.35, SD = 14.50) on the pre-test.

Group 1's post-test scores ranged from 20% (3/15) to 80% (12/15) in which the majority of scores for group 1 still resulted in 64% (n = 9) of students with low knowledge of agriculture, 29% (n = 4) having minimal knowledge, and one student as having moderate knowledge of agriculture (Figure 6).

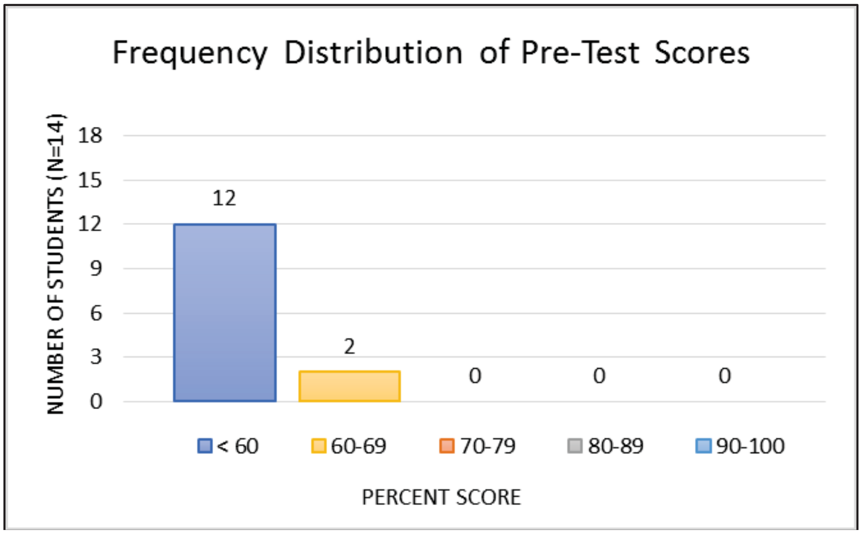

Figure 5 Frequency and distribution of pre-test scores of agricultural knowledge (plant, soil, and water relationships) for Group 1

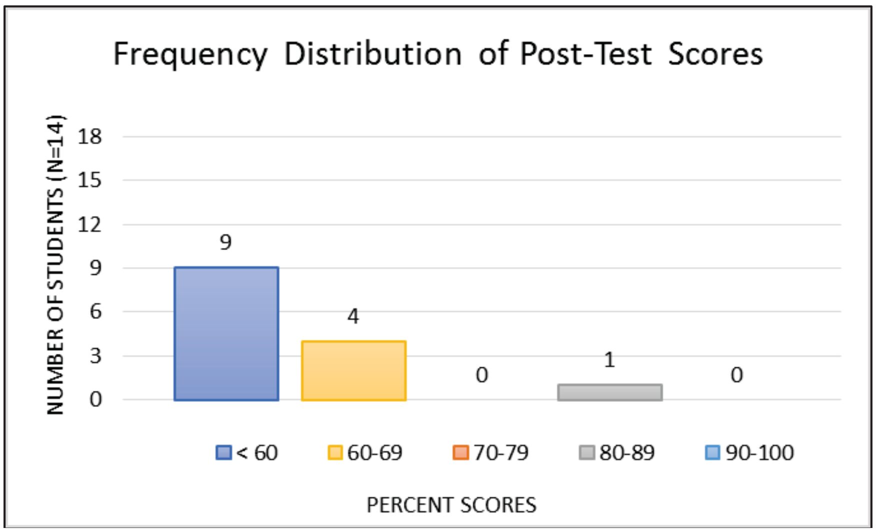

Figure 6 Frequency and distribution of post-test scores of agricultural knowledge (plant, soil, and water relationships) for Group 1

Scores were slightly higher on the post-test than on the pre-test for students in group 1 (M = 47.57, SD = 16.94). Analysis from the paired sample t-test sub-program in SPSS showed there was not a significant difference at the 0.05 alpha level in scores from the pre and post-tests for group 1 (p = .06). (Table 9).

Table 9 Paired Samples Test for Group 1 Pre & Post-Test Scores of Agricultural Knowledge (plant, soil, and water relationships)

	Paired Differences					
	M	*SD*	Std. Error Mean	t	df	Sig.
Pre – Post-Test	-11.21	20.52	5.48	-2.04	13	.062

Test for significance was performed at the 0.05 alpha-level.

Group 2

All students were able to participate in both pre and post-tests with the exception of one student due to sickness. This resulted in 20 of the possible 21 cases being analyzed for this group. Group 2 student's scores on the pre-test ranged from 13% (2/15) to 80% (12/15). Before any intervention was conducted, 76% (n = 16) of the students scored in the 'Unacceptably low knowledge' portion, 19% (n = 4) scored in the 'Minimal knowledge' and one student who scored in the 'Acceptable Knowledge' range (Figure 7). On average, pre-test scores for group 2 resulted in an unacceptably low knowledge of agriculture (M = 44.25, SD = 16.28).

After the teaching intervention, post-test scores ranged from 60% (9/15) to 93% (14/15). A larger portion of students (80%, n =16) scored in the 'Moderate' or 'Acceptable Knowledge' category while the remaining 5% (n = 2) scored in the 'Superior Knowledge' category. The remaining 15% (n = 3) of the students scored in the 'Minimal' range and zero students scored in the 'Unacceptably low knowledge' category (Figure 8).

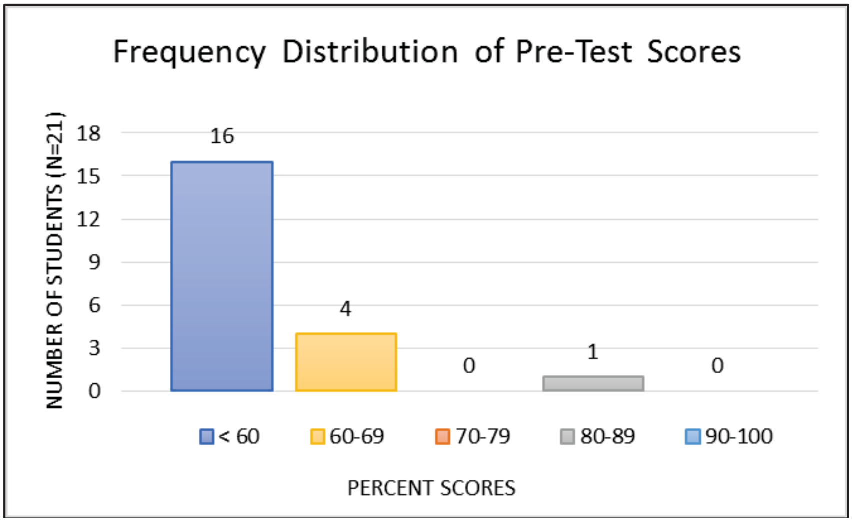

Figure 7 Frequency and distribution of pre-test scores of agricultural knowledge (plant, soil, and water relationships) for Group 2

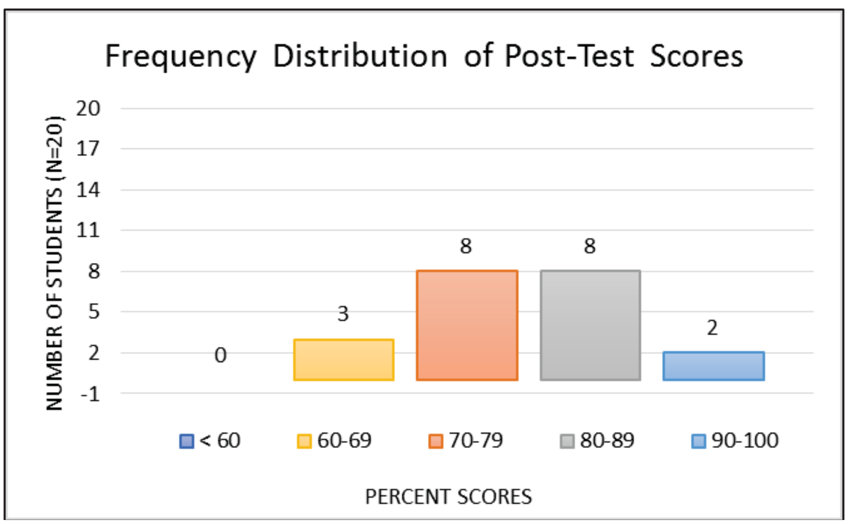

Figure 8 Frequency and distribution of post-test scores of agricultural knowledge (plant, soil, and water relationships) for Group 2

Post-test scores on average were significantly higher than pre-test scores at the 0.05 alpha-level (M = 77.60, SD = 9.35). Analysis from the paired sample t-test sub-program in SPSS showed there was a significant difference at the 0.05 alpha level in scores from the pre and post-tests for group 2 (Table 10).

Table 10 Paired Samples Test for Group 2 Pre & Post-Test Scores of Agricultural Knowledge (plant, soil, and water relationships)

	Paired Differences					
	M	*SD*	Std. Error Mean	t	df	Sig.
Pre – Post-Test	-33.35	20.39	4.56	-7.31	19	.000*

* Indicates significance at the 0.05 alpha-level

Group 3

Group 3 student's scores on the pre-test ranged from 13% (2/15) to 80% (12/15). Before any intervention was conducted, 77% (*n* = 17) of the students scored in the 'Unacceptably low knowledge' while 14% (*n* = 3) of students exhibited minimal knowledge, and the remaining 9% (*n* = 2) fell in the 'Moderate' and 'Acceptable Knowledge' portion (Figure 9). On average, pre-test scores for group 3 resulted in an unacceptably low knowledge of agriculture (*M* = 45.81, *SD* = 17.89).

Comparing Group 3's pre-test scores with post-test scores, Group 3 had zero post-test scores below 70%. Post-test scores ranged from 73% (11/15) to 100% (15/15). Almost half (45%, *n* = 10) of students scored in the 'Superior Knowledge' category, 41% (*n* = 9) scored in the 'Acceptable Knowledge' category, and the remaining 14% (*n* = 3) scored in the 'Moderate Knowledge' category (Figure 10).

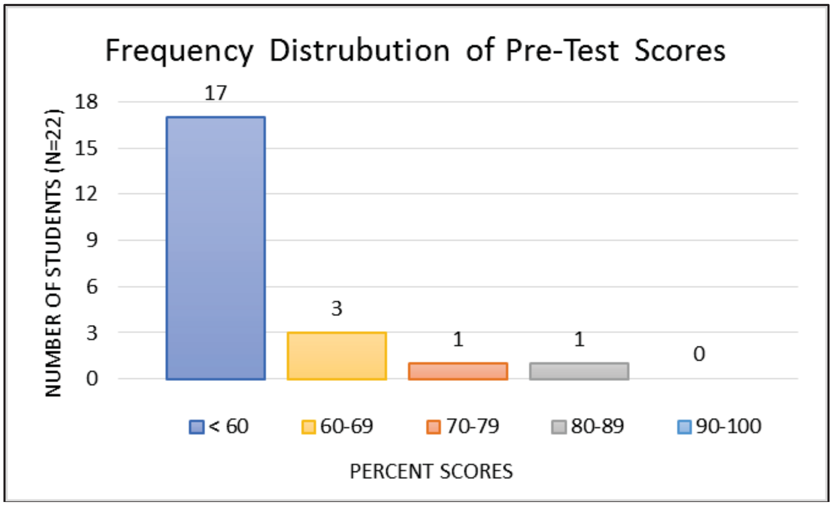

Figure 9 Frequency and distribution of pre-test scores of agricultural knowledge (plant, soil, and water relationships) for Group 3

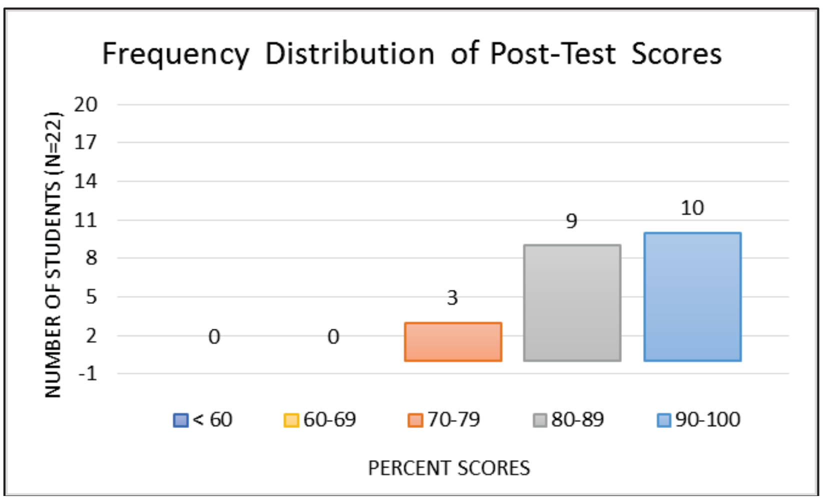

Figure 10 Frequency and distribution of post-test scores of agricultural knowledge (plant, soil, and water relationships) for Group 3

Mean post-test scores for students in group 3 were significantly higher than pre-test scores at the 0.05 alpha-level (M = 87.13, SD = 7.95). Analysis from the Paired Sample t-test sub-program in SPSS revealed there was a significant difference at the 0.05 alpha-level in scores from the pre and post-tests in Group 3 ($p < .001$) (Table 11).

Table 11 Paired Samples Test for Group 3 Pre & Post-Test Scores of Agricultural Knowledge (plant, soil, and water relationships)

	Paired Differences					
	M	*SD*	Std. Error Mean	t	df	Sig.
Pre – Post-Test	-41.32	17.84	17.84	-10.86	21	.000*

* Indicates significance at the 0.05 alpha-level

Objective Three Results - Agricultural Literacy-Knowledge of Agriculture & Perceptions of Agriculture

Objective three was to assess agricultural literacy (knowledge and perceptions of agricultural practices and policies) among private school students in Mississippi prior to and after treatment. Scores for the agricultural literacy section were determined by calculating the percentage of student responses that were correct and dividing by the overall number of questions. The knowledge scores were classified based on the scale that is present in Table 8.

Student scores regarding agricultural perceptions were presented on a Likert-type scale of strongly agree (5) to strongly disagree (1). The higher the perception score the more positively the students perceived agriculture.

Group 1

Based on the scores of the agricultural literacy survey, Group 1 had a low knowledge score of agriculture (*M* = 38.36, *SD* = 13.62) and scores that ranged from 14 to 54 out of a possible 100 (Table 12). Students' perception scores were most closely aligned to the "neutral" category regarding agriculture (*M* = 3.13, *SD* = 0.18) and scores ranged from 2.91 to 3.50 after initial assessment.

Post-test analysis revealed, participant's knowledge scores increased by approximately 6.5 percentage points (*M* = 44.90, *SD* = 19.42); however, perception scores (*M* = 3.06, *SD* = 0.23) decreased. Based on these slight difference in scores, the SPSS paired t-test sub-program indicated the pre and post-test knowledge as not significantly different ($p = .110$) as well as pre and post-test perception scores ($p = .187$) at the 0.05 alpha-level (Tables 13 & 14).

Table 12 Agriculture Literacy Knowledge and Perception Scores for Group 1 (*N* = 14)

Category	*M*	*SD*	Min	Max
Pre-Knowledge Score	38.36	13.62	14.27	54.29
Perception	3.13	0.18	2.91	3.50
Post-Knowledge Score	44.90	19.42	14.27	77.14
Perception	3.06	0.23	2.77	3.48

Table 13 Paired Sample Test of Agricultural Literacy Knowledge Scores for Group 1

	M	Mean Difference	t	df	*p*
Pre-Knowledge Score	38.37	6.53	1.72	13	.110
Post-Knowledge Score	44.90				

Table 14 Paired Sample Test of Agricultural Perception Scores for Group 1

	M	Mean Difference	t	df	*p*
Pre-Perception Score	3.13	-.06	-1.39	13	.187
Post-Perception Score	3.06				

Upon deeper investigation of individual answers selected from the agricultural knowledge portion of the survey, students exhibited varied levels of knowledge within specific categories of the agricultural literacy survey from the pre and post assessments. In the initial assessment, students exhibited low knowledge of agricultural careers (*M* = 25.71, *SD* = 44.02), environmental and natural resources (*M* = 59.18, *SD* = 49.40), general agriculture (*M* = 39.56, *SD* = 49.03), and agricultural policy (*M* = 28.57, *SD* = 45.33). Group 1 post-test scores significantly increased in the general agricultural (*M* = 47.25, *SD* = 50.06) and agricultural policy sections (*M* = 41.43, *SD* = 49.44) (*p* = .04 and .002; respectively) (Table 15). A further breakdown of individual question comparisons can be found in the appendix F-H.

Table 15 Means and Standard Deviations of Paired Samples for Group 1 (*N* = 14)

Category	Pre-Test		Post-Test	
	M	*SD*	*M*	*SD*
Agricultural Careers	25.71	44.02	18.57	39.16
Environmental & Natural Resources	59.18	49.40	64.28	48.16
General Agricultural	39.56	49.03	47.25*	50.06
Agricultural Policy	28.57	45.34	41.43*	49.44

*Indicates significance at the 0.05 alpha-level.

Group 2

For Group 2, the scores on the agricultural literacy survey indicated a low knowledge agriculture (*M* = 35.71, *SD* = 12.76). Scores for Group 2 ranged from 14 to 62 out of a possible 100 (Table 16). Group 2 students' agricultural perceptions were more also more closely aligned with the "neutral" category regarding agriculture (*M* = 3.15, *SD* = 0.23) and scores ranged from 2.8 to 3.7 after initial assessment.

After the post-test was administered, participant's knowledge scores increased by approximately 14 percentage points (*M* = 50.43, *SD* = 9.95); however, there was a slight decrease in agricultural perception scores. The paired t-tests indicated there was a significant difference in agricultural knowledge scores ($p < .001$) at the 0.05 alpha-level (Table 17). At the 0.05 alpha-level, it was observed that there was not a significant difference in student perceptions and attitudes (*p* = .811) (Table 18).

Table 16 Agriculture Literacy Knowledge and Perception Scores for Group Two ($N = 20$)

Category	*M*	*SD*	Min	Max
Pre-Knowledge Score	35.71	12.76	14.29	62.86
Perception	3.15	0.23	2.77	3.68
Post-Knowledge Score	50.43	9.95	28.57	74.29
Perception	3.13	0.28	2.82	3.88

Table 17 Paired Sample Test of Agricultural Literacy Knowledge Scores for Group 2

	M	Mean Difference	t	df	*p*
Pre-Knowledge Score	35.71	14.71	4.75	19	.000
Post-Knowledge Score	50.43				

*Indicates significance at the 0.05 alpha-level.

Table 18 Paired Sample Test of Agricultural Perception Scores for Group 2

	M	Mean Difference	t	df	*p*
Pre-Perception Score	3.15	-.01	-.24	18	.811
Post-Perception Score	3.13				

Significance was conducted at the 0.05 alpha-level.

Upon deeper investigation of individual answers from the agricultural knowledge portion of the survey, students displayed varied levels of knowledge within specific categories of the agricultural literacy. In the initial assessment, students exhibited low knowledge of agricultural careers ($M = 15.00$, $SD = 35.88$), environmental and natural resources ($M = 45.83$, $SD = 50.03$), general agriculture ($M = 36.92$, $SD = 48.35$), and agricultural policy ($M = 31.50$, $SD = 46.57$). Group 2's post-test scores increased significantly in all areas ($p < .001$) except Agricultural Careers ($M = 24.00$, $SD = 42.92$) at the 0.05 alpha-level ($p = 0.07$). Student knowledge in Environmental and Natural Resources ($M = 77.50$, $SD = 41.93$) increased approximately 32 percentage points, while student knowledge regarding general agriculture (*M* = 52.31, *SD* = 50.04) and agricultural policy (*M* = 45.00, *SD* = 49.87) increased by approximately 15 and 14 percentage points, respectively (Table 19).

Table 19 Means and Standard Deviations of Paired Samples for Group 2 (*N* = 20)

Category	Pre-Test		Post-Test	
	M	*SD*	*M*	*SD*
Agricultural Careers	15.00	35.89	24.00	42.93
Environmental & Natural Resources	45.83	50.03	77.50*	41.93
General Agricultural	36.92	48.35	52.31*	50.04
Agricultural Policy	31.50	46.57	45.00*	49.87

* Indicates significance at the 0.05 alpha-level.

Group 3

The scores on the agricultural literacy survey revealed Group 3 had a low knowledge of agriculture (*M* = 44.45, *SD* = 11.32), with scores ranging from 20 to 66 out of a possible 100 (Table 20). Group 3 students agricultural perceptions were more closely aligned with the "neutral" category (*M* = 3.19, *SD* = 0.25) and scores ranged from 2.7 to 3.7 after initial assessment.

After the post-tests, participant's knowledge scores increased by approximately 11 percentage points (*M* = 56.09, *SD* = 13.61), and there was a slight increase in agricultural perception scores (*M* = 3.26, *SD* = 0.28). The paired t-test sub-program in SPSS displayed a significant difference in agricultural knowledge scores (p = .001) at the 0.05 alpha-level (Table 21). At the same alpha-level, it was observed that there was not a significant difference in perception scores (p = .177) (Table 22).

Table 20 Agriculture Literacy Knowledge and Perception Scores for Group 3 (*N* = 22)

Category	*M*	*SD*	Min	Max
Pre-Knowledge Score	44.45	11.32	20.00	65.71
Perception	3.19	0.25	2.71	3.68
Post-Knowledge Score	56.09	13.61	34.29	91.43
Perception	3.26	0.28	2.88	3.85

Table 21 Paired Sample Test of Agricultural Literacy Knowledge Scores for Group 3

	M	Mean Difference	t	df	*p*
Pre-Knowledge Score	44.45	11.64	3.88	18	.001*
Post-Knowledge Score	56.09				

*Indicates significance at the 0.05 alpha-level.

Table 22 Paired Sample Test of Agricultural Perception Scores for Group 3

	M	Mean Difference	t	df	*p*
Pre-Perception Score	3.19	.07	1.41	18	.177
Post-Perception Score	3.26				

Based on answers selected by the participants within the agricultural knowledge portion of the survey, students in Group 3 also exhibited varied levels of knowledge as it pertained to specific categories of the agricultural literacy. In the pre-test, students exhibited low knowledge of agricultural careers (*M* = 22.34, *SD* = 41.87), environmental and natural resources (*M* = 58.33, *SD* = 49.49), general agriculture (*M* = 47.96, *SD* = 50.06), and agricultural policy (*M* = 41.49, *SD* = 49.40). After the treatment, Group 3's post-test scores increased significantly ($p = .001$) by approximately 21 percentage points in Agricultural Careers (*M* = 43.62, *SD* = 49.85); as well as in Environmental and Natural Resources (*M* = 72.73, *SD* = 44.70) ($p < .05$) by approximately 14 points. Group 3 also increased scores by approximately 15 percentage points in Agricultural Policy (*M* = 56.38, *SD* = 49.72) (*p* = .005) points. Group 3 students increased their score by approximately 7.3 percentage points in General Agriculture (*M* = 55.28, *SD* = 49.82); however, the increase was not statistically significant at the 0.05 alpha-level (*p* = .08) (Table 23).

Table 23 Means and Standard Deviations of Paired Samples for Group 3

Category	Pre-Test		Post-Test	
	M	*SD*	*M*	*SD*
Agricultural Careers	22.34	41.87	43.62*	49.85
Environmental & Natural Resources	58.33	49.48	72.73*	44.70
General Agricultural	47.97	50.06	55.28	49.82
Agricultural Policy	41.49	49.40	56.38*	49.72

*Indicates significance at the 0.05 alpha-level

Objective Four Results – Measure and compare the impact of direct instruction and experiential learning on the change in student knowledge of plant, soil, and water relationships, agricultural literacy, and perceptions of agriculture

Objective four compared and measured the impact of direct instruction and experiential learning on the change in student knowledge of plant, soil, and water relationships, agricultural literacy, and perceptions of agriculture. Specifically, objective four attempted to determine if there was a difference in experiential learning and direct instruction as it related to change in knowledge of plant, soil, and water relationships, agricultural literacy, and agricultural perceptions.

The multiple linear regression (MLR) program in SPSS® was used to predict the relationship of intervention on outcome variables. Categorical independent variables were dummy coded based on treatment received in order to achieve the regression analysis using the forced-entry method. Based on the regression model summary, the correlation of scores based on intervention group was interpreted as acceptable (*R* = .82). When comparing intervention groups, Group 3 and Group 2 are weighted heavily in the model with Group 3 given more weight (β= 1.009) than Group 2 (β = .751) (Table 24). Based on the analysis, we can interpret that if a student was in the Group 2, their score would increase 30 points from the time of the pre-test to the time of the post-test, holding other variables constant in the equation, if they were to receive no treatment. The same increase can be concluded from students in Group 3. When holding other variables constant, a student's score in agricultural knowledge would increase by approximately 40 points from the pre-test to the time of the post-test if they were to receive no treatment at all.

On average, pre-test scores for Group 2 (*M* = 44.25, *SD* = 16.28) were slightly higher than Group 1(*M* = 36.35, *SD* = 14.50), but still resulted in an unacceptably low knowledge of agriculture. Comparing mean pre-test scores of the treatment groups to Group 1, pre-test scores were not statistically different at the 0.05 alpha-level; even though pre-test scores for Group 3 (*M* = 45.81, *SD* = 17.89) were slightly higher than both other groups. The SPSS sub-program ANOVA tested the equality the means at one time by using the variance between the three groups of students. When comparing the three groups, the output displayed that mean pre-test scores between the three groups were not significantly different (p = .231).

Table 24 Coefficient Table of Intervention Type[a]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	47.57	3.01		15.81	.000
	Group 2	30.03	3.92	.751	7.65	.000*
	Group 3	39.57	3.84	1.009	10.28	.000*

Dependent Variable: Post Test Score.
*Indicates significance at the 0.05 alpha-level

Multivariate tests were performed to compare test post-scores among the groups of students (Table 25). The Box's Test of equality of covariance matrices revealed that pre-test scores and agricultural literacy scores were normally distributed (p = .982, F = 1.17) across the groups. Due to the significance of Box's M test, the Wilks' lambda test statistic was used. Data revealed there was not a significant difference in the pre-test or agricultural literacy pre-assessment scores between the three groups, Wilk's $\lambda = .859$, $F(4, 100) = 1.98$, $p < .103$. Using Pillai's trace, there was a significant difference among post-test scores, $V = .70$, $F(4, 104) = 14.07$, $p < .001$ (Table 26).

Table 25 Multivariate Test of Pre-Test Scores

Effect		Value	F	Hypothesis df	Error df	Sig.
Group	Pillai's Trace	.14	2.01	4.00	102.00	.098
	Wilks' Lambda	.85	1.98[b]	4.00	100.00	.103
	Hotelling's Trace	.15	1.94	4.00	98.00	.108
	Roy's Largest Root	.10	2.69[c]	2.00	51.00	.077

Design: Intercept + Group
b. Exact statistic

Table 26 Multivariate Test of Post-Test Scores

Effect		Value	F	Hypothesis df	Error df	Sig.
Group	Pillai's Trace	.702	14.70	4.00	102.00	.000
	Wilks' Lambda	.314	20.01[b]	4.00	102.00	.000
	Hotelling's Trace	2.131	26.64	4.00	100.00	.000
	Roy's Largest Root	2.106	54.74[c]	2.00	52.00	.000

Follow-up univariate ANOVAs indicated that there were significant differences between groups and post-test scores $F(2, 52) = 52.50$, $p < .001$ (Table 27). Post-hoc comparisons were conducted and revealed significant differences in post-test scores in the treatment groups (Groups 2 and 3) (Table 28). Group 2 and 3 had significantly higher mean scores than Group 1 ($p < .001$, $p < .001$; respectively). Additionally, mean scores for Group 3 student's post-tests, were also significantly higher than students in group 2 ($p = .012$).

Table 27 Univariate Tests of Post-Test Scores and Group

Dependent Variable		Sum of Squares	df	Mean Square	F	Sig.
Post Test Score	Contrast	13494.94	2	6747.47	52.50	.000
	Error	6682.80	52	128.51		

The *F* tests the effect of Group Type. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.

Table 28 Multiple Comparisons of Agricultural Knowledge (plant, soil, and atmospheric relationships) Means by Group

Dependent Variable	Group	Treatment Group	Mean Difference
Pre-Test Scores	Control	Direct Instruction	-7.89
		Experiential Learning	-10.74
	Direct Instruction	Control	7.89
		Experiential Learning	-2.85
	Experiential Learning	Control	10.74
		Direct Instruction	2.85
Post-Test Scores	Control	Direct Instruction	-30.03*
		Experiential Learning	-38.98*
	Direct Instruction	Control	30.03*
		Experiential Learning	-8.95*
	Experiential Learning	Control	38.98*
		Direct Instruction	8.95*

* Indicates significance at the 0.05 alpha-level

The effect size was computed between pre and post-test scores and treatment groups by displaying the measure of association between an effect (teaching method) and the dependent variable (pre and post-test scores) according to Davis (1971) (Table 29). There was a negligible association between pre-test scores and treatment received which accounted for a small portion of the variance ($\acute{\eta}^2 = .073$). After intervention treatment, there was a substantial association between treatment and post-test scores ($\acute{\eta}^2 = .67$) as compared to the pre-test scores (Table 30). From this statistic, we can infer that approximately 67% of the variance in scores are attributed to the teaching method received, which is substantial according to Davis (1971).

Table 29 Magnitude of Relationships between Variables.

Coefficient	Description of Relationship
.70 or higher	Very strong association
.50 to .69	Substantial association
.30 to .49	Moderate association
.10 to .29	Low association
.00 to .09	Negligible association

Note: Table is adapted from values reported by Davis (1971).

Table 30 Strength of Association Between Pre & Post-Test Scores and Group

	Eta Squared
Pre-Test Scores * Group	.07
Post-Test Scores *Group	.67

For agricultural literacy post-assessment scores, a follow-up univariate ANOVA test indicated significant differences between the groups $F(2, 52) = 3.45$, $p = .039$ (Table 31). Post-hoc comparisons were conducted and revealed significant differences in agricultural literacy post-assessment scores in Group 3 (Table 32). Group 3 scores were significantly higher than that of Group 1 ($p = .013$), but there were no significant differences between Group 1 and Group 2 scores ($p = .287$) or Group 2 and Group 3 scores ($p = .108$).

Table 31 Univariate Test of Post-Assessment Scores and Group

Dependent Variable		Sum of Squares	df	Mean Square	F	Sig.
Ag Literacy Post-	Contrast	1500.55	2	750.27	3.44	.039
Assessment	Error	11311.64	52	217.53		

The *F* tests the effect of Group Type. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.

Table 32 Multiple Comparison of Ag Literacy Post-Assessment Means by Group

Dependent Variable	Group	Treatment Group	Mean Difference
Ag Literacy Pre-Assessment Scores	Control	Direct Instruction	2.58
		Experiential Learning	-6.08
	Direct Instruction	Control	-2.58
		Experiential Learning	-8.67*
	Experiential Learning	Control	6.08
		Direct Instruction	8.67*
Ag Literacy Post-Assessment Scores	Control	Direct Instruction	-5.53
		Experiential Learning	-13.10*
	Direct Instruction	Control	5.53
		Experiential Learning	-7.53
	Experiential Learning	Control	13.10*
		Direct Instruction	7.53

* Indicates significance at the 0.05 alpha-level

The effect size was computed between pre and post-test scores and treatment groups by displaying the measure of association between an effect (teaching method) and the dependent variable (agricultural literacy pre and post-assessment scores). There was a negligible association between pre-test scores and treatment received which accounted for a small portion of the variance ($\acute{\eta}^2 = .09$). After intervention treatment, there was a low association between treatment and post-test scores ($\acute{\eta}^2 = .12$) as compared to the pre-test scores (Table 33). From this statistic, we can infer that approximately 12% of the variance in agricultural literacy post-assessment scores are attributed to the teaching method received.

Table 33 Strength of Association Between Agricultural Literacy Pre & Post-Assessment Scores and Group

	Eta Squared
Pre-Test Scores * Group	.09
Post-Test Scores *Group	.12

Objective Five Results - Perceptions of Agricultural Lessons and Interventions

Objective five was to investigate the perceptions of the agricultural lessons and method of intervention among students (experiential learning, direct instruction, no intervention). Focus groups were utilized to gain a deeper understanding of students' views and perceptions of the agricultural lessons they received. Seven questions were utilized as guides for focus group discussions (Table 34). In an attempt to make the participants feel comfortable, the focus group took place at their respective school. Focus groups were conducted by an additional researcher who had prior knowledge of the study without the principal investigator present. The focus group for Group 2 consisted of 12 females and 9 males and Group 3 consisted of 10 females and 12 males.

Table 34 Focus Group Questions for Participants in Groups 2 & 3

1. What were your thoughts on the agricultural lessons? Did you like/find them interesting?
2. Were the topics in these lessons new to you or have you been taught them before?
    a) If so, where?
3. What could have been better about the teachings?
4. Think back on the pre-test, were you better equipped to answer them on the post-test?
5. Is there anything the teachings didn't offer or something that you would've liked to learn more about?
6. In regard to the teachings, what do you think could have been done to better understand the material?
7. When you think about agriculture, what comes to mind?

Group 2

Group 2 consisted of 12 females and 9 males who received the agriculturally related lessons via direct instruction. Qualitative data analysis revealed five overarching themes that emerged from student responses. The five themes were: the interesting and dynamic nature of agriculture and the lessons, stereotypical preconceived notions of agriculture, lack of connection to the lessons, desire to learn more about agricultural topics, and an increase in knowledge, awareness, and appreciation of agriculture.

Theme 1: The Interesting and Dynamic Nature of Agriculture and the Lessons

The consensus across focus group participants was the dynamic nature of the agricultural lessons. Several students indicated they did not realize that agriculture encompassed so many aspects of society, science, and biology. They also mentioned how interesting the lessons were. One student said, “I thought it was cool to know how many elements were present in the soil, I didn’t think that some were [important as] they were.” Another student echoed similar sentiments and said, “I didn’t know there were that many essential plant elements, [I] didn’t know they needed that much.” One student exclaimed, “agriculture is a bigger deal than I thought it was,” and “[I didn’t] know the percentages about what places are used for agriculture and how much land is used for actual farming.” Many of the students further revealed how interesting the lessons were, another student responded “[the lessons] were interesting, just learning about stuff I didn’t know about [was fun].” Students indicated they thoroughly enjoyed the agricultural lessons and found the content to be of interest to them.

Theme 2: Stereotypical Preconceived Notions of Agriculture

Although participants' perceptions of agriculture changed at the conclusion of the agricultural lessons, there was an overwhelming stereotype of agriculture among participants. Prior to the agricultural lessons, the vast majority of participants viewed agriculture as "farming" or "farms" only and, "plants, animals, and rural areas" based on the amount of responses that indicated this in the open-ended section of the agricultural literacy survey. Participants viewed agriculture as labor intensive, whether it be with plants or animals, and a line of work that was uninteresting and not for everyone. Participants said agriculture is, "how we get our food and where it comes from" and "growing crops to sell." Participants indicated they had relatives they knew of living on a farm, but when asked if they had ever been on a farm, zero participants had been to a farm because they felt it was an outdated way of life.

Theme 3: Lack of Connection to the Lessons

Due to the nature of direct instruction with regard to the agricultural lessons, the principal investigator provided handwritten notes, drawings, and print-outs of the materials. Because of this participants indicated they had trouble really connecting with the lessons. One student said, "he drew everything, I had to get used to that." Other participants echoed similar statements by saying, "he could have better drawing [skills]," and "the pictures could have been better." Another student responded, "he gave us a lot of handouts, they helped a little bit, [but] if he didn't give us a handout, he would draw it and that was ok, but the nitrogen had too many big words and so many arrows."

In particular, students expressed the desire to connect deeper with the learning material via experiences. In particular, the majority of the students indicated the soil related lessons were extremely boring and interested them very little. One student said, "we learned about soil via the handout, if we could have gone outside and dug a hole or looked at it some way it would have been better and a lot more interesting" and "[there was] nothing interesting about the soil." Another student responded, "I think he did a good job with the handouts, but I guess it would have been a little more interesting if we could have went outside to learn about the soil" and "[going outside] would have been good, I like hands on better than note-taking and I would have been more involved" and "I could have done without learning about soil [profiles], soils, [it's] not the most exciting stuff." One student pointed out "maybe if he took us to a farm [it would have been easier to learn]" while another responded "something more hands-on [would have made it stick]."

Theme 4: Desire to Learn More about Agricultural Topics

Many participants indicated that although they learned a lot via the agricultural lessons, there are topics within agriculture they would be interested in learning more about. Many students were interested in expanding on the six lessons and being taught more lessons. A student said, "I wish we could have more time [for] more lessons, even a couple more weeks" and "we learned a lot, but [I wanted] a couple more sessions."

One topic in particular students were interested in was FFA. When prompted to respond regarding knowledge of FFA, no student indicated they had ever heard of FFA. One student responded "I wanted to hear more about FFA because I had never heard about it. [One question] asked us 'are you in FFA' and I was like 'what was that?" Another student responded "I would have loved to learn about FFA more."

Additionally, students expressed an interest in learning more about animals, insects, and land use within agriculture. One student commented, “I [wanted] to hear about animals more than plants” and “I have never been in an agricultural class, [but I thought] it was going to be about animals [too].” The majority of the participants indicated they were not aware of land dedicated to agricultural use and wanted to know more in-depth information about the topic.

Theme 5: An Increase in Knowledge, Awareness, and Appreciation of Agriculture

At the conclusion of the teachings, the majority of the participants indicated how the agricultural lessons increased their knowledge of agriculture. Students claimed they were more knowledgeable after the study about plants, plant nutrients, genetically modified organisms, and other various aspects of agriculture. Many students agreed the post-test was much easier than the pre-test after the lessons. One student said, “the [post-test] was easier the second time, (…) the second time it made a lot more sense.” Another participant echoed those sentiments and said, “[the post-test] was a whole lot easier and on the [pre-test], I didn’t even know what some of those words were.”

Additionally, the students acknowledged how their view of agriculture has changed and are aware of implications of what agriculture means to society and how it could possibly shape society. A student responded, “I could apply [what I learned] for the rest of my life.” One student commented, “[I never thought] agriculture was a large polluter because I never thought about the fertilizer going on plants and what would happen if it didn’t stay there.” Another student had similar sentiments and said, “[now I know] farmers can over-fertilize and it will then get into streams and lakes and other places.” One participant said, “when I go into the grocery store and I see people in the organic section, I wonder if they know what they are buying" and "I saw the label 'Made Without GMO's' on some chips and thought to myself I bet they're nasty." Students' perspectives varied in how much they believed they learned. Students' perspectives also varied as to how much knowledge they have applied to their everyday lives.

The topic of genetically modified organisms appeared to resonate most with the students and they became more aware of the topic. Many students revealed they actually sought their own understanding when it came to these issues in the media. Students responded, "[GMO's] was pretty interesting because I've never thought of it in depth." Another student said, "If GMO's don't hurt the plant and helps it grow, then I don't see what the big deal is" and "I thought GMO's were bad, but I don't think they are. [My] perspective has changed on it."

Students were able to identify common aspects of agriculture such as "no farmers, no food." One student said, "I thought [agriculture] was all about animals, I didn't know agriculture had so many issues or that it was important. I thought it was just animals and [didn't] have anything to do with plants." Another student said, "I didn't understand how important agriculture was, that's how we get our food and without agriculture, we wouldn't be here." The consensus of the participants was that more people need to be aware of agricultural issues.

Group 3

Group 3 consisted of 12 females and 10 males who received the agricultural lessons via experiential learning. Qualitative data analysis revealed four overarching themes that emerged from student responses. The four themes were: the interesting and dynamic nature of agriculture and the lessons, stereotypical preconceived notions of agriculture, the role of experiential learning in the lessons, and an increase in knowledge, awareness, and appreciation of agriculture.

Theme 1: The Interesting and Dynamic Nature of Agriculture and the Lessons

Group 3 participants stated they enjoyed the agriculturally related lessons and thought they were interesting. The students indicated they were unaware of the complex nature of agriculture and were also unaware it encompassed so many aspects. One student responded, "[the lessons] were interesting, I learned a lot of things that I didn't know about agriculture" and "[every lesson] was interesting, every lesson we learned something." Another student responded, "[the lessons] were great, (…) it was fun getting to a certain amount of extra knowledge about things we probably already knew about [roots, water movement] than we do regularly." Many of the students noted how interesting it was learning about the complex nature of many aspects of agriculture such as soils, plant nutrients, and fertilizers. A student responded, "things [like] plant deficiencies and discoloration and things like that I knew [something was wrong with the plant], but [Mr. Bradford] pointed out what they were and how to distinguish what [nutrient] deficiencies [the plant was suffering from], that was neat." One student exclaimed, "[learning about] planting things, working with soil and fertilizer and stuff like that, but also going a few steps further and learning why it works like that [in agriculture] and why you should use it [was interesting to me]." Another student responded, [learning] different fertilizers, different textures of the soil, what they do and how they hold water [was interesting]" and "different levels (horizons) of the soil have different colors and shapes [I didn't know that before]." One student responded, "[what was interesting was] learning about sand, silt, and clay. The more you have of each of them affects the balance between them and how each of them work [differently] to help plants grow." The students revealed how encompassing agriculture was and it was fascinating to uncover such information.

Theme 2: Stereotypical Preconceived Notions of Agriculture

Although the students in Group 3's views of agriculture changed after the lessons, students had stereotypical views of agriculture before the lessons began. The majority of students associated agriculture as "boring," "farming," and hard, manual labor. One student responded, "I didn't think the lessons would be interesting because it was just dirt." Students indicated before the lessons, they could not differentiate between farming and agriculture, nor could they bridge the connections of agricultural policy, laws, and economic impact of agriculture in society. Most students attributed agricultural activities as "farming," "dirt," "fertilizer," "hard work," or "growing food," but students were able make the connection that farmers produce food for the world.

Participants expressed familiarity of being around agriculture, but a career in agriculture or farming related work was unappealing. Students further characterized agricultural employment as "hard work" and enjoyment for the older generation and something not for younger people as one student responded, "when I think of agriculture, I think of farming and my grandparents" and another student replied "[my] paw paw's fields."

Theme 3: The Role of Experiential Learning in the Lessons

Group 3 indicated they experienced more of a connection with the subject matter due to the role experiential learning played. When asked to describe their views on the lessons and why they enjoyed them, the students frequently identified the hands-on approach as to why they enjoyed the lessons. Students further revealed the relevant experiences helped maintain their interest and helped them remember the information longer. One student replied, "[Mr. Bradford] didn't just read stuff and tell us what was on the paper, he [let us do things] so we could see it," while another replied, "being outside helped me learn more and it was more interesting," and "I feel like I learned more from the hands-on instead of just teaching," and "[the experiences were like] seeing it and having a mental image of how to do it [and that helped me remember.]" Another student said, "[with the experiences], I learned more in 6 teachings than I have all year in Biology." Another student stated a similar sentiment and said, "[Mr. Bradford] only came like once a week and I feel like I learned more in one day than I did the whole year in science class." Other students noted that because of the hands-on experiences, they felt more involved with what they were learning.

When asked in particular about the relevant experiences the students encountered, the students responded that the activities had a significant impact on the learning experience. One student said, "we got to see how everything worked instead of just hearing it, you get a mental image of what's going on and you can remember what it was like to do it." Another student elaborated:

> When you do hands-on [experiments], I feel like it just makes the students feel more excited and involved. [I feel] that really it's something not that you just learn in the classroom, it's actually something that you go [perform] and do and [it makes me feel like] the teacher cares.

Another student said, "(…) teachers can teach and tell us 'this substance feels like this and it looks like this,' but until you really get your hands on it and can feel it and smell it, you don't really understand it for yourself." The students indicated that through experiential learning, they were able to intimately connect with the subject and it had a lasting effect on them as individuals.

Theme 4: An Increase in Knowledge, Awareness, and Appreciation of Agriculture

In addition to theme one, students indicated they learned a significant amount about different components of agriculture. Group 3 indicated they could answer the questions on the post-test with more ease than on the pre-test. Many students responded a few concepts on the pre-test they had heard throughout biology, but did not have enough information to correctly answer the question. They responded that because of these lessons, it helped reinforce other science concepts such as diffusion, osmosis, active transport, and photosynthesis.

Students in Group 3 responded they learned most and are more aware of GMO's and organic food production and sources of commercial and organic fertilizers. One student responded, "[learning about] how GMO's and organic stuff and how GMO's help [plants] grow and some helps to keep certain bugs away" while another student said, "I liked learning about the GMO's because I've always heard sometimes they can be bad for you, you shouldn't mess with it, but now I've learned apparently they are helpful in growing faster and better [crops]." Another student said, "people tell you [that] organic is better, (…) [Mr. Bradford] showed us how much [land] is used for food. (…) organic is not always the better choice for certain things" and "organic [food] takes too long [to harvest]." Based on what they learned about agricultural topics, students indicated they now believe they have the proper foundational knowledge base to begin to explore agriculture more comprehensively and with passion.

At the conclusion of the lessons, students revealed more of an awareness and appreciation of agriculture. Students concluded agriculture is more than meets the eye and agriculturalists have a large task in feeding the world's growing population in the future and said, "[agriculture] is more in-depth and more complex than I thought." One student said, "until this class, I didn't have that perception [of all that agriculture encompassed]. You think of the work, but you don't really see it. I [used] to just think 'there goes food.'" Several students indicated they have more of an appreciation of agriculture now they have begun to learn about agriculture. One student further elaborated, "We appreciate it more now, [you begin] to understand how hard people work to get [food] to you" and "it's a lot of work people put into it." Another student elaborated and said, "[after the lessons I] don't think of it as dirt, you think of different levels and horizons and types of soil there are. [It] gives you a deeper perception and appreciation." One student elaborated and said:

> You see [farmers] planting all these foods to grow and [it seems] they know exactly how to tend to them and [consumers] come out and buy them in stores. It is fun to know that we [did] the exact same thing [in the high-tunnel] that a bunch of people do. It just makes [agriculture] seem, not easier, but that it's a neat skill [for everyone] to learn.

Another student said, "[you never knew] how much preparation goes into [just] planning before you even start planting [and how much] you need to do before you even start planting the [crop]."

Students also identified the need for agricultural literacy amongst consumers of all age groups. One student said, "a lot of people have a lack of knowledge on how to grow things and how to provide for themselves and what [goes into it.]." Another student said, "[since the lessons] I think I have a better knowledge and better know how [of agriculture] so when you see problems in agriculture on the news, we can have more knowledge of what they are talking about." At the conclusion of the lessons, the students revealed the high-tunnel that was constructed to aid in the lessons led the school to start the first ever horticultural club in the school's 40 year history.

CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

The study aimed to determine the current knowledge and perceptions, as well as the change in knowledge and perceptions, of agriculture among biology students at three private schools in Northeast Mississippi. This study also aimed to assess the degree of which direct instruction and experiential learning played in the change in knowledge and perceptions of agriculture. The specific research objectives were:

Objective 1: Describe the demographics of students who participated in the study.

Objective 2: Assess the agricultural knowledge (plant, soil, and water relationships) among private school students in Mississippi prior to and after treatment.

Objective 3: Assess agricultural literacy (knowledge and perceptions of agricultural practices and policies) among private school students in Mississippi prior to and after treatment.

Objective 4: Measure and compare the impact of direct instruction and experiential learning on the change in student knowledge of plant, soil, and water relationships, agricultural literacy, and perceptions of agriculture.

Objective 5: Investigate the perceptions of the agricultural lessons and method of intervention among students (experiential learning, direct instruction, no intervention).

Ultimately, this study sought to change students' perceptions of agriculture and increase their knowledge of agriculture by introducing students to agriculturally contextualized lessons.

Conclusions Related to Objective One

Objective one collected demographic data of participants who participated in the study. Demographics attempt to quantify characteristics of specific populations and are necessary for the determination of whether the sample is representative to the target population (Salkind, 2010). Demographic data was collected via questions contained in section three of the agricultural literacy survey.

Of the students surveyed in this study, the majority were Caucasian (93%). White males comprised almost half of the study population (46%) while Caucasian females comprised 47% of the study population. The data found in this study is consistent with private school data in Mississippi. Only 7% of students self-reported as having grew up on a farm, while 54% of students reported they have relatives who currently live on a farm. Student responses indicated although their parents and relatives were raised on farms, they had not had this experience for themselves. The information received from the students indicates and confirms that from this area and sample size, younger generations are being further removed from the farm. This is consistent with publications by Frick et al. (1995) and others citing the relative trend of urbanization and future generations becoming more distant with agrarian life.

A substantial percentage (67%) of the students indicated they had been involved in raising crops, gardens, & plants. Upon further investigation, it was revealed that students did not have general knowledge regarding plant growth, but had at least been exposed to growing potted or container plants and small gardens by family members. Only 23% of students indicated they had been involved in raising farm animals. Similar to student experiences regarding growing crops and gardens, it was revealed that student's experiences were that of family members having farm animals without the student having experienced it for themselves.

Approximately 95% of students reported they had not taken any agriculturally related classes prior to the study and zero students were familiar with the agricultural organizations FFA. According to the National Research Council (1988), agriculture is a topic too important to not be taught in the classroom. This study revealed the majority of private school students indicated they had not been offered an opportunity to receive agriculturally related instruction. This study indicates that private school students are underrepresented in Northeast Mississippi in regard to agricultural education.

Conclusions Related to Objective Two

Objective two of this study was to assess the agricultural knowledge (plant, soil, and water relationships) among private school students in Mississippi prior to and after treatment. Approximately 93% of participants in this study had an unacceptably low or minimal knowledge of agriculture prior to any treatment being administered. This was expected due to the fact students were not at an secondary institution that offered agriculture as part of the curriculum.

Participant knowledge of agriculture was classified using a 10-point grading system (Table 6). When comparing the change in distribution of pre and post-test scores for students in Group 1, results revealed 13 of 14 students still had a minimal to low level of agricultural knowledge (< 60%). A more drastic change was observed in Group 2 participants. The post-test scores showed that only three participants in Group 2 exhibited low agricultural knowledge (60-69%) as compared to 16 participants prior to the treatment. Similar to Group 2, there was also a drastic change in knowledge level among students in Group 3. Prior to the treatment, 17 students exhibited an unacceptably low knowledge of agriculture (< 60%) compared to zero students scoring below 60% on the post-test. The researcher believes the increase in scores among treatment groups can be directly attributed to the intervention the students received which led to an increase in agricultural knowledge.

Conclusions Related to Objective Three

Objective three was to assess agricultural literacy (knowledge and perceptions of agricultural practices and policies) among private school students in Mississippi prior to and after treatment. The first section of agricultural literacy instrument consisted of 35 true/false statements of competencies in areas of agricultural policy, general agriculture, environmental and natural resources, and agricultural careers. Group 1 students' pre-test scores were categorized as unacceptably low (M = 38.36, SD = 13.62). Students in Group 1 significantly increased their scores in the specific areas of general agriculture and agricultural policy. As a whole, Group 1 overall scores were not significantly different (M = 44.90, SD = 19.42; p = .110). It was concluded this increase was either due to chance or student guessing since the group received no treatment. The researchers also believe this increase was due to student maturation as a result of the pre-assessment and becoming familiar with agricultural issues after the initial assessment. The results indicating a lack of agricultural literacy among this population coincides with previous literature citing a lack of agricultural literacy among the population (Frick et al., 1995, Elliot, 1999).

Group 2 students scores also were categorized in the unacceptably low category prior to the study (*M* = 35.71, *SD* = 12.76). At the conclusion of the study, Group 2 students significantly increased scores in all categories (Environmental and Natural Resources *M* = 77.50, *SD* = 41.93; General Agriculture *M* = 52.31, *SD* = 50.04; and Agricultural Policy (*M* = 45.00, *SD* = 49.87) except Agricultural Careers (*M* = 24.00, *SD* = 42.92). Overall, Group 2 scores increased by 14 percentage points (*M* = 50.43, *SD* = 9.95, which was significant at the 0.05 alpha-level ($p < .001$).

Group 3 students agricultural literacy pre-test scores were categorized as unacceptably low (*M* = 44.45, *SD* = 11.32). Group 3 students significantly increased scores in all agricultural literacy categories (Agricultural Careers *M* = 43.62, *SD* = 49.85; Environmental and Natural Resources *M* = 72.73, *SD* = 44.70; Agricultural Policy *M* = 56.38, *SD* = 49.72) except General Agricultural. Overall, Group 3 scores increased by 12 percentage points (*M* = 56.09, *SD* = 13.61) which was significant at the 0.05 alpha-level ($p = .001$). The results of this study are similar to that as reported by Duncan and Broyles (2004). The authors reported that introducing an agricultural intervention positively enhanced literacy of agriculture among a population.

Section II of the agricultural literacy survey assessed the participants' perceptions of agriculture. This section utilized a Likert-scale and 35 statements regarding various agricultural practices. All three groups of student's perception scores in both pre and post-assessments closely aligned with a "neutral" category. The scores in this section were not normally distributed and therefore could not be further analyzed.

Conclusions Related to Objective Four

Objective four measured and compared the impact of direct instruction and experiential and their role in the change in knowledge and perceptions of agriculture. Specifically, objective four attempted to determine if there was a difference in experiential learning and direct instruction as it related to change in knowledge of plant, soil, and water relationships, agricultural literacy, and agricultural perceptions. Multiple linear regression showed that treatment received was a significant predictor for post-test scores. According to the model, groups that received agricultural lessons could expect their score to increase on average by 35 percentage points on the post-test. Linear regression analysis also revealed an acceptable correlation in the model (R = .82), and experiential learning (β= 1.009) was weighted more heavily than direct instruction (β = .751). This inferred that students who received lessons via experiential learning were more likely to receive higher post-test scores.

Statistical analysis revealed no significant differences among pre-test scores among the three groups (p = .231); however, analysis revealed significant increases in post-test scores among students in Group 2 (p < .000) and Group 3 (p < .000). There was an increase in mean scores of Group 1 post-test scores although they were not significant. The researcher believes this increase can be attributed to an increase in student consciousness of testing methods and using deductive reasoning and focus in order to achieve better scores. The researcher also believes this increase could have come about by knowledge gained in a high school biology course during the semester.

Group 2 students scored approximately 33 percentage points higher on the post-test than the pre-test, while Group 3 scored approximately 41 percentage points higher on the post-test than the pre-test. Group 3 scores were significantly higher than Group 1 and 2 scores, despite the fact Group 3 students had the least experience with agriculture prior to the study while Group 3 scores showed the largest increase of the three groups. The researcher attributes the larger increase in Group 3 students' scores to the influence of experiences related to experiential learning students experienced.

Additionally, multivariate tests followed up by univariate ANOVA's revealed there were significant differences between groups in regard to post-test scores ($p < .001$). Multiple comparisons of means by treatment group revealed post-test scores were significantly higher than pre-test scores for Group 2 & 3. Furthermore, Group 3 student's mean scores were significantly higher than Group 2 students at the 0.05 alpha-level. The effect size was computed ($\acute{\eta}^2 = .67$) and was determined that there was a substantial association between treatment received and post-test scores. From the computed regression statistic, it was determined that approximately 67% of the variance in scores can be explained by treatment received which was reported to be substantial according to Davis (1971).

From the results in this study, we can conclude that students who received a treatment performed better on the curriculum post-tests than those who did not. Additionally, this study found students who received experiential learning as a treatment had higher scores than direct instruction on the curriculum post-tests. The researchers attributed this increase to the added value experiential learning contributes by providing students with deeper understanding and richer experiences. This agrees with Dewey's (1938) and Kolb's (1984) beliefs that experiential learning provides the learner with a lasting and deeper connection with the material.

Multivariate tests followed up by univariate ANOVA's also revealed there were significant differences between groups in regard to agricultural literacy scores at the conclusion of the study. Multiple comparisons of means by treatment group revealed Group 3's post-test scores were only significantly higher than Group 1. The effect size was determined there was a low association between treatment received and post-test scores. From the computed statistic, it was determined that approximately 12% of the variance in agricultural literacy post-test scores can be explained by treatment received. There was not a strong association between the curriculum taught and questions within the agricultural literacy survey. Therefore, the researcher concluded that any increase in agricultural literacy can be attributed to the concepts and ideas that were presented in the curriculum materials and/or experiences related to experiential learning.

Conclusions Related to Objective Five

Objective five was to investigate the perceptions of the agricultural lessons and method of intervention among students (experiential learning, direct instruction, no intervention). This was achieved by utilizing focus groups in order to gain a deeper perspective from treatment groups of their perceptions and thoughts of the agricultural lessons.

Focus groups revealed that prior to the agriculturally contextualized lessons, participants had a stereotypical view of agriculture. No student indicated the notion of agriculture being linked to various aspects beyond plants and soils, similar to the results presented by Elliot (1999). Agricultural competencies and emphasis areas such as genetics, domestic and international significance of agriculture, agricultural policy, agricultural economics, and agricultural research were not mentioned by participants.

Holz-Clause and Jost (1995) reported similar results when investigating youth perceptions of agriculture. Although participants' views changed to more specific and defined views of agriculture at the conclusion of the study, many of the students held the preconceived notion that agriculture was essentially only farming, which is similar to the findings of Holz-Clause and Jost (1995). Many of the students also associated Mississippi State University as the institution where agricultural knowledge was readily available and students who were interested in farming would attend.

Participants who were in treatment groups indicated they enjoyed the lessons, being taught agricultural concepts, and were appreciative to learn agricultural information. Participants stated they learned new information from a variety of subjects within agriculture including, fertilizers, soil, plant processes, plant growth and development, genetically modified organisms, and organic agriculture that they did not know prior to the lessons. Participants in treatment groups expressed their desire to learn more regarding agriculture and a change in their perspective of agriculture at the conclusion of the lessons. Group 3 indicated they gained a deeper appreciation for agriculture and the knowledge gained would assist them in future decisions in regard to how they view agriculture. This coincides with research conducted by Blair (2009) in which the author states experiential learning provides a sense of connection with students and the environment.

Additionally, Group 2 students specifically indicated they had a hard time connecting to the material presented. Students expressed the desire to have more hands-on approach to the lessons and believe having hands-on lessons would have assisted in retaining more information from the lessons. The majority of the participants requested in the future, hands-on experiences in concept areas of such as soils, plant growth and development, and fertilizer would be beneficial in retaining material. Group 3 students who received relevant experiences with the lessons stated they believed experiential learning played a role in the way they view the lessons. Group 3 participants expressed the interactive nature of experiential learning helped them connect with the material and conceptualize the processes of agriculture which is consistent with Dewey (1938) and Kolb (1984).

Recommendations

There are several recommendations that can be made for future researchers and practitioners. The first is the importance of agricultural literacy and the role it plays in society. Attacks on agricultural production by companies have instilled uncertainty in society and paints agriculture in a negative light to those who are not agriculturally literate. To combat this, there needs to be a continued systematic push for agricultural literacy within the agricultural education profession. According to Kovar and Ball (2010) there have been few studies published in regard to agricultural literacy since the National Research Council's findings in 1988 regarding the state of agricultural literacy. From the findings of this study, the vast majority of participants were agriculturally illiterate. This is alarming due to the fact that agriculture plays a larger role in society than just food production. The inability for consumers to make basic connections of the food and fiber systems and society can have detrimental implications. As the world population is expected to reach 9 billion by the year 2050, it will be of extreme importance for the public to familiar with agricultural concepts. As one becomes literate in basic agricultural concepts and knowledgeable of the food and fiber system, consumers will be able to make well informed decisions regarding agricultural topics which can influence their day to day lives, economics, and legislative policies.

The National Research Council (1988) regarded agriculture as an important topic that should be taught to students at an early age. The home is no longer a feasible option for youth to become familiar with agriculturally related concepts due to urbanization. Agriculture should be introduced to children as early as five years old. By introducing youth to agriculturally related concepts at an early age, they will begin to form their own opinions of agriculture and view agriculture realistically and objectively.

Within Mississippi specifically, more efforts should be made by researchers to assess the current state of agricultural literacy and perceptions of agriculture, among high school students especially. By targeting secondary students and exposing them to an agriculture curriculum, researchers can gain a deeper perspective of how agriculture is viewed by younger generations. This study revealed that secondary students had a stereotypical view of agriculture before they received an agricultural treatment, but after intervention, their views changed. Secondary students have the cognitive ability to make connections with their environment and are able to conceptualize how agriculture resonates with society.

More efforts should be conducted to increase knowledge of agriculture in secondary students who aren't traditionally targeted through formal settings. Most of formal agricultural education in secondary schools are conducted within Career and Technical Education (CTE) programs with the public school system. In these settings, agricultural education is readily provided through teachers, greenhouses, curriculum, etc. By targeting those who are in various secondary educational settings, researchers and practitioners can further provide agricultural education to those who traditionally are forgotten. In Mississippi specifically, private schools offer the perfect demographic for introducing agricultural concepts. Private schools in Mississippi offer the flexibility for modifications within the curriculum to allow for agricultural lessons to be introduced. Furthermore, agriculture closely resonates with a secondary educational curriculum that could fit within a Biology classroom.

Experts and practitioners in the field of agriculture should attempt to secure funding to implement practical solutions to conduct more systematic agricultural education in schools. Public and private schools could benefit from simple approaches to agriculture such as school gardens, high-tunnels, greenhouses, or technical assistance and teachings from specialists. Universities that are responsible for the transfer of technology and knowledge of agriculture should attempt to retain agricultural literacy specialists. Those who hold these positions should have experience and education in agriculture and education and would also be responsible for securing external funding to assist schools in implementing these educational related endeavors.

Another recommendation based on this research would be for researchers to explore other agriculture curriculums that could be utilized in secondary classrooms and increase agricultural literacy. Many curriculums offer a variety of agricultural topics and materials that can be taught within a traditional classroom setting. Future research should be conducted to assess agricultural knowledge gain within available curriculums and how they impact and correlate with agricultural literacy and perception changes.

Future efforts should be focused on training more teachers in agricultural practices. Research by Hazzard et al. (2011) has shown a lack of knowledge as being a barrier for implementation of school gardens. Pre-school, elementary, and secondary teachers should receive training by professionals who have experience in the agriculture industry to build their confidence and knowledge base in regard to agriculture.

Agricultural researchers should work to develop a new or modify the existing the agricultural literacy survey. While the survey still contains some relevant topics and information, 20 years has passed since its inception. Agriculture has changed tremendously since this survey was first employed and a newer version should reflect this. Newer versions of the agricultural literacy survey instrument should encompass concepts of precision agriculture, more elements of food safety, plant resistance, and genetically modified plants.

Future research should be conducted to assess the role experiential learning has in acquiring agricultural knowledge. This study showed that experiential learning had a large role in students' ability to connect with the material and retain information longer. This study should be replicated in the future utilizing similar time frames for treatments (direct instruction and experiential learning) and conduct follow-ups with participants in the future to investigate if students retained knowledge longer than other methods instructed. Dewey (1938) believed that relevant experiences are what connected the students to the material more than the curriculum itself. Future research should be conducted to find avenues for experiential leaning in agricultural curriculums.

The model presented by Elliot (1999) indicated a positive change in agricultural knowledge and opinions of agriculture in participants. This study attempted to only influence on aspect of the independent variables (education) while attempting to hold the others constant (personal characteristics, agricultural activities). Future research should attempt to introduce systematic agricultural education to those populations with higher levels of involvement in agricultural activities and lower levels of knowledge to investigate knowledge and opinion change of agriculture.

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APPENDIX A

LETTER TO CONSENTING PARENTS FOR CONTROL GROUPS

Parental Permission Form

You are being asked to allow your child to participate in a research project. This form provides you with information about the project. Please read the information below and ask any questions you might have before deciding whether or not to allow your child to participate.

Title of Research Study: *Measuring Agricultural Knowledge Gains in Private School Students and Assessing Their Agricultural Knowledge and Perceptions*

Study Site: Columbus Christian School, Columbus, MS

Name of Researcher(s) & University affiliation: T.J. Bradford, Dr. Gaea Hock, Dr. Ryan Akers, Dr. Marina Denny, Dr. Laura Lemons, Dr. William Kingery; Mississippi State University

The purpose of this research project:

- The purpose of this research is to determine the agricultural knowledge and perceptions of students in Northeast Mississippi. Additionally, this study attempts to investigate the differences in agricultural knowledge based on various teaching methods and their effects on increasing agricultural knowledge.

If you agree to allow your child to participate in this research project, we will ask your child to do the following things:

- At the beginning of the semester, complete a pretest to indicate their current level of agricultural knowledge.
- Take the same test at the end of the school year.
- Complete a survey to indicate their knowledge and perceptions of agricultural practices and industry.
- Provide general demographic information.
- Participate in a focus group at the end of the semester.

The total estimated time to participate in this research project: 30 minutes

Confidentiality and Privacy Protections:

- The pre and posttest and surveys will be read **ONLY** by the lead researcher and kept in the lead researcher's office in a locked file-cabinet. Names will only be used only to assign special identifiers and real names will be omitted.
- Focus groups will be audio recorded.

- It is important to understand that these records will be held by a state entity and; therefore, are subject to disclosure if required by law.

Questions

- If you have any questions about this research project, please feel free to contact T.J. Bradford at 601-832-0361 or at tb306@msstate.edu. For information regarding your child's rights as a research participant, please contact the MSU Research Compliance Office by phone at 662-325-3994.

If you do not want your child to participate:
Please understand that your child's participation is **voluntary.** Your refusal to allow your child to participate will involve **no penalty** to their class grade. You may discontinue your child's participation **at any time** without penalty to their grade. Your child may skip any items that he or she chooses not to answer. Your refusal will not impact current or future relationships with Mississippi State University. To do so, simply tell the researcher that you wish to stop.

If after reading the information above, you agree to allow your child to participate, please sign below. If you decide later that you wish to withdraw your permission, simply tell the researcher. You may discontinue your child's participation at any time. You will be given a copy of this form for your records. Your child will also receive a permission form detailing this research study and asking for their assent to participate.

____
Child's name (please print)

____
Parent or *Legally Authorized Representative's Signature Date

____
Investigator's Signature Date

If a Legally Authorized Representative (rather than a parent), must have documentation to show LAR status.

APPENDIX B

PARENTAL CONSENT LETTER FOR TREATMENT GROUPS

Parental Permission Form

You are being asked to allow your child to participate in a research project. This form provides you with information about the project. Please read the information below and ask any questions you might have before deciding whether or not to allow your child to participate.

Title of Research Study: *Measuring Agricultural Knowledge Gains in Private School Students and Assessing Their Agricultural Knowledge and Perceptions*

Study Site: Oak Hill Academy, West Point, MS, Victory Christian Academy , Columbus, MS

Name of Researcher(s) & University affiliation: T.J. Bradford, Dr. Gaea Hock, Dr. Ryan Akers, Dr. Marina Denny, Dr. Laura Lemons, Dr. William Kingery; Mississippi State University

The purpose of this research project:

- The purpose of this research is to determine the agricultural knowledge and perceptions of students in Northeast Mississippi. Additionally, this study attempts to investigate the differences in agricultural knowledge based on various teaching methods and their effects on increasing agricultural knowledge.

If you agree to allow your child to participate in this research project, we will ask your child to do the following things:

- At the beginning of the semester, complete a pretest to indicate their current level of agricultural knowledge and complete the same test at the end of the school year.
- Complete a survey to indicate their knowledge and perceptions of agricultural practices and the agricultural industry.
- Provide general demographic information.
- Coinciding with their current biology class schedule, your child will be asked to participate in six (6) 45-minute agricultural teachings that will be taught during class.
- At the end of the six (6) teachings, your child will be asked to participate in a focus group to discuss their feelings toward the lessons and agricultural related topics.

The total estimated time to participate in this research project: Six (6) class meetings

Confidentiality and Privacy Protections:

- The pre and posttest and surveys will be read **ONLY** by the lead researcher and kept in the lead researcher's office in a locked file-cabinet. Names will only be used only to assign special identifiers and real names will be omitted.
- The teacher will have access to names of students for classroom purposes **ONLY**.
- Focus groups will be audio recorded.
- It is important to understand that these records will be held by a state entity and; therefore, are subject to disclosure if required by law.

Questions

- If you have any questions about this research project, please feel free to contact T.J. Bradford at 601-832-0361 or at tb306@msstate.edu. For information regarding your child's rights as a research participant, please contact the MSU Research Compliance Office by phone at 662-325-3994.

If you do not want your child to participate:
Please understand that your child's participation is **voluntary.** Your refusal to allow your child to participate will involve **no penalty** to their class grade. You may discontinue your child's participation **at any time** without penalty to their grade. Your child may skip any items that he or she chooses not to answer. Your refusal will not impact current or future relationships with Mississippi State University. To do so, simply tell the researcher that you wish to stop.

If after reading the information above, you agree to allow your child to participate, please sign below. If you decide later that you wish to withdraw your permission, simply tell the researcher. You may discontinue your child's participation at any time. You will be given a copy of this form for your records. Your child will also receive a permission form detailing this research study and asking for their assent to participate.

____
Child's name (please print)

____
Parent or *Legally Authorized Representative's Signature Date

____
Investigator's Signature Date

If a Legally Authorized Representative (rather than a parent), must have documentation to show LAR status.

APPENDIX C

STUDENT ASSENT LETTER FOR CONTROL GROUP

Student Assent Document

Project Title: *Measuring Agricultural Knowledge Gains in Private School Students and Assessing Their Agricultural Knowledge and Perceptions*

Investigators & University Affiliation: T.J. Bradford, Dr. Gaea Hock, Dr. Ryan Akers, Dr. Marina Denny, Dr. Laura Lemons, Dr. William Kingery; Mississippi State University

We are doing a research study about how much students' know about agriculture, what they think about agriculture, and if teaching a few lessons help in learning about agriculture. A research study is a way to learn more about people. If you decide that you want to be part of this study, you will be asked to complete a survey which asks questions about what you know about agriculture, what you think about agriculture, and how you feel toward agriculture. This survey will take you around 30 minutes to complete.

During your scheduled biology class, you will be asked to take a short pretest and survey at the beginning of the project. At the end of the semester, you will be asked to take the same test and be part of a group discussion about what you learned and what you think about the survey and other materials. This group discussion will be audio recorded. Everything will be done in class so you won't have to do anything outside of the regular school day. If you need more time or help with anything, please ask and you can stop at any point when completing the survey.

Your participation in this study will help determine if other schools can be taught agriculture lessons, how effective the agriculture lessons are, and what are the general knowledge and perceptions of agriculture in high school students. You will be helping in whether other students will be able to receive agricultural teachings and helping me complete my Ph.D.

When we are finished with this study, we will write a report about what we learned. This report will not include your name or that you were in the study and you do not have to be in this study if you do not want to be. If you decide to stop after we begin, that's okay too.

If you decide you want to be in this study, please sign your name.

______ *Yes, I'll be in the study* ______ *No, I do not want to be in the study.*

Participant's Name (Please Print):____

____

Signature Date

____

Investigator's Signature Date

APPENDIX D

STUDENT ASSENT LETTER FOR TREATMENT GROUPS

Student Assent Document

Project Title: *Measuring Agricultural Knowledge Gains in Private School Students and Assessing Their Agricultural Knowledge and Perceptions*

Investigators & University Affiliation: T.J. Bradford, Dr. Gaea Hock, Dr. Ryan Akers, Dr. Marina Denny, Dr. Laura Lemons, Dr. William Kingery; Mississippi State University

We are doing a research study about how much students' know about agriculture, what they think about agriculture, and if teaching a few lessons help in learning about agriculture. A research study is a way to learn more about people. If you decide that you want to be part of this study, you will be asked to complete a survey which asks questions about what you know about agriculture, what you think about agriculture, and how you feel toward agriculture. This survey will take you around 30 minutes to complete.

During your scheduled biology class, you will be asked to take a short pretest and survey at the beginning of the project and asked to participate in six (6) lessons. At the end of the project, you will be asked to take the same test and be part of a group discussion about what you learned. This group discussion will be audio recorded. Everything will be done in class so you won't have to do anything outside of the regular school day. If you need more time or help with anything, please ask and you can stop at any point when completing the survey.

Your participation in this study will help determine if other schools can be taught agriculture lessons, how effective the agriculture lessons are, and what are the general knowledge and perceptions of agriculture in high school students. You will be helping in whether other students will be able to receive agricultural teachings and helping me complete my Ph.D.

When we are finished with this study, we will write a report about what we learned. This report will not include your name or that you were in the study and you do not have to be in this study if you do not want to be. If you decide to stop after we begin, that's okay too.

If you decide you want to be in this study, please sign your name.

______ *Yes, I'll be in the study* ______ *No, I do not want to be in the study.*

Participant's Name (Please Print):____

____
Signature Date

____
Investigator's Signature Date

APPENDIX E

AGRICULTURAL LITERACY SURVEY INSTRUMENT

This survey is made up of three sections. Section I relates to the general information about agriculture, food, and food production. Section II relates to your general perceptions of agriculture, food, and food production. Section III requests demographic information.

Responses to the survey will be kept confidential and should be recorded on the answer sheet provided. After completing each of the three sections, please return the answer sheet and the survey form.

Section I

Directions: Read each statement and mark "✓" if you think the statement is TRUE or FALSE. Please do not guess, if you don't know place a "✓" under the DON'T KNOW column.

Statements	True	False	Don't Know
1. There are more farmers in the U.S. than there were 10 years ago.			
2. Less than 3 percent of the U.S. gross national product is from agriculture.			
3. Soil erosion does not pollute U.S. lakes and rivers.			
4. The use of pesticides has increased the yield of crops.			
5. Animal health and nutrition are important to farmers.			
6. Food safety is a major concern of the food processing industry.			
7. Processing increases the cost of food products.			
8. U.S. research has improved farming methods in other countries.			
9. One of every five jobs in the U.S. is related to agriculture.			
10. Many farmers use tillage practices that conserve the soil.			
11. Plant products are the main source of human foods.			
12. Animals can be a valuable source of medical products.			
13. Homogenization kills bacteria in milk with heat.			
14. The U.S. does not sell its feed grains on the world market.			
15. Thousands of people in the world die of starvation each year.			
16. Local laws and regulations have little effect on farmers.			
17. Farming and wildlife cannot survive in the same geographic area.			
18. Biotechnology has increased the pest resistance of plants.			
19. Animals eat foodstuffs that cannot be digested by			

humans.			
Statements	**True**	**False**	**Don't Know**
20. New products have been developed using surplus grains.			
21. Grain exports are usually transported between continents by airplane.			
22. The average U.S. farm is larger than 500 acres.			
23. U.S. agricultural policies influence food prices in other countries.			
24. Animal wastes are used to increase soil fertility.			
25. Profits increase as farmers strive for the maximum crop yields.			
26. Biotechnology has increased animal production in the U.S.			
27. Pasteurization kills bacteria in milk with heat.			
28. An efficient food distribution system is essential to the agricultural industry.			
29. Several countries depend on U.S. agricultural exports for food and fiber.			
30. Government subsidy payments to farmers are used to stabilize food prices.			
31. Water, soil, and minerals are important in agriculture.			
32. Very little of the grain produced in the U.S. is exported.			
33. Hamburger is made from the meat of pigs.			
34. Using grain alcohol for fuel reduces the U.S. dependence on foreign oil.			
35. Transportation and storage affects the supply of agricultural products.			

Section II

Directions: Read each statement completely. Indicate with a "✓" under the column that best fits your view of the statement.

Example:

Statements	**Strongly Agree**	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**
Farmers make too much money			✓		

36. U.S. citizens spend a higher percent of their income on food than in other countries.
37. Agriculture employs a large number of people in this country.
38. Pesticides can be used safely when producing food.
39. Organic production methods are a realistic alternative to using pesticides.
40. Confinements is an acceptable practice when raising livestock.

41. Consumers prefer processed foods to raw products.
42. Developing countries need help to be able to store food safely.
43. People are moving away from rural areas due to changes in agriculture.
44. Farmers earn too much money.
45. Not all land is suitable for farming.

46. Biotechnology has increased the yield of crops in developing countries.
47. Farmers take good care of their animals.
48. Processing adds value to farm products.
49. Farmers should develop new and innovative marketing strategies.
50. A strong agricultural industry is more important than military power.

51. Agricultural exports help to reduce the U.S. trade deficit.
52. Agricultural practices are harmful to the environment.
53. Raising hybrid plants results in higher yields.
54. Farmers are concerned about the humane treatment of animals.
55. Processing food products is a benefit to consumers.

56. The U.S. should allow free trade with other countries for food products.
57. The world food supply has increased as a result of improved technology.
58. The U.S. needs a steady supply of food and fiber products to remain strong.
59. Only organic methods should be used to produce food.
60. Farmers should not use chemicals in crop production.

61. Animals have the same rights as people.
62. Processing adds more to the cost of food than the raw product.
63. Farmers have no control over food prices.
64. Developing countries lack the ability to produce enough food.
65. The government should exert more control over farming.

66. Agriculture is the greatest polluter of our water supplies.
67. Agriculture has become too mechanized.
68. Animals should not be used for food.
69. Farm grains are becoming an important energy source in the U.S.
70. Developing countries need help in distributing food among needy people.

Section III

Directions: Read each statement in this section completely. Select the most accurate response to each statement and mark with a "✓."

Gender:

_____Female
_____Male

What is Your Age? ________ (write in your age as of today)

What is your ethnicity?

_____Asian
_____White
_____Hispanic
_____African American
_____Other

When you think of the word "Agriculture" what comes to mind? (Words, phrases, ideas, etc.).

____
____
____
____
____

Questions	Yes	No
Did you grow up on a farm?		
Do you have relatives who live or work on a farm?		
Have you taken any agricultural courses in before?		
Are you an active member in FFA?		
Have you been involved in raising farm animals?		
Have you been involved in raising plants, gardens, or crops?		

APPENDIX F

COMPLETE PRE & POST AGRICULTURAL LITERACY SURVYEY RESULTS

FOR GROUP I

Statements	Pre		Post	
	Correct %	*SD*	Correct %	*SD*
1. There are more farmers in the U.S. than there were 10 years ago.	42.8	0.51	28.5	0.47
2. Less than 3 percent of the U.S. gross national product is from agriculture.	28.5	0.47	21.4	0.43
3. Soil erosion does not pollute U.S. lakes and rivers.	42.8	0.51	57.1	0.51
4. The use of pesticides has increased the yield of crops.	28.5	0.47	42.8	0.51
5. Animal health and nutrition are important to farmers.	50.0	0.52	64.2	0.50
6. Food safety is a major concern of the food processing industry.	42.8	0.51	64.2	0.50
7. Processing increases the cost of food products.	14.2	0.36	35.7	0.50
8. U.S. research has improved farming methods in other countries.	35.7	0.50	57.1	0.51
9. One of every five jobs in the U.S. is related to agriculture.	28.5	0.47	28.5	0.47
10. Many farmers use tillage practices that conserve the soil.	57.1	0.51	57.1	0.51
11. Plant products are the main source of human foods.	50.0	0.52	64.2	0.50
12. Animals can be a valuable source of medical products.	14.2	0.36	35.7	0.50
13. Homogenization kills bacteria in milk with heat.	7.14	0.27	21.4	0.43
14. The U.S. does not sell its feed grains on the world market.	28.5	0.47	28.5	0.47
15. Thousands of people in the world die of starvation each year.	92.8	0.27	100.0	0.00
16. Local laws and regulations have little effect on farmers.	35.7	0.50	42.8	0.51
17. Farming and wildlife cannot survive in the same geographic area.	57.1	0.51	57.1	0.51
18. Biotechnology has increased the pest resistance of plants.	42.8	0.51	42.8	0.51
19. Animals eat foodstuffs that cannot be digested by humans.	50.0	0.52	28.5	0.47
20. New products have been developed using surplus grains.	7.14	0.27	14.2	0.36
21. Grain exports are usually transported between continents by airplane.	28.5	0.47	28.5	0.47
22. The average U.S. farm is larger than 500 acres.	28.5	0.47	14.2	0.36
23. U.S. agricultural policies influence food prices	14.2	0.36	35.7	0.50

in other countries.				
24. Animal wastes are used to increase soil fertility.	85.7	0.36	100.0	0.00
25. Profits increase as farmers strive for the maximum crop yields.	0.00	0.00	0.00	0.00
26. Biotechnology has increased animal production in the U.S.	21.4	0.43	28.5	0.47
27. Pasteurization kills bacteria in milk with heat.	57.1	0.51	64.2	0.50
28. An efficient food distribution system is essential to the agricultural industry.	57.1	0.51	57.1	0.51
29. Several countries depend on U.S. agricultural exports for food and fiber.	28.5	0.47	50.0	0.52
30. Government subsidy payments to farmers are used to stabilize food prices.	7.14	0.27	7.14	0.27
31. Water, soil, and minerals are important in agriculture.	100.0	0.00	92.8	0.27
32. Very little of the grain produced in the U.S. is exported.	21.4	0.43	35.7	0.50
33. Hamburger is made from the meat of pigs.	85.7	0.36	71.4	0.47
34. Using grain alcohol for fuel reduces the U.S. dependence on foreign oil.	14.2	0.36	35.7	0.50
35. Transportation and storage affects the supply of agricultural products.	35.7	0.50	57.1	0.51

APPENDIX G

COMPLETE PRE & POST AGRICULTURAL LITERACY SURVYEY RESULTS

FOR GROUP II

Statements	Pre Correct %	Pre SD	Post Correct %	Post SD
1. There are more farmers in the U.S. than there were 10 years ago.	33.3	0.48	40.0	0.50
2. Less than 3 percent of the U.S. gross national product is from agriculture.	9.5	0.30	30.0	0.47
3. Soil erosion does not pollute U.S. lakes and rivers.	52.3	0.51	80.0	0.41
4. The use of pesticides has increased the yield of crops.	23.8	0.44	60.0	0.50
5. Animal health and nutrition are important to farmers.	71.4	0.46	65.0	0.49
6. Food safety is a major concern of the food processing industry.	95.2	0.22	80.0	0.41
7. Processing increases the cost of food products.	47.6	0.51	50.0	0.51
8. U.S. research has improved farming methods in other countries.	23.8	0.44	70.0*	0.47
9. One of every five jobs in the U.S. is related to agriculture.	14.2	0.36	25.0	0.44
10. Many farmers use tillage practices that conserve the soil.	19.0	0.40	60.0	0.50
11. Plant products are the main source of human foods.	52.3	0.51	65.0	0.49
12. Animals can be a valuable source of medical products.	38.1	0.50	50.0	0.51
13. Homogenization kills bacteria in milk with heat.	0.00	0.00	25.0*	0.44
14. The U.S. does not sell its feed grains on the world market.	14.2	0.36	20.0	0.41
15. Thousands of people in the world die of starvation each year.	76.1	0.44	100.0*	0.00
16. Local laws and regulations have little effect on farmers.	28.5	0.46	40.0	0.50
17. Farming and wildlife cannot survive in the same geographic area.	71.4	0.46	70.0	0.47
18. Biotechnology has increased the pest resistance of plants.	28.5	0.46	50.0	0.51
19. Animals eat foodstuffs that cannot be digested by humans.	14.2	0.36	40.0*	0.50
20. New products have been developed using surplus grains.	19.0	0.40	50.0	0.51
21. Grain exports are usually transported between continents by airplane.	19.0	0.40	15.0	0.37
22. The average U.S. farm is larger than 500 acres.	14.2	0.36	20.0	0.41
23. U.S. agricultural policies influence food prices in other countries.	19.0	0.40	45.0	0.51

24. Animal wastes are used to increase soil fertility.	95.2	0.22	100.0	0.00
25. Profits increase as farmers strive for the maximum crop yields.	0.00	0.00	5.0	0.22
26. Biotechnology has increased animal production in the U.S.	4.7	0.22	45.0*	0.51
27. Pasteurization kills bacteria in milk with heat.	14.2	0.36	45.0*	0.51
28. An efficient food distribution system is essential to the agricultural industry.	47.6	0.51	75.0	0.44
29. Several countries depend on U.S. agricultural exports for food and fiber.	42.8	0.51	65.0	0.49
30. Government subsidy payments to farmers are used to stabilize food prices.	9.5	0.30	20.0	0.41
31. Water, soil, and minerals are important in agriculture.	100.0	0.00	95.0	0.22
32. Very little of the grain produced in the U.S. is exported.	19.0	0.40	20.0	0.41
33. Hamburger is made from the meat of pigs.	90.4	0.30	80.0	0.41
34. Using grain alcohol for fuel reduces the U.S. dependence on foreign oil.	4.7	0.22	15.0	0.37
35. Transportation and storage affects the supply of agricultural products.	38.1	0.50	50.0	0.51

*Indicates significant increase at the 0.05 alpha-level.

APPENDIX H

COMPLETE PRE & POST AGRICULTURAL LITERACY SURVYEY RESULTS

FOR GROUP III

Statements	Pre		Post	
	Correct %	*SD*	Correct %	*SD*
1. There are more farmers in the U.S. than there were 10 years ago.	42.1	0.50	71.4*	0.46
2. Less than 3 percent of the U.S. gross national product is from agriculture.	11.1	0.32	28.5	0.46
3. Soil erosion does not pollute U.S. lakes and rivers.	47.3	0.51	57.1	0.51
4. The use of pesticides has increased the yield of crops.	42.1	0.50	66.6	0.48
5. Animal health and nutrition are important to farmers.	73.6	0.45	95.2	0.22
6. Food safety is a major concern of the food processing industry.	84.2	0.37	80.9	0.40
7. Processing increases the cost of food products.	47.3	0.51	47.6	0.51
8. U.S. research has improved farming methods in other countries.	31.5	0.47	66.6*	0.48
9. One of every five jobs in the U.S. is related to agriculture.	26.3	0.45	47.6	0.51
10. Many farmers use tillage practices that conserve the soil.	31.5	0.47	80.9*	0.40
11. Plant products are the main source of human foods.	68.4	0.47	80.9	0.40
12. Animals can be a valuable source of medical products.	63.1	0.49	42.8	0.51
13. Homogenization kills bacteria in milk with heat.	0	0	14.2	0.36
14. The U.S. does not sell its feed grains on the world market.	31.5	0.47	38.1	0.50
15. Thousands of people in the world die of starvation each year.	89.4	0.31	76.1	0.44
16. Local laws and regulations have little effect on farmers.	50	0.51	71.4	0.46
17. Farming and wildlife cannot survive in the same geographic area.	61.1	0.50	66.6	0.48
18. Biotechnology has increased the pest resistance of plants.	52.6	0.51	71.4	0.46
19. Animals eat foodstuffs that cannot be digested by humans.	44.4	0.51	71.4	0.46
20. New products have been developed using surplus grains.	31.5	0.47	38.1	0.50
21. Grain exports are usually transported between continents by airplane.	31.5	0.47	28.5	0.46
22. The average U.S. farm is larger than 500 acres.	15.7	0.37	28.5	0.46
23. U.S. agricultural policies influence food prices in other countries.	15.7	0.37	38.1	0.50

24. Animal wastes are used to increase soil fertility.	89.4	0.31	90.4	0.30
25. Profits increase as farmers strive for the maximum crop yields.	15.7	0.37	28.5	0.46
26. Biotechnology has increased animal production in the U.S.	15.7	0.37	47.6*	0.51
27. Pasteurization kills bacteria in milk with heat.	26.3	0.45	38.1	0.50
28. An efficient food distribution system is essential to the agricultural industry.	68.4	0.47	85.7	0.36
29. Several countries depend on U.S. agricultural exports for food and fiber.	42.1	0.50	52.3	0.51
30. Government subsidy payments to farmers are used to stabilize food prices.	26.3	0.45	38.1	0.50
31. Water, soil, and minerals are important in agriculture.	84.2	0.37	95.2	0.22
32. Very little of the grain produced in the U.S. is exported.	21.0	0.41	38.1	0.50
33. Hamburger is made from the meat of pigs.	89.4	0.31	85.7	0.36
34. Using grain alcohol for fuel reduces the U.S. dependence on foreign oil.	42.1	0.50	47.6	0.51
35. Transportation and storage affects the supply of agricultural products.	42.1	0.50	71.4*	0.46

*Indicates significant increase at the 0.05 alpha-level.

APPENDIX I

COMPLETE PRE & POST AGRICULTURAL LITERACY SURVYEY ATTITUDES

RESULTS FOR GROUP I

	Pre		Post	
Statements	*M*	*SD*	*M*	*SD*
36. U.S. citizens spend a higher percent of their income on food than in other countries.	3.86	0.86	3.86	0.95
37. Agriculture employs a large number of people in this country.	2.86	0.77	2.71	0.83
38. Pesticides can be used safely when producing food.	2.79	1.37	2.86	1.17
39. Organic production methods are a realistic alternative to using pesticides.	3.71	0.73	3.71	0.83
40. Confinements is an acceptable practice when raising livestock.	3.00	0.88	2.21	0.89
41. Consumers prefer processed foods to raw products.	2.85	0.90	3.07	1.14
42. Developing countries need help to be able to store food safely.	4.21	0.70	4.21	0.70
43. People are moving away from rural areas due to changes in agriculture.	3.07	1.00	3.00	0.55
44. Farmers earn too much money.	2.07	0.62	2.21	1.12
45. Not all land is suitable for farming.	4.36	0.50	4.00	0.68
46. Biotechnology has increased the yield of crops in developing countries.	3.29	0.61	3.29	0.73
47. Farmers take good care of their animals.	2.86	0.66	2.86	0.77
48. Processing adds value to farm products	2.86	1.10	2.93	1.21
49. Farmers should develop new and innovative marketing strategies.	3.36	0.74	3.43	0.85
50. A strong agricultural industry is more important than military power.	2.21	0.80	2.54	0.52
51. Agricultural exports help to reduce the U.S. trade deficit.	3.07	0.83	3.07	0.62
52. Agricultural practices are harmful to the environment.	2.50	0.85	1.86	0.86
53. Raising hybrid plants results in higher yields.	3.43	0.85	3.50	0.76
54. Farmers are concerned about the humane treatment of animals.	3.00	0.96	2.93	0.92
55. Processing food products is a benefit to consumers.	2.93	1.00	2.64	1.08
56. The U.S. should allow free trade with other countries for food products.	2.93	0.92	3.14	1.17
57. The world food supply has increased as a result of improved technology.	3.64	0.63	3.71	0.73
58. The U.S. needs a steady supply of food and fiber products to remain strong.	3.71	0.83	3.64	0.63
59. Only organic methods should be used to produce food.	3.64	0.93	3.50	1.02

60. Farmers should not use chemicals in crop production.	3.57	1.02	3.29	1.20
61. Animals have the same rights as people.	2.29	0.91	2.21	1.05
62. Processing adds more to the cost of food than the raw product.	3.50	0.85	2.93	1.14
63. Farmers have no control over food prices.	3.00	0.96	3.07	0.73
64. Developing countries lack the ability to produce enough food.	3.79	0.58	3.79	0.80
65. The government should exert more control over farming.	2.93	1.00	2.86	0.77
66. Agriculture is the greatest polluter of our water supplies.	2.64	0.84	2.57	0.76
67. Agriculture has become too mechanized.	2.86	1.10	2.86	1.17
68. Animals should not be used for food.	1.50	0.65	1.64	0.74
69. Farm grains are becoming an important energy source in the U.S.	3.14	0.66	3.38	0.65
70. Developing countries need help in distributing food among needy people.	4.21	0.70	3.86	0.86

APPENDIX J

COMPLETE PRE & POST AGRICULTURAL LITERACY SURVYEY ATTITUDES

RESULTS FOR GROUP II

	Pre		Post	
Statements	*M*	*SD*	*M*	*SD*
36. U.S. citizens spend a higher percent of their income on food than in other countries.	4.35	0.88	3.6	1.14
37. Agriculture employs a large number of people in this country.	3.2	0.95	3.25	0.91
38. Pesticides can be used safely when producing food.	3	0.79	3.61	0.78
39. Organic production methods are a realistic alternative to using pesticides.	3.35	0.81	3.2	1.01
40. Confinements is an acceptable practice when raising livestock.	2.95	1.05	3	0.86
41. Consumers prefer processed foods to raw products.	2.9	1.02	3.05	1.00
42. Developing countries need help to be able to store food safely.	3.9	0.85	4.2*	0.70
43. People are moving away from rural areas due to changes in agriculture.	3.1	0.85	3.3	0.80
44. Farmers earn too much money.	2.1	0.64	1.75	0.64
45. Not all land is suitable for farming.	4.65	0.49	4.6	0.50
46. Biotechnology has increased the yield of crops in developing countries.	3.45	0.60	3.5	0.76
47. Farmers take good care of their animals.	3.4	1.05	3.55	0.69
48. Processing adds value to farm products	2.7	0.80	3	0.97
49. Farmers should develop new and innovative marketing strategies.	3.65	0.93	3.55	0.69
50. A strong agricultural industry is more important than military power.	2.35	0.88	2.2	0.89
51. Agricultural exports help to reduce the U.S. trade deficit.	3.45	0.60	3.5	0.69
52. Agricultural practices are harmful to the environment.	2.3	0.98	2.4	0.88
53. Raising hybrid plants results in higher yields.	3.25	0.44	3.05	0.39
54. Farmers are concerned about the humane treatment of animals.	3.45	1.19	3.75	0.79
55. Processing food products is a benefit to consumers.	2.45	0.89	3.15*	0.75
56. The U.S. should allow free trade with other countries for food products.	3	1.03	2.95	0.83
57. The world food supply has increased as a result of improved technology.	4.15	0.88	4	0.73
58. The U.S. needs a steady supply of food and fiber products to remain strong.	4	0.73	4.15	0.59
59. Only organic methods should be used to produce food.	3.2	0.89	1.95*	0.89

60. Farmers should not use chemicals in crop production.	3.75	0.85	2.5*	0.61
61. Animals have the same rights as people.	3.05	1.05	2.8	1.11
62. Processing adds more to the cost of food than the raw product.	3.35	0.75	3.05	0.94
63. Farmers have no control over food prices.	2.8	0.95	2.9	1.02
64. Developing countries lack the ability to produce enough food.	3.05	0.69	3.75*	0.79
65. The government should exert more control over farming.	2.9	0.79	2.9	0.91
66. Agriculture is the greatest polluter of our water supplies.	2.5	0.89	2.65	0.81
67. Agriculture has become too mechanized.	2.5	0.69	2.42	0.84
68. Animals should not be used for food.	1.4	0.60	1.75	1.12
69. Farm grains are becoming an important energy source in the U.S.	3.35	0.59	3.3	0.66
70. Developing countries need help in distributing food among needy people.	3.8	0.77	4	0.79

1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree
*Denotes significance at the 0.05 alpha-level.

APPENDIX K

COMPLETE PRE & POST AGRICULTURAL LITERACY SURVYEY ATTITUDES

RESULTS FOR GROUP III

Statements	Pre		Post	
	M	*SD*	*M*	*SD*
36. U.S. citizens spend a higher percent of their income on food than in other countries.	4.44	0.51	4.19	0.87
37. Agriculture employs a large number of people in this country.	2.84	1.17	2.57	1.16
38. Pesticides can be used safely when producing food.	3.74	0.93	3.90	1.09
39. Organic production methods are a realistic alternative to using pesticides.	3.47	1.17	3.45	0.83
40. Confinements is an acceptable practice when raising livestock.	3.11	1.15	3.48	1.25
41. Consumers prefer processed foods to raw products.	3.11	1.24	3.43	1.25
42. Developing countries need help to be able to store food safely.	4.16	1.01	3.95	1.07
43. People are moving away from rural areas due to changes in agriculture.	3.16	1.07	3.43	0.98
44. Farmers earn too much money.	1.42	0.69	1.29	0.46
45. Not all land is suitable for farming.	4.11	0.94	4.62*	0.50
46. Biotechnology has increased the yield of crops in developing countries.	3.11	0.94	3.57	0.81
47. Farmers take good care of their animals.	4.00	1.11	4.10	0.89
48. Processing adds value to farm products	2.95	0.97	3.38	1.02
49. Farmers should develop new and innovative marketing strategies.	3.58	0.90	3.90	0.85
50. A strong agricultural industry is more important than military power.	2.53	1.17	3.24*	1.14
51. Agricultural exports help to reduce the U.S. trade deficit.	2.89	0.81	3.20	0.77
52. Agricultural practices are harmful to the environment.	2.22	1.22	2.00	0.89
53. Raising hybrid plants results in higher yields.	3.42	1.02	3.48	0.87
54. Farmers are concerned about the humane treatment of animals.	3.89	0.96	3.76	0.89
55. Processing food products is a benefit to consumers.	3.00	1.14	3.71	0.85
56. The U.S. should allow free trade with other countries for food products.	3.22	1.35	3.00	1.26
57. The world food supply has increased as a result of improved technology.	3.83	1.04	3.57	1.16
58. The U.S. needs a steady supply of food and fiber products to remain strong.	3.94	0.80	4.25	0.91

59. Only organic methods should be used to produce food.	2.78	1.11	2.48	1.12
60. Farmers should not use chemicals in crop production.	2.39	1.09	2.52	1.29
61. Animals have the same rights as people.	2.22	1.26	2.38	1.40
62. Processing adds more to the cost of food than the raw product.	3.17	1.34	3.43	1.08
63. Farmers have no control over food prices.	3.72	1.23	3.48	1.12
64. Developing countries lack the ability to produce enough food.	3.33	0.77	3.48	0.87
65. The government should exert more control over farming.	2.71	1.05	3.14	1.35
66. Agriculture is the greatest polluter of our water supplies.	2.56	1.04	2.45	1.15
67. Agriculture has become too mechanized.	2.78	1.11	2.86	1.11
68. Animals should not be used for food.	1.56	1.20	1.43	0.75
69. Farm grains are becoming an important energy source in the U.S.	3.89	0.96	3.76	1.00
70. Developing countries need help in distributing food among needy people.	4.39	0.70	4.33	0.80

Note: 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree
Pre-test *N*=19; Post-test *N*=21

APPENDIX L

BSCS PRE-TEST

Name: Class Period:

Pre-test: In the box, place a check (✓) if you are sure about your answer. Place a tilde (~) if you guessed. Place a question mark (?) if you do not have enough knowledge to guess. Please be honest.

_A._ [~] *Example: ____ refers to the ability of soil to transmit water throughout its depth.*

a. Percolation

b. Active transport

____ [ ] 1. Plants require ___ different elements to be healthy.
- a. 2
- b. 17

____ [ ] 2. Plants and humans require ____ essential elements.
- a. similar
- b. different

____ [ ] 3. Plants obtain their essential elements from ____.
- a. air, water, and soil.
- b. air, water, and pollen.
- c. air, pollen, and soil.

____ [ ] 4. Soil ___________.
- a. serves as a nutrient bank for plants.
- b. contain both organic and inorganic material.
- c. differ in their abilities to hold and transmit water.
- d. All of the above.
- e. None of the above.

____ [ ] 5. Plants transport water from the roots through ______and food from the leaves through ______.
- a. the xylem; the phloem.
- b. the phloem; photosynthesis.
- c. diffusion; photosynthesis.

____ [ ] 6. Plants require nutrients to be present in certain amounts to be healthy. The essential components of most fertilizers are _______.
- a. Nitrogen, Zinc, Boron.
- b. Nitrogen, Iron, Manganese.
- c. Nitrogen, Phosphorus, Potassium.

NUTRIENTS FOR LIFE FOUNDATION

____ ☐ 7. _______ is a process used by cells to move molecules from an area of lower concentration to one of higher concentration.
   a. Osmosis
   b. Active transport
   c. Inertia
   d. Diffusion

____ ☐ 8. Nutrients enter root cells through the process of _______.
   a. diffusion
   b. osmosis

____ ☐ 9. Plant roots grow______.
   a. where water is already present.
   b. until they find water .

____ ☐ 10. Plants primarily use ____ to absorb water.
   a. filaments
   b. root hairs
   c. the anther

____ ☐ 11. Plants primarily extract nutrients from the ____.
   a. soil.
   b. atmosphere.

____ ☐ 12. Approximately _________ of land in the world is devoted to farming.
   a. 83 percent
   b. 11 percent

____ ☐ 13. Fertilizers help ______ food productivity.
   a. increase
   b. decrease

____ ☐ 14. Fertilizers can be ____________.
   a. Plant-Incorporated-Protectant (PIPS), biochemical, or microbial.
   b. commercial or organic.

____ ☐ 15. Excessive amounts of nutrients _______.
   a. can pollute water environments.
   b. make plants grow even faster.

APPENDIX M

BSCS POST-TEST

Name: Class Period:

Post-test: Write the correct answer on the line. In the box, place a check (✓) if you are sure about your answer. Place a tilde (~) if you guessed. Place a question mark (?) if you do not have enough knowledge to guess. Please be honest.

_A._ ☐✓ *Example: ____ refers to the ability of soil to transmit water throughout its depth.*

c. Percolation

d. Active transport

____ ☐ 1. Nutrients enter root cells through the process of _______.
  a. diffusion
  b. osmosis

____ ☐ 2. Plants require nutrients to be present in certain amounts to be healthy. The essential components of most fertilizers are _______.
  a. Nitrogen, Zinc, Barium.
  b. Nitrogen, Iron, Manganese.
  c. Nitrogen, Phosphorus, Potassium.

____ ☐ 3. Plants primarily extract nutrients from the ____.
  a. atmosphere.
  b. soil.

____ ☐ 4. Excessive amounts of nutrients _______.
  a. can pollute water environments.
  b. make plants grow even faster.

____ ☐ 5. Approximately _________ of land in the world is devoted to farming.
  a. 26 percent
  b. 64 percent
  c. 11 percent

____ ☐ 6. Plant roots grow______.
  a. until they find water .
  b. where water is already present.

____ ☐ 7. Plants primarily use ____ to absorb water.
  a. root hairs
  b. filaments
  c. the anther

NUTRIENTS FOR LIFE FOUNDATION

____ ☐ 8. Plants require ___ different elements to be healthy.
  a. 2
  b. 17

____ ☐ 9. _______ is a process used by cells to move molecules from an area of lower concentration to one of higher concentration.
  a. Osmosis
  b. Inertia
  c. Active transport
  d. Diffusion

____ ☐ 10. Plants and humans require ____ essential elements.
  a. similar
  b. different

____ ☐ 11. Fertilizers can be ____________.
  a. commercial or organic.
  b. Plant-Incorporated-Protectant (PIPS), biochemical, or microbial.

____ ☐ 12. Plants obtain their essential elements from ____.
  a. air, water, and pollen.
  b. air, pollen, and soil.
  c. air, water, and soil.

____ ☐ 13. Soil ___________.
  a. serves as a nutrient bank for plants.
  b. contain both organic and inorganic material.
  c. differ in their abilities to hold and transmit water.
  d. All of the above.
  e. None of the above.

____ ☐ 14. Plants transport water from the roots through ______and food from the leaves through ______.
  a. the phloem; photosynthesis.
  b. the xylem; the phloem.
  c. diffusion; photosynthesis.

____ ☐ 15. Fertilizers help ______ food productivity.
  a. increase
  b. decrease

NUTRIENTS FOR LIFE

APPENDIX N

TRANSCRIPT OF VERBAL RECRUITMENT

Good morning/afternoon,

My name is Timothy Bradford Jr. (T.J.), and I am a Ph.D. student at Mississippi State University. I would like to briefly introduce myself and let you all know about my project and would like to see if you all will be willing to help me out. I would greatly appreciate it.

First of all, I'm a plant nerd. I received my Bachelor's and Master's in Agronomy from Mississippi State and I have a passion for plants and soils. I also love teaching agriculture. In searching for a research project to conduct, I wanted to do something I was passionate about and what I'm passionate about it agricultural literacy.

Agricultural literacy is basically being literate about agriculture. I want everyone to know something about agriculture. This research project aims to see what you know and think about agriculture. Also, how much knowledge you gain by teaching a few agricultural lessons.

Should you choose to participate, you will receive a parental permission form for one of your parents to sign. After that is returned, you will receive a student assent document agreeing to be a participant in my project. After BOTH forms have been returned, I will give a survey and a pretest to see what you know about agriculture. Then, I will teach 6 lessons on agriculture and you will take the same test at the end. Also, we will have a focus group session to further investigate what you thought about the lessons and agriculture.

If you don't want to participate, that's fine as well. You will have to write a one page paper on a topic that goes with the lesson that day.

I appreciate your participation and hope you will help me out.

If you have any questions about this research, please contact me at tb306@msstate.edu or (601) 832-0361. For questions about your rights as a participant contact the MSU Office of Research Compliance, Mississippi State University or call (662) 325-3994.

Does anyone have any questions?