BRIDGING THE DIVIDE: UNDERSTANDING THE AGRICULTURAL LITERACY OF GEORGIA CONSUMERS

by

SARA SPINKS HAND

(Under the Direction of ASHLEY YOPP)

ABSTRACT

This study measured the level of agricultural literacy based on demographic characteristics among adults aged 18 and older in Georgia. The Judd-Murray Agricultural Literacy Instrument was used to measure knowledge of agriculture. This quantitative evaluation utilized the five National Agricultural Literacy Outcome (NALO) themes to determine overall agricultural understanding and identify if there were specific topics less understood by consumers. Of the NALO themes, Theme 5: Culture, Society, Economy, and Geography was the most understood, while Theme 2: Plants and Animals for Food, Fiber, and Energy was the least understood. The overall mean score for Georgia residents was 53.33%. Individuals with the highest agricultural literacy were those responding as male, possessing a bachelor's degree, identifying as white and those from generations including Silent, Boomer and Gen X. These results reveal Georgia citizens to collectively possess minimal understanding regarding agriculture.

INDEX WORDS: Agriculture, Agriculture Education, Agricultural Literacy, Consumers, Georgia

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SARA SPINKS HAND

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by

SARA SPINKS HAND

Major Professor: ASHLEY YOPP
Committee: NICK FUHRMAN
DON EDGAR

Electronic Version Approved:

Ron Walcott
Interim Dean of the Graduate School
The University of Georgia
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DEDICATION

This work is dedicated to my mother Stephanie McGinty Spinks and my daughter Della Mackenzie Hand. I consider this work as much a reflection of my mother as myself. Without her, I would have never followed the path to my dreams. Thank you for always encouraging me to push the boundaries of my own abilities and never settle for just good enough.

For my daughter, sweet Della Mac, you are the reason for everything I do and pursue. Your smile is the joy in my life, and I can’t wait to see what adventures you will take us on.

Here’s to strong women.

May we know them.

May we be them.

May we raise them.

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CHAPTER 1

INTRODUCTION

The agriculture industry experienced rapid technological change during the 20th century causing innovations and inventions… [which] resulted in larger yields but fewer farmers" (Roberts et al, 2016-2020, p. 14). In 1990, Pope discussed how fewer people were directly involved in production agriculture even then. Consequently, only 1% of Americans work on farms today (Lusk & McCluskey, 2018, p. 5). By 2050, the global population is expected to rise to nine billion people (Doerfert, 2011). In order to supply the amount of food to meet demand, production must continue to increase through new methods and technology. However, the growing disconnect between consumers and producers has resulted in decreased consumer knowledge of agriculture. Limited interactions with production agriculture have led modern consumers to rely on their own "assumptions and beliefs" (Knutson, 2017, para. 2) along with mass media as "the most important source of information about food quality and safety" (Verbeke, 2005, p. 357). This can be problematic due to "how the media covers agriculture is important because it can influence consumers' perceptions of how food is produced, handled, or processed" (Meyers & Abrams, 2010, p. 22).

The Center for Food Integrity described the divide between consumers and producers as "dangerous," explaining consumers "lack of trust (in the food system) can result in increased pressure for additional oversight and regulations, rejection of products or information, and consumers seeking alternate, and perhaps unreliable, information sources" (Beck, 2018, para. 5). In response, various organizations and individuals have sought to define what it means to be *agriculturally literate* (Powell et al., 2008; American Farm Bureau Foundation for Agriculture, n. d.; Frick, 1990; Frick et al., 1991; Kovar & Henry, 2013; Mesichen & Trexler, 2003; National Research Council, 1988; Spielmaker et al., 2014). The importance of the public's agricultural literacy is identified in the National Research Agenda for the American Association of Agricultural Education (AAAE). The AAAE's first research priority targets "public and policy maker understanding of agriculture and natural resources" (Roberts et al., 2016, p. 13).

Many consumers are simply unaware of and not exposed to firsthand experience with the multifaceted industry of agriculture and its essential role in modern society. The industry contributes "to the U.S. economy by ensuring a safe and reliable food supply, improving energy security and supporting job growth and economic development" (Klobuchar, 2013, p. 1). The American Farm Bureau Federation (2019) noted "in 2018, $139.6 billion worth of American agricultural products were exported around the world." Klobuchar explained exports of the industry "support nearly one million jobs across the country" (p. 1). These jobs are just a fraction of the "roughly 21 million jobs… supported by the U.S. agriculture industry" (Iowa Agriculture Literacy Foundation, n.d., para. 1). Despite the availability of careers in agriculture, the industry continues to experience a lack in a stable workforce. Purdue University and the United States Department of Agriculture estimated nearly 58,000 positions would open between 2015 and 2020, with non-agriculture graduates needed to fill 39% of these vacancies (Goecker et al., 2015).

In Georgia, agribusiness is the leading industry, contributing "over $75 billion in economic impact every year" (Georgia Department of Economic Development, n.d., para. 1). This impact extends into the state's workforce with "one in seven Georgians work[ing] in agriculture, forestry or related fields" (Georgia Farm Bureau, n.d., para. 1). The overall impact agriculture has on Georgia and the United States is often unknown or overlooked by consumers. Improving consumer knowledge of agriculture will contribute to a stronger industry workforce, understanding of necessary farming and production methods and the ability to make purchases based on evidence from factual sources. In addition to feeding a growing population, Warnick (2014-2019) explained the agriculture industry influences multiple aspects of modern life including "food, health, economy, environment, technology, and well-being of all" (Statement of Issues and Justification section, para. 1). Public support for new innovations and technology in agriculture will be essential for the industry to meet the growing needs of the global population. Stofer and Newberry (2017) noted there is "lower than desired levels of understanding among U.S. adults of … agriculture" (p. 133). Additionally, Stofer and Newberry found "perceptions of agriculture may not always be good" (p. 133). Spielmaker and Leising (2013) explained the "daily decisions made by individuals, through dollars and voting, affect our agricultural system" (p. 1). As such, citizens and policymakers, regardless of their exposure to agriculture, need an informed understanding of the industry and the vital role it plays in their daily lives.

This need for improved agricultural literacy is evident in cases such as nuisance lawsuits to hog farmers in North Carolina who were sued "over foul smells, loud noises and declining water quality" (Broome, 2019, para. 1). Broome noted juries awarded "nearly $550 million in penalties" (para. 1) to 500 plaintiffs in 29 cases. Occurrences such as this support the need for voters and policy makers who understand at least a minimum about agriculture production and its realities.

In order to create effective approaches to improve consumer knowledge of agriculture, researchers must have an effective tool for measurement. Several instruments have been created to determine agricultural literacy such as the Food and Fiber Systems Literacy Framework

(Leising et al., 1998), MOSART project (Sadler, 2011), Ordinary Science Intelligence Scale (Kahan, 2014), and Brandt's (2016) assessments based on the National Agricultural Learning Outcomes (NALOs). However, these have lacked a focus on adult agricultural literacy, or have not fully encompassed all aspects of agriculture's role in our daily lives. In 2019, the National Center for Agricultural Literacy released a new assessment that could be used for individuals on or above a high school level providing an opportunity to measure adult agricultural literacy based on specific benchmarks by the NALOs (Judd-Murray, 2019). Results from this new instrument have the potential to impact adult consumer awareness, knowledge, behavior and attitudes about agriculture. Prior to the present study, only Judd-Murray's study utilized this tool to assess agricultural literacy.

Statement of the Problem

A common theme among individuals, organizations, and businesses in the agricultural industry is the understanding of agriculture's importance to our daily lives. Equally, these groups share the weight of engaging the public to build consumer connections with agriculture. Not long ago, agriculture was a universal theme nearly which every American citizen easily connected with. However, the transition of 40% of Americans farming in 1900 to today's 1% has caused the population to lose much of its connection to the industry affecting all aspects of modern life (Lusk & McCluskey, 2018). The agriculture industry must go beyond simply educating consumers with facts and figures, it must meet consumers where they are and start with building trust.

Building trust and transparency between producers and consumers is the focus of The Center for Food Integrity. At the Nebraska Governor's Ag Conference in 2016, Chief Executive Officer of the Center for Food Integrity, Charlie Arnot explained that answering consumer concerns with research and facts "doesn't hit home with consumers," (Arens, 2016, para. 3) and provided suggestions on improving transparency and fostering trust with the public. Arnot recommended producers "use shared values to engage the public…, use digital platforms to provide avenues for transparency… [and] commit to engaging with consumers early, often, and consistently" (Arens, 2016, para. 6, 7, 8). These sentiments were echoed at the Future Food-Tech Conference in 2018 by Linda Eatherton of the global public relations firm Ketchum. Eatherton explained new technologies may provide advancements for the food industry, but these innovations "must be communicated to consumers early and often" (Food Business News, 2018, para. 2). The food and agriculture industry learned the importance of communication from the fallout of the introduction of genetically modified organisms in food which resulted in confusion, uncertainty, and an ultimately lack of trust in the food system by consumers (Arnot, 2015).

Blogging and social media have provided new ways for agriculturalists to engage with consumers in real time. The Modern Farmer website featured various farm bloggers in 2013 highlighting that many followers of these blogs were individuals residing in urban areas (Rotenberk, 2013). Arnot (2015) explained food companies, agricultural organizations and others involved in providing consumer goods from agricultural products can also contribute to building trust and transparency through "information on product labels [and] offering engagement opportunities through company websites" (para. 9).

By understanding consumer's actual knowledge of agriculture, agricultural organizations can identify where gaps are in their understanding and focus on providing additional resources to address these. Enhancing consumer's agricultural literacy is part of the process to engage the public and begin building trust with the agriculture industry. However, first the current agricultural literacy must be measured before efforts to address deficiencies can be made.

Purpose of the Study

The purpose of this study was to identify and analyze the level of agricultural literacy among Georgia residents' ages 18 or older.

Research Objectives

This study focused on the following research objectives:

1. Identify current levels of agricultural literacy of Georgia residents based on the National Agricultural Literacy Outcomes (NALOs)
2. Determine if individuals' demographics affect their level of agricultural literacy.

Significance of the Study

This study contributed to the current knowledgebase of Georgia adults' level of agricultural literacy. This information can be used to identify common misunderstandings of agricultural concepts and support expanding agriculture education efforts for adult consumers. There are a multitude of formal and informal efforts to educate youth about agriculture (4-H, FFA, Agriculture in the Classroom, etc.) but far fewer opportunities for adults to enhance their knowledge of and experience with the industry. Between 1988 and 2011, Kovar and Henry (2013) identified only 10 agricultural literacy studies which involved teachers and only six including non-educator adults. These individuals are voters and consumers of products provided by agriculture every day and need a certain level of knowledge about the industry to make informed decisions. A lack of agricultural understanding "makes a lot of people vulnerable to misinformation on matters relating to food and agriculture" (Mercier, 2018, para. 2). Spielmaker and Leising (2013) further support the need for understanding agriculture and "how this system meets our basic needs (food, clothing, shelter), and relates or interacts with a sustainable environment and our quality of life" (p. 1). Agriculture will not be able to expand its capacity to meet the needs of a growing population without new technology and novel production methods unless consumers understand and approve of these innovations.

Further, this study provided an opportunity to test the validity and reliability of the Judd-Murray Agricultural Literacy Instrument (JMALI) among a diverse population and in a different region of the United States. The JMALI has been previously validated, but Judd-Murray (2019) notes it utilized a sample of convenience resulting in an overrepresentation of individuals who are "white, suburban, and relatively middle-class" (p. 118).

Operational Definitions

Agriculture

Agriculture refers to "the science or practice of farming, including growing crops and raising animals for the production of food, fiber, fuel and other products" (United States Department of Agriculture, n.d., para. 1).

Agricultural literacy

The National Agricultural Literacy Logic Model developed in 2013 defines agricultural literacy as "having the ability to understand and communicate the source and value of agriculture as it affects our quality of life" (Spielmaker et al., 2014, p. 2).

Food and Fiber Systems Literacy

A framework for agricultural literacy which outlines five thematic areas with criterion benchmarks (Leising et al., 1998).

Judd-Murray Agricultural Literacy Instrument (JMALI)

This agricultural literacy instrument is based primarily on grade-level indicators and proficiency-scale measures of the NALOs. The JMALI can be used to determine three distinct levels of knowledge (i.e., exposure, factually literate, proficient) in post K-12 adults through summative evaluation (Judd-Murray, 2019).

National Agricultural Literacy Outcomes (NALOs)

The NALOs provide grade level (K-12) benchmarks for agricultural literacy organized by five themes: "Agriculture and the Environment; Plants and Animals for Food; Fiber & Energy; Food, Health, and Lifestyle; Science, Technology, Engineering & Math; and Culture, Society, Economy & Geography" (Spielmaker & Leising, 2013, p. 2).

Assumptions

The following assumptions helped inform this study:

1. The study was concerned with populations of adults aged 18 or older.
2. The study utilized only the first assessment of the JMALI instrument (JMALI Instrument 9-12: 1).
3. It is assumed all respondents will answer instrument questions honestly and to the best of their abilities.

Theoretical Framework/ Instrument Background

This study utilized the NALOs as a framework to examine levels of agricultural literacy among Georgia residents. The NALOs were selected for its ability to measure if agricultural knowledge among post-secondary individuals is consistent with that of 12th grade students (Warnick, 2014-2019). Additionally, the alignment of the NALOs with national educational standards for science, social studies and health supports the accuracy and relevance of the framework themes to daily life (Spielmaker & Leising, 2013). The connection with education standards and grade level (K-12) organization assists educators with incorporating these topics in current lessons they teach.

Spielmaker and Leising (2013) explain the NALOs were developed using the National Agricultural Literacy Logic Model and “a synthesis of influential research and published agricultural literacy frameworks (American Farm Bureau Foundation for Agriculture, 2012; Food, Land & People, 2012; Leising et al., 1998)” (p. 1). The logic model was developed in 2013 by “researchers, practitioners, and government officials” (Spielmaker & Leising, 2013, p. 1). The NALOs are benchmarks for agricultural literacy organized by five themes: “Agriculture and the Environment; Plants and Animals for Food, Fiber & Energy; Food, Health, and Lifestyle; Science, Technology, Engineering & Math; and Culture, Society, Economy & Geography” (Spielmaker & Leising, 2013, p. 2). Table 1 provides a detailed description of each theme.

Table 1

National Agricultural Literacy Outcome Themes and Descriptions

Theme	Description
Theme 1: Agriculture and the Environment	Examines how natural ecosystems and agriculture work together “to fulfill societal needs” (Spielmaker & Leising, 2013, p. 3).
Theme 2: Plants and Animals for Food, Fiber & Energy	Focuses on “sustainable delivering of high quality food, fiber, and energy while at the same time maintaining a quality environment” (Spielmaker & Leising, 2013, p. 6).
Theme 3: Food, Health & Lifestyle	“Explores the relationship between food production, storage, preparation, consumption, and health” (Spielmaker & Leising, 2013, p. 8).
Theme 4: Science, Technology, Engineering & Mathematics	Incorporates topics of agriculture into teaching these concepts (Spielmaker & Leising, 2013).
Theme 5: Culture, Society, Economy, & Geography	Explains the role of agriculture in the development of societies across the globe over time (Spielmaker & Leising, 2013).

CHAPTER 2

REVIEW OF LITERATURE

Defining Agricultural Literacy

The National Research Council (1988) first defined agricultural literacy as an understanding of “the food and fiber system…, includ[ing] its history and its current economic, social and environmental significance to all Americans” (p. 8). Frick et al. (1991) redefined the term “person 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” (p. 52). Eleven subject areas were identified by Frick et al. to attain agricultural literacy, including: “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” (p. 54).

Meischen and Trexler (2003) stated, “agricultural literacy entails knowledge and understanding of agriculturally related scientific and technologically-based concepts and processes required for personal decision making, participation in civic and cultural affairs, and economic productivity” (p. 44). Their definition incorporated both agricultural content and conversational literacy as components of its meaning. Powell et al. (2008) included aspects of Meischen and Trexler’s definition in the creation of their paradigm shift to promote a shared vision of agricultural literacy. The framework by Powell et al. proposed "agricultural literacy revolves around the ability to think critically and make value judgments about the impact of agriculture as an economic and environmental activity and the concurrent societal and political pressures that result from those judgments" (p. 86). Powell et al. further described an agriculturally literate person as one who should be able to analyze and evaluate "trade-offs" (p. 86) to individuals and to society resulting from agricultural enterprises." Kovar and Henry (2013) conducted a synthesis of literature relating to agricultural literacy. They described agricultural literacy as the ability "to see beyond emotional pleas and make informed decisions" on agricultural issues (Kovar & Henry, 2013, p.168).

In 2013, a meeting was convened to develop the National Agricultural Literacy Logic Model along with a supporting definition of agricultural literacy. The group included a variety of organizations and perspectives and deemed an agriculturally literate person to be one who "understands and can communicate the source and value of agriculture as it affects our quality of life" (Spielmaker & Leising, 2013, p. 1). This definition was adopted by the National Agriculture in the Classroom program.

Other agricultural industry organizations have formed their own definitions of agricultural literacy. The American Farm Bureau Foundation for Agriculture (n.d.) defines an agriculturally literate person as one who "understands the relationship between agriculture and the environment, food, fiber and energy, animals, lifestyle, the economy and technology" (para. 1). The American Farm Bureau Foundation for Agriculture (2013) not only provided a definition for agricultural literacy, the organization also developed The Pillars of Agricultural Literacy as a tool to educate children and adults about the agriculture industry. The Pillars represent knowledge expectations by age/grade level from early childhood through adulthood regarding various agricultural topics. The topics consist of "Foundational Knowledge, The Relationship Between Agriculture and the Environment, The Relationship Between Agriculture and Food, Fiber and Energy, The Relationship Between Agriculture and Animals, The Relationship Between Agriculture and Lifestyle, The Connection Between Agriculture and Technology, and The Relationship Between Agriculture and the Economy" (American Farm Bureau Foundation for Agriculture, 2013, p. 1).

Despite the various interpretations of what it means to be agriculturally literate, the importance of understanding how agriculture affects every individual cannot be understated. A shared vision of agricultural literacy is critical to developing a framework which can direct education efforts for all populations. In an earlier work some three decades ago, Pope (1990) noted fewer people are directly involved in production agriculture. More recently, Doerfert (2011) explained "the non-agriculture population has little to no understanding of the complexities involved with sustaining a viable agriculture system" (p. 8). As the global population continues to grow, individuals must gain an understanding of agriculture in order to ensure its continued ability to meet the growing food, fiber and shelter demands of the world. These facts, combined with increasing complexity of agricultural issues, depict the need for an agriculturally literate society to ensure individuals can make educated decisions regarding agriculture.

Assessing Agricultural Literacy

Early assessments of agricultural literacy were introduced by Birkenholz et al. (1994), Leising and Zilbert (1994), Frick et al. (1995), Nunnery (1996), and Boatner (2004). Additional instruments have been created for specific studies and their respective needs (Hess & Trexler, 2011; Lewis, 2018; Mabie, 1996; Mesichen & Trexler, 2003; Terry et al., 1992; Trexler, 2000).

The formative Food and Fiber Systems Literacy (FFSL) Framework was introduced in 1998 by Leising et al. The FFSL has been used by various researchers as a framework and assessment mechanism for agricultural literacy (Colbath & Morrish, 2010; Crawford, 1998; Hubert et al., 2000; Jones, 2013; Pense et al., 2005; Powell & Agnew, 2011).While the FFSL has been utilized as a framework for agricultural literacy, Judd-Murray (2019) recognized the need "for a uniform instrument that had consistent standards, could unify results, allow educators to work toward larger program goals, and be used across both formal and non-formal platforms of education" (p. 120).

In addition to the FFSL, the National Center for Agricultural Literacy (2019) lists five other agriculture literacy evaluations including the Ordinary Science Intelligence Scale, MOSART project, K-5 LMALI and 9-12 JMALI. The Ordinary Science Intelligence Scale and the MOSART project, also known as Misconceptions-Oriented Standards-based Assessment Resources for Teachers, focus on assessing science knowledge through their respective instruments. Brandt (2016) developed initial assessments utilizing the NALOs as the basis of her assessment "in the areas of agriculture and the environment (AgE) and the STEM dimensions of agriculture (STEM) for third through fifth grade students" (p. 3). In 2019, the LMALI instrument was validated by Longhurst et al. (2019) as a K-5 grade agricultural literacy assessment using the NALO benchmarks for criterion reference, Delphi methods for validation, and PISA-type proficiency scoring. This study showed the NALOs were an effective framework to design valid agricultural literacy instruments. Following the K-5 instrument, Judd-Murray (2019) validated the JMALI to measure agricultural literacy in post-12th grade adults with the intention to provide a single instrument to assess agricultural understanding. Utilizing one instrument will allow for longitudinal studies and comparison studies across populations. At present, findings are based on multiple frameworks and instruments, making cross-study evaluations difficult. Judd-Murray measured agricultural literacy based on JMALI-based participant proficiency levels, resulting in 16.90% at the exposure level, 67.40% at the factual literacy level, and 15.73% at the proficient level. Individuals at the exposure level correctly answered ≤7 question, those on the factual literacy level correctly answered ≥ 8 questions, and proficient level respondents correctly answered ≥ 12 questions (Judd-Murray, 2019).

Most of the agricultural literacy research has focused on students and/or educators in K-12. Only six studies were identified measuring the agricultural knowledge of adults not within an education setting (Bell, 1995; Frick, 1995; Howell, 1995; Richard, 1995; Wearley et al., 1999; & Lewis, 2018). Bell (1995) measured agricultural literacy among civic organizations of Lubbock, Texas with a survey including

> An instrument used in a study of agricultural awareness by Birkenholz (1993), in a Missouri study; a test which determined knowledge of agriculture written by Terry (1992); and a fact sheet on the importance of agriculture developed by High Plains Underground Water District No. 1 (1994). (p. 12)

The mean score for general knowledge of agriculture from the Bell (1995) study was 4.1, out of a possible 15, or 27.33%. However, the agricultural awareness section of Bell's research had a 28.7 mean score out of 34 possible, or 84.4%. Because Bell used three different instruments for this assessment, response differences should be expected.

Frick et al. (1995) found rural adults' mean score for agricultural knowledge was 24.25 and 24.68 for urban adults, respectively, based on a scale ranging from 0 to 35, resulting in an average score for the groups of 24.47 or 69.9%. The instrument was based on the Frick (1990) study and included seven concept areas "(a) Societal and Global Significance of Agriculture, (b)

Public Policy in Agriculture, (c) Agriculture's Relationship with the Environment and Natural Resources, (d) Plant Science, (e) Animal Science, (f) Processing of Agricultural Products, and (g) Marketing and Distribution of Agricultural Products" (p. 45).

In 1995, Howell examined agricultural knowledge among Oklahoma radio station news reporters due to their role in distributing information to wider public audiences. The Howell instrument included aspects of "Cox's (1994) Ag in the Classroom "What do you know" questionnaire.… [and] agricultural literacy elements identified by Frick (1992)" (pp. 26-27). Howell determined, out of 30 questions, the mean score for reporters was 19.06 or 63.53%.

Richard (2009) determined "the overall mean agriculture knowledge scores of adult residents of Louisiana was 13.60" (p. 64) out of 20 questions, resulting in an average of 68%. The Richard study was similar to that of Frick et al. (1995), however it included fewer items and measured five subject areas within agriculture. Included in Richard's subscales of agriculture were "environmental science, policy, plant science, animal science, and processing" (p. 65). The highest agricultural understanding was found in the environmental science subscale "(M = 3.07, SD = .959) and the lowest reported level of knowledge in the subscale of processing (M = 2.51, SD = .828)" (p. 68).

Wearley et al. (1999) "assessed the level of agricultural knowledge and perceptions of elected officials who served in Montana's 54th legislative session in 1995 as members of the House of Representatives and of the Senate" (p. 31). The study used an instrument based on Frick's (1991) work, however it reduced the 11 concept areas to seven including Significance, Policy, Natural Resources, Plants, Animals, Processing, and Marketing. The mean score for knowledge of agriculture was 30.63 out of 35 (87.51%), with the highest mean score for a concept was Marketing with 4.81, and the lowest concept score was 3.90 for the Plant section (Wearley et al., 1999).

In 2018, Lewis created an assessment based on the American Farm Bureau Foundation for Agriculture's Pillars of Agricultural Literacy to measure agricultural understanding among a national sample of U.S. participants. Additionally, Lewis compared the effects of certain demographics on agricultural literacy. The overall mean of the sample was 3.54 out of 5, or 70.8%. Lewis found scores highest "in the *Relationship between Agriculture and the Economy*…. [and lowest] "in the construct/pillar, *the Relationship between Agriculture and Animals*" (p. 34). The history of measuring agricultural literacy has included multiple instruments designed for single studies, however, there also seems to be a trend of building on former frameworks and instruments to create relevant assessments for the present.

Demographic Effects on Agricultural Literacy Level

Gender

Bell's 1995 study on civic organizations in Lubbock, Texas revealed no significant relationship between gender and general agriculture knowledge. Males in the Bell study did score slightly higher regarding agricultural knowledge of the High Plains and South Plains of Texas, but there was no significant difference between males and females on their overall scores. Additionally, males accounted for 77.6% of the total respondents, while females only represented 22.4% causing a distortion in gender representation. Boatner (2004) developed an instrument in conjunction with Ag in the Classroom staff to survey "fourth grade students in Oregon's Willamette Valley schools" (p. 4). The mean score for male respondents was 53% and females was 51%, suggesting that males have slightly higher agricultural knowledge. However, this study did have limitations regarding effects of gender on agricultural literacy. Boatner noted that multiple children skipped the question on gender and the small sample size limits "any definite conclusions" (p. 14). Another study by Luthman et al. (2007) compared fourth grade students' knowledge gains after participating in a farm day. A significant relationship between gender and increased knowledge of the students was not found by Luthman et al.

Colbath and Morrish (2010) used the Food and Fiber Systems Literacy (FFSL) framework as their conceptual framework to examine agricultural literacy among college freshman. Utilizing the FFSL Assessment developed by Leising et al. (2003), Colbath and Morrish compared the mean agricultural literacy scores based on gender and found males were more knowledgeable of agriculture than females. The FFSL Assessment was later used by Jones (2013) to also measure agricultural literacy among college freshman and identified a statistically significant difference between mean scores of male and female students' agricultural literacy test scores. Jones' findings also concluded that males possessed more knowledge about agriculture than females. In 2018, Lewis found a significant difference between males' and females' knowledge of agricultural literacy. Lewis determined males to be "more agriculturally literate in every construct" (p. 36) within the assessment used. Understanding if a disparity exists between males and female's agricultural knowledge could lead to finding if underlying issues are affecting if discrepancies exist in how the genders are connected to or experience agriculture.

Generation

Age is identified by Dimock (2015) as "one of the most common predictors of differences in attitudes and behaviors" (para. 2). Dimock discussed, "the nature of age as a variable allows researchers to employ an approach known as cohort analysis to track a group of people [born at a similar time] over the course of their lives" (para. 2). Utilizing age cohorts enables researchers to understand how a generation's worldview is shaped by shared experiences throughout their lifetime. Dimock explained “a generation typically refers to groups of people born over a 15-20 year span” (para. 4) and can be used to group individuals into age-based cohorts. To date, few studies have made comparisons between age of respondents and knowledge of agriculture, much less a study of generational differences. Only one study (Lewis, 2018) was identified which specifically measured the effect of generation on agricultural literacy. Lewis (2018) found “Baby Boomers were more agriculturally literacy than Generations X and Millennials” (p. iv). However, Lewis (2018) determined Millennials to be more agriculturally literate on the Relationship between Agriculture and Technology. Bell (1995) used age to determine older participants scored lower overall on general agricultural knowledge than younger participants. Although Bell’s approach used age specifically, it still provided findings relevant to the present study.

By analyzing the mean score on the JMALI by generation, the researcher can identify if differences exist between generations and their respective levels of agricultural literacy. This information would be useful in making recommendations for how educational programs could be targeted to address specific agricultural literacy deficiencies among age demographics.

Education

Analyses of agricultural literacy based on education level are slim at best. Only one study was found comparing education level with agricultural literacy. Bell (1995) found no significant difference between education of respondents and agricultural knowledge, however this study only included response options of “high school equivalency, some college, [and] bachelor’s or higher” (p. 21) which limits accuracy of respondent choices. Determining agricultural literacy for specific education levels would show whether more education results in greater agricultural understanding.

Ethnicity/ Race

Birkenholz et a. (1994) determined Caucasian college students possessed higher knowledge of agriculture than other ethnicities including Asian, Black, Hispanic, and Other. Bell (1995) did not find a significant difference between ethnicity of respondents and agricultural knowledge. Frick and Wilson (1996) studied Native American high school students' overall knowledge of agriculture and determined it to be moderately high. A study by Whitehead and Estepp in 2016 compared the agricultural literacy of Hispanic and non-Hispanic students in Texas counties. The research by Whitehead and Estepp revealed Hispanic students possessed less agricultural knowledge than their Non-Hispanic counterparts, however Hispanic students did score slightly higher than Non-Hispanic students on the Agricultural Career Knowledge construct. A discernable difference was not found between races of American Indian/Alaskan Native, Asian, Black/African American, Native Hawaiian/or Pacific Islander, or White/Caucasian/other regrading agricultural literacy in Lewis' (2018) study. Results from Lewis did find the Non-Hispanic/Latino population scored higher on the construct of Relationship between Agriculture and Animals than the Hispanic/Latino population. Understanding if and how ethnicity affects one's agricultural knowledge could result in recommendations addressing agricultural literacy across different cultures and customs.

Summary and Rationale

The term agricultural literacy has had several iterations since its inception in 1988. These variations have in turn resulted in multiple evaluation methods and instruments utilized to measure agricultural understanding across populations. Historically, adult populations and agricultural literacy by demographic characteristics have been overlooked. The present study seeks to fill this knowledge gap by utilizing an instrument which has the potential to address previous methodological issues within agricultural literacy assessment.

CHAPTER 3

RESEARCH METHODS

This quantitative study utilized a descriptive cross-sectional approach to assess the overall knowledge of agriculture among Georgia residents. Objectives for this study included: 1) identify current levels of agricultural literacy of Georgia residents based on the NALOs and determine if individuals' demographics effect their level of agricultural literacy.

All research was reviewed and approved September 4, 2019 by the University of Georgia Institutional Review Board (IRB) for research involving human subjects. IRB approval documentation (ID: PROJECT00000983) is included in Appendix A.

Participants

Participants were selected using an online market research panel formed by Qualtrics. The panel was recruited by Qualtrics on behalf of the researcher. These individuals are "chosen from a pre-arranged pool of respondents who have agreed to be contacted by a market research service in order to respond to surveys" (Qualtrics, 2020, What are market research panels section). Qualtrics notes "as the respondents have already agreed to be part of a panel, online samples tend to achieve higher response rates than other methods" (What are market research panels section). Further, benefits of online samples noted by Qualtrics include quicker response turn around, and a simpler and more cost-effective option for gathering responses.

However, the American Association for Public Opinion Research Standards Committee Task Force (2010) estimated that up to "one-third of the U.S. adult population does not use the Internet on a regular basis…. Thus, all nonprobability online panels have inherent and significant coverage error" (p. 713). While individuals may not use the internet regularly, Boyle et al. (2017) noted that access has increased from 18% in 1997 to 78.5% in 2013 which has led to "widespread adoption of Internet surveys in market and public opinion research" (p. 1).

The American Association for Public Opinion Research Standards Committee Task Force (2010) does account for instances "when a nonprobability online panel is an appropriate choice" (p. 714) and discusses growing pressure to adopt such methods due to "increasing nonresponse in traditional methods, rising costs and shrinking budgets, dramatic increases in Internet penetration, the opportunities in questionnaire design on the Web, and the lower cost and shorter cycle times of online surveys" (p. 716). Despite these issues, the researcher accepted the abovementioned limitations as part of this methodological approach due to its benefits including the ease of implementation and response collection, low cost and time constraints for completing this study.

Qualtrics (2020) allows a researcher to "choose any target audience" (para. 1), and for this research, it enabled the identification of specific respondent criteria and a selected number of responses. All respondents were required to be over 18 years old and reside in Georgia. Respondent recruitment was further defined based on an individual's fit within quotas for demographic characteristics including gender, ethnicity and age. Quotas determined which demographic were needed to create a response sample representative of Georgia's population. A disparity exists between Census data used by the researcher and that used by Qualtrics to determine the percentages for each demographic characteristic. This is further discussed in Table 2.

The confidence level for the population measured is 95% with a 5% margin of error. Assuming access to a demographically representative sample, the planned sample size amount was 385 and is based on the population of Georgia which is 10.51 million (United States Census Bureau, 2019). A total of 716 responses were collected. Of those, 422 respondents completed every question on the instrument and were included in the data analysis.

Table 2 details the percentages of respondents for the present research compared with the United States Census Bureau (2019) percentage estimates for gender and ethnicity among Georgia residents. The gender of respondents compared with gender percentages of Georgia residents differs by less than 1%. Table 2 shows the final respondents within the panel were not fully representative of Georgia's population based on ethnicity. There was a -1.61-mean difference between Census estimates for Georgia ethnicities and panel respondent's ethnicity. Overrepresented ethnicities include white, Native Hawaiian and Other Pacific Islander, and multiracial. Ethnicities which were underrepresented in the respondent sample included Black/African American, American Indian or Alaskan Native, Asian, and Hispanic/Latino/ or Spanish origin. The ethnicity of Other was included as a response option on the instrument but is not an option for the Census. The present research included Other as an ethnicity because it was an option on the first study using the JMALI.

Table 2

Gender and Ethnicity of Panel Respondents vs. Georgia Population

Characteristic	Census %	Panel %	% Difference
Gender			
Male	48.60	49.30	0.70
Female	51.40	50.70	-0.70
Ethnicity			
White	60.50	69.40	8.90
Black/ African American	32.40	11.80	-20.60
American Indian or	0.50	0.90	0.40

Characteristic	Census %	Panel %	% Difference
Alaskan Native			
Native Hawaiian or Other Pacific Islander	0.10	0	-0.10
Asian	4.30	3.10	-1.20
Hispanic, Latino, or Spanish origin	9.80	8.30	-1.50
Multiracial	2.20	5.00	2.80
Other	n/a	1.40	n/a

Table 3 lists the age ranges of panel participants compared with estimates for Georgia's populations provided by the United States Census Bureau (American Community Survey, 2018). The age range 15 to 19 was underrepresented in the research panel, however that can be partly attributed to the inclusion of only individuals ages 18 and 19 for purposes of this study. Age groups 50 to 54, 75 to 79, 80 to 84 and 85 and older were also underrepresented by the research panel compared with Census estimates for these ages. Overrepresentation occurred in age groups 20 to 24, 25 to 29, 30 to 34, 35 to 39, 40 to 44, 45 to 49, 55 to 59, 60 to 65, 66 to 69, and 70 to 74. The mean difference between the Census population estimates and the panel respondents for age was 1.31 overall.

Table 3

Age Range Percentages of Panel Respondents vs. Georgia Population

Age	Census %	Panel %	% Difference
15-19	7.20	2.80	-4.40
20-24	6.80	11.00	4.20
25-29	7.10	7.30	0.20
30-34	6.60	9.30	2.70
35-39	6.80	13.40	6.60
40-44	6.50	6.90	0.40
45-49	6.80	9.20	2.40
50-54	6.50	6.20	-0.30
55-59	6.30	8.60	2.30

Age	Census %	Panel %	% Difference
60-65	5.80	8.30	2.50
66-69	4.70	9.20	4.50
70-74	3.80	5.00	1.20
75-79	2.50	1.20	-1.30
80-84	1.50	1.30	-0.20
85+	1.40	.20	-1.20

Instrumentation

This study utilized a three-part instrument to gather responses (Appendix B). Part I included qualifying questions to ensure quality responses and respondents residing in Georgia. Questions within Part II analyzed respondent demographics such as year born, gender, etc., followed by respondents' connection to and experience with agriculture. Part III was comprised of the JMALI Instrument 9-12: 1 to measure levels of agricultural literacy among Georgia residents. The instrument also required respondents to answer each question to ensure only complete submissions were recorded.

The JMALI was developed by Judd-Murray in 2019 and operationalized the NALOs as an instrument to measure agricultural literacy among adults. This instrument was selected because it "provide[s] agricultural literacy stakeholders with a standardized tool of assessment" (Judd-Murray, 2019, p. 58). Judd-Murray described two problems regarding past agricultural literacy assessments. The first was "a lack of consistency regarding what criterion and constructs determined literacy levels" and second, previous assessments have become "outdated" (Judd-Murray, 2019, p. 40). Overall, the Judd-Murray instrument provides "a level of standardization and updated techniques not seen in previous research (Brandt, 2016; Jones, 2013)" (p. 110).

The JMALI was validated over three phases. In phase one, the instrument was developed by "two expert committee panels and used a Delphi method… to construct and refine the instrument questions" (Judd-Murray, 2019, p. 43). The initial instrument included 45 questions from phase one. In phase two, the survey was distributed via Qualtrics to 600 college students enrolled at Utah State University, Logan, Utah (Judd-Murray, 2019). Phase three involved analysis of the instrument for validity utilizing "Exploratory factor analysis (EFA), confirmatory factor analysis (CFA), item analysis, discriminant analysis (DA), and estimates of reliability (internal consistency) among the test items" (Judd-Murray, 2019, p. 50). Based on the results of these analyses, items were revised or removed from the final instrument resulting in 30 validated questions. The final assessment comprised of two instruments with 15 questions each. The first instrument from the final JMALI was selected for this research since there was not a need for a pre and post measurement of knowledge (due to a lack of treatment testing).

The instrument used constructs to group questions for each of the five NALOs themes. These constructs included three questions each, with each question representing a different knowledge level of either: exposure, factually literate, or proficient. Judd-Murray (2019) explained individuals answering exposure level questions

> would have the most limited understanding of the agricultural literacy standard… [those] who can answer questions at the factual literacy level would display understanding related to content knowledge or the challenge skills Joplin (1981) identified… and [those] who can answer questions at the applicable proficiency level would display agricultural literacy as a level where they could communicate understanding and the value of the standard. (p. 35)

Questions 14 through 28 in the instrument measured level of knowledge based on the five themes within the NALOs. Questions 14, 15 and 16 comprised Theme 1: Agriculture and the Environment. Theme 2: Plants and Animals for Food, Fiber, and Energy consisted of Questions

17, 18, and 19. Theme 3: Food, Healthy, & Lifestyle included Questions 20, 21, and 22. Questions 23, 24, and 25 measured Theme 4: Science, Technology, Engineering and Mathematics. Theme 5: Culture, Society, Economy, and Geography is measured by questions 26, 27, and 28.

Data Analysis

Data were analyzed using SPSS version 24. The instrument utilized was non-experimental and used descriptive, bivariate, and multivariate analysis to describe the quantitative data gathered in the study. The initial data set included 429 completed submissions. Four respondents were deleted for incomplete birth year entered. A blank response and two rows of descriptive headings were also deleted to result in 422 complete respondents. Respondents selecting more than one ethnicity were recoded as 10, and all other single responses for ethnicity remained coded as their original value. Year born was used to calculate age and then transformed into generation. Questions 14 through 28 comprised the JMALI part of the questionnaire. The responses to these questions were recoded as either 0 for incorrect answers or 1 for correct answers. The correct and incorrect answers for each question from the JMALI were combined and analyzed to determine overall agricultural literacy scores. Proficiency level was then determined using the agricultural literacy scores. Proficiency levels include exposure (correctly answering ≤ 7), factually literate (correctly answering ≥ 8), and proficient (correctly answering ≥ 12) (Judd-Murray, 2019).

The results were analyzed using quantitative research methods. Using descriptive statistics, the researcher calculated frequencies and measures of central tendencies such as means and standard deviations. Further analysis utilized independent samples *t*-tests and one-way ANOVAs to compare the mean(s) of variables of interest. The reliability of the instrument was conducted using Cronbach's alpha. Cronbach's alpha was analyzed in the present study for each theme and results are as follows: Theme 1 was .237, Theme 2 was .241, Theme 3 was -.218, Theme 4 was .287, and Theme 5 was .537. Combining all themes, resulted in a Cronbach's alpha of .686 in the current study. The item analysis revealed removing question 21 would increase reliability of the instrument to .710. However, Judd-Murray (2019) explains "Cronbach's Alpha is not as reliable for measuring internal consistency, as the instrument scores are recorded as either 0 (not correct) or 1 (correct). This limits the effectiveness of reviewing an alpha value between 0 and 1" (p. 52). Other analyses were relied on to measure the instrument's validity including exploratory factor and item analyses, along with confirmatory factor and discriminant analyses in the previous year's study (Judd-Murray, 2019).

Limitations of the Study

The study's external validity may be limited due to overrepresentation and/or underrepresentation of respondent's demographics in the sample, rendering it not fully representative of Georgia's population. Additional limits to external validity may result from the sample being collected via a purchased Qualtrics panel. Individuals registered as a Qualtrics responder may be different than those who are not registered or do not use similar software to gain personal rewards.

The selected research design does pose threats to internal validity as it only included a single observation at one point in time. Thus, these results may not be generalizable to other locations or settings. However, the purpose of this study was to determine current levels of agricultural literacy as a basis for future studies on the influence of demographics on agricultural literacy.

CHAPTER 4

RESULTS

Two objectives were identified in this study: 1) identify current levels of agricultural literacy of Georgia residents based on the NALOs; and 2) determine if individuals' demographics affect their level of agricultural literacy. These objectives were addressed through Part I and II of the instrument containing constructs analyzing participant demographics and knowledge of agriculture.

Participant Demographics

Age & Generation

Respondent ages were calculated based on their year of birth. Respondent ages ranged from 18 to 90, with the mean age being 45.37. The generation of each participant was then determined utilizing the Pew Research Center's age bounds (Dimock, 2019, see Appendix C). Table 4 lists respondent generations represented including Gen Z (7-22; only ages 18-22 were included in the study), Millennial (23-38), Gen X (39-54), Boomer (55-73) and Silent (74-91). Millennials and Boomers were the largest groups of generational respondents.

Gender

The respondents were 49.30% male and 50.70% female (Table 4).

Ethnicity

Table 4 denotes respondent ethnicity. Respondents identified as 69.40% White, 11.80% Black/African American, .90% American Indian or Alaskan Native, 3.10% Asian, 8.30%

Hispanic, Latino, or Spanish origin, and 1.40% Other. Participants who selected more than one ethnicity were coded as Multiracial (5.00% of participants).

Education

Participants' education level is described in Table 4. Those with less than a high school diploma accounted for 4.70% of respondents. Participants achieving a high school diploma or equivalent totaled 25.10% and 19.20% completed some college. A total of 50.90% of respondents attained at least one tertiary degree beyond a high school diploma (including trade/technical/vocational training).

Table 4

Demographic Characteristics of Respondents (N = 422)

Characteristic	*n*	%
Gender		
Male	208	49.30
Female	214	50.70
Generation		
Gen Z (18-22)	41	9.70
Millennial (23-38)	131	31.00
Gen X (39-54)	107	25.40
Boomers (55-73)	129	30.60
Silent (74-91)	14	3.30
Ethnicity		
White	293	69.40
Black/ African American	50	11.80
American Indian or Alaskan Native	4	.90
Asian	13	3.10
Hispanic, Latino, or Spanish origin	35	8.30

Characteristic	*n*	%
Multiracial	21	5.00
Other	6	1.40
Highest educational level		
<High School Diploma	20	4.70
High School Diploma or GED	106	25.10
Some college, no degree	81	19.20
Trade/ technical/ vocational training	28	6.60
Associate's	46	10.90
Bachelor's	101	23.90
Master's	29	6.90
Doctorate	5	1.20
Professional	6	1.40

Objective 1: Identify the Current Levels of Agricultural Literacy of Georgia Residents based on the National Agricultural Literacy Outcomes (NALOs)

Utilizing the JMALI 9-12: 1 instrument, the researcher measured agricultural literacy by each NALO theme and overall. Each theme contained three content related questions with differing levels of difficulty. The researcher first analyzed the frequency between correct and incorrectly answered questions for each theme's construct (Table 5). Table 5 shows how many respondents correctly answered all three questions within each construct, as well as the number of respondents answering two correctly, one correctly, or none. Of respondents, 54.88% answered two or more questions correctly for each theme's construct. Theme 5 had the highest number of respondents (35.50%) answering all three questions correctly. Theme 2 had only 1.70% answer all three construct questions correctly.

Table 5

Correctly Answered Questions for Theme 1-5 Constructs

Theme	0		1		2		3	
	n	%	*n*	%	*n*	%	*n*	%
Theme 1: Agriculture and the Environment	6	1.40	135	32.00	174	41.20	107	25.40
Theme 2: Plants and Animals for Food, Fiber, and Energy	154	36.50	198	46.90	63	14.90	7	1.70
Theme 3: Food, Healthy, & Lifestyle	20	4.70	146	34.60	238	56.40	18	4.30
Theme 4: Science, Technology, Engineering and Mathematics	22	5.20	135	32.00	210	49.80	55	13.00
Theme 5: Culture, Society, Economy, and Geography	29	6.90	107	25.40	136	32.20	150	35.50
Total	46.2	10.94	144.2	34.18	164.2	38.9	67.4	15.98

Table 6 uses constructs to compare the means and standard deviations among the NALO theme constructs. The most understood was Theme 5: Culture, Society, Economy, and Geography (M = 1.97, SD = .94), followed by Theme 1: Agriculture and the Environment (M = 1.90, SD = .80), Theme 4: Science, Technology, Engineering, and Mathematics (M = 1.71, SD = .76), and Theme 3: Food, Health & Lifestyle (M = 1.60, SD = .65). Theme 2: Plants and Animals for Food, Fiber, and Energy (M = .82, SD = .74) was the least understood NALO.

Table 6

Means and Standard Deviations of Respondents' Scores for NALO Themes 1-5

Theme	*M*	*SD*
Theme 1: Agriculture and the Environment	1.90	.80
Theme 2: Plants and Animals for Food, Fiber, and Energy	.82	.74
Theme 3: Food, Healthy, & Lifestyle	1.60	.65
Theme 4: Science, Technology, Engineering and Mathematics	1.71	.76
Theme 5: Culture, Society, Economy, and Geography	1.97	.94

Table 7 analyzes the questions with the lowest mean scores and identifies Theme 2 as having two of the most incorrectly answered questions, Question 17 (M = .18, SD = .39) and Question 19 (M = .07, SD = .26). Question 19 also had the lowest overall mean score of all the questions. The remaining themes were each represented in a single question with the overall lowest mean scores. Four of the six questions most missed were on the proficient level. Theme 2 had the most missed question (#19), with only 30 respondents answering it correctly resulting in a mean score of .07.

Table 7

Indicators of Knowledge Deficits by Theme

Theme	Question	Question Level	*M*	*SD*
Theme 1: Agriculture and the Environment	Q16: Select all the potential outcomes of practicing sustainable agriculture.	Proficient	.38	.49
Theme 2: Plants and Animals for Food, Fiber, and Energy	Q17: Select all the examples of organic nutrients.	Exposure	.18	.39
Theme 2: Plants and Animals for Food, Fiber, and Energy	Q19: Select all the following practices that provide the best balance for agricultural production, while maintaining balance with natural resources.	Proficient	.07	.26
Theme 3: Food, Healthy, & Lifestyle	Q21: Select all the ways that consumers can prevent food-borne illness.	Factually Literate	.12	.32
Theme 4: Science, Technology, Engineering and Mathematics	Q25: Select all the technological advancements in agriculture that contribute to the ability to feed a growing population with a smaller number of producers.	Proficient	.16	.37
Theme 5: Culture, Society, Economy, and Geography	Q28: A farmer has 50 acres of land to grow a crop; which factors would need to be considered before making a choice about what to plant? Select all of the correct choices.	Proficient	.42	.50

To determine the overall understanding of agriculture knowledge in Georgia, the researcher combined the means of the five NALO theme constructs into the JMALI Instrument 9-12: 1 construct. The overall mean score for respondents was 7.99/15 (*SD* = 2.636), or 53.33%. Based on the JMALI mean score, respondents were categorized into three proficiency levels (Table 8): exposure, factually literate, or proficient. Of the respondents, 40% were considered to have an exposure level, meaning they scored ≤ 7. The factually literate level includes those scoring ≥ 8 which totaled 52.4% of participants. Only 7.60% of respondents were considered at the proficient level, answering 12 or more questions correctly. Comparatively, Judd-Murray's 2019 study found 16.90% at the exposure level, 67.40% at the factual literacy level, and 15.73% at the proficient level.

Table 8

Respondents' Agricultural Literacy Proficiency Level

Proficiency Level	*n*	%
Exposure	169	40.0
Factually Literate	221	52.40
Proficient	32	7.60
Total	422	100.0

Objective 2: Determine if Individuals' Demographics affect their Level of Agricultural Literacy

The researcher used independent samples *t*-tests and one-way ANOVAs to compare the means of participant scores from Part III of the instrument (JMALI score) for each demographic group. Utilizing the JMALI score of respondents, the agricultural literacy proficiency level of participants was calculated and then compared with means for each demographic group utilizing *t*-tests and ANOVA. Individuals whose score was ≥ 12 were proficient, those with a score of ≥ 8 were factually literate, and those with a score of ≤ 7 were considered at an exposure level (Judd-Murray, 2019).

Total scores of the JMALI instrument (Table 9) showed higher mean scores overall among male respondents ($M = 8.27$, $SD = .2.75$) than females ($M = 7.72$, $SD = 2.50$); $t(420) =$

2.17, p = .03. Evidence exists to suggest there is a statistically significant difference between the agricultural literacy proficiency level of males and females on the JMALI instrument. Cohen's effect size value (*d* = 0.21) suggests a small practical significant difference between the agricultural literacy of males (*M* = 8.27, *SD* = .2.75) and females (*M* = 7.72, *SD* = 2.50).

Table 9

JMALI Score Differences Between Males and Females

Gender	*n*	*M*	*SD*	*df*	*t*	*p*	η^2
Male	208	8.27	2.75				
				420	2.17	.03	0.21
Female	214	7.72	2.50				

A one-way ANOVA was used to compare agricultural literacy proficiency level based on generations Gen Z, Millennial, Gen X, Boomer, and Silent (Table 10). There was a statistically significant difference of generation on agricultural literacy proficiency level ($p<.05$) for the five conditions [$F(4, 417) = 6.67$, $p = .000$]. Post hoc comparisons using the Games-Howell test indicated the mean score for Gen Z (*M* = 1.32, *SD* = .52) was statistically significantly different than Gen X (*M* = 1.78, *SD* = .59), and the Boomer (*M* = 1.79, *SD* = .61) generations (Table 10).

Table 10

One-Way Analysis of Variance Summary Table for the Effects of Generation on Agricultural Literacy Proficiency Level

Generation	*df*	*SS*	*MS*	*F*	*p*	η^2
Between-group	4	9.41	2.35	6.67	.000	0.81
Within-group	417	147.11	.35			
Total	421	156.52				

Cohen's effect size value (*d* = 0.8064) suggested a large practical significant difference between Gen Z (*M* = 1.32, *SD* = .52) and Gen X (*M* = 1.78, *SD* = .59). A moderate practical significant difference was determined by Cohen's effect size value (*d* = 0.81) between Gen Z (*M* = 1.32, *SD* = .52) and Boomers (*M* = 1.79, *SD* = .61). A small practical significant difference was found by Cohen's effect size value (*d* = 0.346) also exists between Millennials (*M* = 1.58, *SD* = .61) and Boomers (*M* = 1.79, *SD* = .61). There was not a practical significant difference between the Silent generation (*M* = 1.79, *SD* = .58) and other generations.

Based on generation, agricultural literacy levels were highest among Silent (*M* = 1.79, *SD* = .58), Boomer (*M* = 1.79, *SD* = .61), and Gen X (*M* = 1.78, *SD* = .59) respondents (Table 11). Millennial (*M* = 1.58, *SD* = .61) and Gen Z (*M* = 1.32, *SD* = .52) participants had the lowest agricultural literacy levels.

Table 11

Means and Standard Deviations for Generation and Agricultural Literacy Proficiency Level

Generation	*n*	*M*	*SD*
Gen Z	41	1.32	.52
Millennial	131	1.58	.61
Gen X	107	1.78	.59
Boomer	129	1.79	.61
Silent	14	1.79	.58
Total	422	1.68	.61

A one-way ANOVA was used to compare agricultural literacy proficiency level based on ethnicity including Multiracial, White, Black/African American, American Indian or Alaskan Native, Asian, Other, and Hispanic/Latino/or Spanish Origin (Table 12). There was a statistically significant difference of ethnicity on agricultural literacy proficiency level ($p<.05$) for the seven conditions [$F(6, 415) = 5.86$, $p = .000$].

Table 12

One-Way Analysis of Variance Summary Table for the Effects of Ethnicity on Agricultural Literacy Proficiency Level (N = 422)

Ethnicity	*df*	*SS*	*MS*	*F*	*p*	η^2
Between-group	6	12.23	2.04	5.86	.000	.08
Within-group	415	144.29	.35			
Total	421	156.52				

Post hoc comparisons using the Games-Howell test indicated the mean score for White respondents ($M = 1.78$, $SD = .60$) was statistically significantly different than Black/African

American respondents (*M* = 1.32, *SD* = .47), and the Hispanic/Latino/or Spanish Origin respondents (*M* = .324, *SD* = .10). Cohen's effect size value (*d* = .07923) suggested a moderate practical significant difference between White respondents (*M* = 1.78, *SD* = .60) and Black/African American respondents (*M* = 1.32, *SD* = .47). A large practical significant difference was determined by Cohen's effect size value (*d* = 2.57) between White respondents (*M* = 1.78, *SD* = .60) and Hispanic/Latino/or Spanish Origin respondents (*M* = 1.46, *SD* = .56).

Table 13 shows agricultural literacy levels among white (*M* = 1.78, *SD* = .560) respondents were highest, followed by respondents reporting their identity as other (*M* = 1.67, *SD* = .82). Respondents identifying as Black/African American (*M* = 1.32, *SD* = .47) had the lowest level of agricultural literacy.

Table 13

Means and Standard Deviations for Ethnicity on Agricultural Literacy Proficiency Level

Ethnicity	*n*	*M*	*SD*
Multiracial	21	1.57	.75
White	293	1.78	.56
Black/ African American	50	1.32	.47
American Indian or Alaskan Native	4	1.50	.58
Asian	13	1.46	.52
Other	6	1.67	.82
Hispanic, Latino, or Spanish origin	35	1.46	.56
Total	422	1.68	.61

A one-way ANOVA was used to compare agricultural literacy proficiency level based on education level including less than high school diploma, high school diploma or equivalent, some college/no degree, associate's degree, bachelor's degree, doctorate degree, trade/technical/vocational training, or professional degree (Table 14). There was a statistically significant difference of education on agricultural literacy proficiency level ($p<.05$) for the eight conditions [$F(8, 413) = 3.678$, $p = .000$].

Table 14

One-Way Analysis of Variance Summary Table for the Effects of Education on Agricultural Literacy Proficiency Level

Education	*df*	*SS*	*MS*	*F*	*p*	η^2
Between-group	8	10.42	1.30	3.68	.000	.07
Within-group	413	146.12	.35			
Total	421	156.52				

Post hoc comparisons using the Games-Howell test indicated the mean score for individuals with less than high school diploma (M = 1.30, SD = .57) was statistically significantly different than individuals with a bachelor's degree (M = 1.84, SD = .60). The Games-Howell test also indicated the mean score for individuals with a high school diploma or equivalent (M = 1.50, SD = .56) was statistically significantly different than individuals with a bachelor's degree (M = 1.84, SD = .60). Cohen's effect size value (d = 0.91) suggested there was not a practical significant difference between individuals with less than high school diploma (M = 1.30, SD = .57) and those possessing a bachelor's degree (M = 1.84, SD = .60). A practical significant difference was not found by Cohen's effect size value (d = 0.590) between individuals with a high school diploma or equivalent (*M* = 1.50, *SD* = .56) and those with a bachelor's degree (*M* = 1.84, *SD* = .60).

Overall, individuals with a bachelor's degree (*M* = 1.84, *SD* = .60) are more agriculturally literate than other education levels (Table 15). Following this were respondents with trade/technical/vocational training (*M* = 1.82, *SD* = .67), doctorate degrees (*M* = 1.80, *SD* = .454), associate's degrees (*M* = 1.78, *SD* = .63), some college/no degree (*M* = 1.70, *SD* = .56), and master's degrees (*M* = 1.62, *SD* = .68). The lowest agricultural literacy levels were found among individuals possessing professional degrees (*M* = 1.50, *SD* = .834), a high school diploma/equivalent (*M* = 1.50, *SD* = .56) and those with less than a high school diploma (*M* = 1.30, *SD* = .57).

Table 15

Means and Standard Deviations for Education on Agricultural Literacy Proficiency Level

Education	*n*	*M*	*SD*
Less than high school diploma	20	1.30	.57
High school diploma or equivalent (e.g., GED)	106	1.50	.56
Some college, no degree	81	1.70	.56
Associate's degree	46	1.78	.63
Bachelor's degree	101	1.84	.60
Master's degree	29	1.62	.68
Doctorate degree	5	1.80	.45
Trade/ technical/ vocational training	28	1.82	.67
Professional degree	6	1.50	.83
Total	422	1.68	.61

CHAPTER 5

CONCLUSIONS

Summary

This study measured the level of agricultural literacy based on demographic characteristics among adults aged 18 and older. The JMALI was used to measure knowledge of agriculture. This quantitative evaluation utilized the five National Agricultural Literacy Outcome themes to determine overall agricultural understanding and identify if there were specific topics less understood by consumers. Results suggest agricultural literacy level can vary based on demographics such as gender, generation, education and ethnicity.

Conclusions

Objective 1: Identify the Current Levels of Agricultural Literacy of Georgia Residents based on the National Agricultural Literacy Outcomes (NALOs)

A comparison of missed questions based on their level of difficulty revealed four out of the five proficient level questions were included in the list of questions with overall mean scores of .50 or less. This suggests that as agricultural concepts become more complex, they are less understood by the general public. The present study found Theme 5: Culture, Society, Economy, and Geography (*M* = 1.97, *SD* = .94), to be the most understood NALO which relates to scores on Lewis' (2018) assessment which determined the highest scores "in the *Relationship between Agriculture and the Economy*" (p. 34). The Lewis findings also support the current results which show Theme 2: Plants and Animals for Food, Fiber, and Energy (*M* = .82, *SD* = .74) was the least understood NALO. Lewis identified "*the Relationship between Agriculture and Animals*"

(p. 34) as the lowest construct in her study. The study by Richard (2009) resulted in highest understanding in environmental science and lowest in processing. While respondent knowledge on environmental science differed between Richard's and the current study, both did find poor understanding on topics relating to Theme 2: Plants and Animals for Food, Fiber, and Energy. Marketing is listed as the highest scoring construct from Wearley et al. (1999), which does not support the present research. However, the Wearley et al. research did find the lowest score regarding Plants, which is also found by this inquiry. Frick et al. (1995) also identified plants and processing as a low knowledge topic similar to findings of this study regarding poor understanding of Theme 2: Plants and Animals for Food, Fiber, and Energy. Results by Frick et al. (1995) also note low knowledge scores regarding policy which was not indicated by this study.

Overall, the Georgia population shows a deficit in agricultural knowledge. Only 7.60% of respondents were identified as having a proficient level of understanding about agriculture. The JMALI mean score was 7.99/15.00 or 53.5% for all respondents. This is lower than findings from other studies. The mean score for agricultural knowledge was 24.47 out of 35 or 69.90% by Frick et al. (1995). Howell (1995) reported a mean score of 19.06 out of 30, or 63.53%. An assessment by Wearley et al. (1999) determined agricultural knowledge mean score as 30.63 out of 35 (87.51%). Lewis (2018) found the overall mean from a national sample to be 3.54 out of 5 or 70.80%. Lewis (2018) also found a lack of agricultural literacy among a sample of the U.S. population with an overall mean of 3.54/5 (SD = .48), or 70.80%. While the Lewis (2018) study shows a higher percentage of knowledge, 70% is still considered barely passing in educational contexts, and underwhelming for a country as agriculturally productive and dependent as this. In

2009, Richard's study resulted in an overall mean of 13.60 out of 20, or an average of 68%. Since this is only the second study conducted using the JMALI, future research should further investigate the validity and reliability of the instrument in other populations and settings and to determine if the items are sensitive enough to detect specific knowledge gaps.

Objective 2: Determine if Individuals' Demographics affect their Level of Agricultural Literacy

Gender

Males were found to be more knowledgeable about agriculture than females based on the JMALI. This finding is also concluded by Boatner (2004), Colbath and Morrish (2010), Jones (2013), and Lewis (2018). However, neither Bell (1995) or Luthman et al. (2007) found a significant difference between agricultural knowledge and gender.

Generation

The oldest generations (Silent, Boomer, and Gen X) had the highest levels of agricultural literacy. As new generations develop, they seem to have less knowledge about agriculture. Research from Lewis (2018) partially supports this finding, which determined Boomers to have higher agricultural literacy than Millennials. However, Lewis also found Boomers to be more agriculturally literate than Gen X which is not established by the present research. Bell's (1995) study including age comparisons, also differs from the current findings, which identified older individuals as having less agricultural understanding than younger.

Education

Respondents with bachelor's degrees had the highest level of agricultural literacy of all educational backgrounds. This suggests that more education does not necessarily mean greater knowledge of agriculture, since individuals with master's, doctorate's and professional degrees scored lower than those with a bachelor's only. However, the lowest agricultural literacy levels identified individuals with less than a high school diploma, those with a high school diploma, and those with professional degrees. The only other study analyzing education as a variable affecting agricultural literacy was conducted by Bell in 1995. Bell did not find a significant difference among participants based on their level of education.

Race/Ethnicity

Agricultural literacy was highest among white respondents, echoing findings by Birkenholz et al. (1994). Results from Whitehead and Estepp (2016) found overall agricultural knowledge was higher among Hispanic students than non-Hispanic. Neither Bell (1995) or Lewis (2018) identified a significant difference between race/ethnicity and agricultural knowledge. The JMALI also determined Black/African American participants to have the lowest knowledge of agriculture.

Implications

Many efforts have focused on agricultural literacy of youth and educators, however adults in the general public directly affect the agriculture industry through purchasing and voting. The findings of this study reveal Georgia citizens to collectively possess minimal understanding regarding the state's number one industry. The agriculture industry and educators within agriculture education must prioritize adult knowledge of agriculture. Educational programs, marketing campaigns, and other opportunities to engage consumers with agriculture must be explored and implemented to ensure current adults and younger generations have a basic understanding of agriculture's impact in their daily lives.

These results also indicate that Georgia residents may possess lower agricultural understanding than individuals in other areas of the U.S. The Judd-Murray (2019) study on college students in Utah resulted in more individuals in the factually literate and proficient levels than in Georgia. Based on the study by Lewis (2018), Georgian's also rank lower on agricultural understanding than a national sample from the U.S. Except for the Bell (1995) study, other agricultural literacy assessments throughout the U.S. identified in this study resulted in higher mean scores than the present research including Frick et al. (1995), Howell (1995), Richard (2009) and Wearley et al. (1999).

Recommendations for Practice

The researcher recommends the agricultural literacy of citizens become a priority of the National Institute of Food and Agriculture, including state Cooperative Extension Services. Land-grant institutions through the Cooperative Extension Service "reach out to offer their resources to address public needs" (Extension, n.d.). Agricultural illiteracy represents a significant need among the public. Limited knowledge of agriculture results in consumer misinformation (Mercier, 2018) and unawareness of the full effect agriculture has in meeting basic needs and sustaining modern quality of life (Spielmaker & Leising, 2013). The network of land-grant institutions across the U.S. and local Cooperative Extension Service offices could implement agricultural literacy activities to engage adults and begin expanding their knowledge on agriculture's positive impact. Further, agricultural education programs, activities, and events should evolve to incorporate adult participation. National programs such as Ag in the Classroom and the American Farm Bureau Foundation for Agriculture should add resources for communities and agricultural literacy advocates to utilize to begin addressing this issue sooner than later.

Additional efforts to expand agriculture's connection to consumers can take place wherever agricultural products are sold or provided. These efforts should especially consider ways to reach populations with the lowest scores of agricultural knowledge including females, Black/African American individuals and those of the Millennial and Gen Z generations. Opportunities to engage consumers should be explored at shopping malls, home improvement stores, and of course grocery stores. Further, on-farm visits can provide an immersive experience to connect consumers with direct sources of their food and fiber. These opportunities can be simple or complex, such as displaying agricultural equipment or replicas in malls, listing information about where products are grown, or installing educational signage connecting production agriculture to everyday consumer products such as toothpaste or medications.

Recommendations for Research

Based on the outcomes of this study, several opportunities exist for further inquiry. A survey using the JMALI should be conducted using a national sample to further compare results with the present study and other national studies such as Lewis (2018). A national study should include both instruments of the JMALI (9-12: 1 and 9-12: 2) to further evaluate reliability and validity of the assessment. While the Lewis (2018) study did represent a national sample, it utilized an assessment based on the Pillars of Agricultural Literacy instead of the NALOs. Agricultural educators must identify an assessment to be used across multiple agricultural literacy efforts in order to effectively compare results and changes over time. A national study could also reveal if certain NALO themes are less understood than others and could be used to tailor specific educational activities to address such deficits.

While there are multiple efforts to improve children's agricultural literacy, more insight is needed to determine the most effective methods to increase agricultural literacy knowledge among adults in the general public. An assessment of the most appropriate nontraditional and informal educational opportunities will begin to guide knowledge building for this audience. It is also recommended that future research should analyze the effect of demographic characteristics, including age/generation, race/ethnicity, location, education level, gender, and others, as variables of agricultural literacy level. Additional investigations regarding demographics should utilize qualitative research methods to determine why knowledge differences exist if they are found.

Findings from this research along with others show various levels of agricultural literacy exist in U.S. adult populations. The finding that younger generations possess less agricultural understandings suggests the importance of continuing to educate K-12 students on agriculture. Additionally, the present study’s overall mean score of 53.33% further supports the need to also expand agriculture education opportunities beyond grade 12 to adult audiences.

References

American Community Survey. (2018). *Age and Sex Table.* United States Census Bureau. Retrieved February 29, 2020, from https://data.census.gov/cedsci/table?q=georgia%20ages&g=0400000US13&hidePreview=false&tid=ACSST1Y2018.S0101&vintage=2018&cid=S0101_C01_001E

American Farm Bureau Federation. (2019). *Fast Facts About Agriculture & Food*. https://www.fb.org/newsroom/fast-facts

American Farm Bureau Foundation for Agriculture. (n.d.). What is Ag Literacy? https://www.agfoundation.org/what-is-ag-literacy

American Farm Bureau Foundation for Agriculture. (2013). *Pillars of Agricultural Literacy*. https://www.agfoundation.org/files/PillarsPacket062016.pdf

American Association for Public Opinion Research Standards Committee Task Force. (2010). *American Association for Public Opinion Research Standards Committee Task Force Research synthesis: AAPOR report on online panels*. American Association for Public Opinion Research. *Public Opinion Quarterly, 74*(4), 711-787. https://doi.org/10.1093/poq/nfq048

Arens, C. (2016, March 12). *3 ways farmers can improve food transparency*. Nebraska Farmer. https://www.farmprogress.com/story-3-ways-farmers-improve-food-transparency-9-138726

Arnot, C. (2015, November 30). *Transparency is no longer optional: How food companies can restore trust*. Forbes. https://www.forbes.com/sites/gmoanswers/2015/11/30/transparency-no-longer-optional/#30e53a0e69d4

Beck, R. (2018, May 14). *Breaking through the "big food" bias*. The Center for Food Integrity. https://www.foodintegrity.org/blog/2018/05/14/breaking-through-the-big-food-bias/

Bell, J. M. (1995). *Agricultural literacy of civic organizations in Lubbock.* [Doctoral dissertation, Texas Tech University]. Texas Digital Library. https://ttu-ir.tdl.org/ttu-ir/bitstream/handle/2346/22541/31295009252924.pdf?sequence=1

Birkenholz, R. J., Harris, C. R., & Pry, H. W. (1994). A pilot study: Assessment of agricultural literacy among college students. *NACTA Journal, 38*(1), 63-66. https://www.jstor.org/stable/43764991

Boatner, S. M. (2004). *A measure of agricultural literacy in Willamette Valley fourth grade students.* [Undergraduate Thesis, Oregon State University]. ScholarsArchive@OSU. https://ir.library.oregonstate.edu/concern/undergraduate_thesis_or_projects/q237hx05p

Boyle, J. M., Ronaldo, I., Freedner-Maguire, N., & Fakhouri, T. H. (2017). Characteristics of the Population of Internet Panel Members. *Survey Practice, 10*(4). https://doi.org/10.29115/SP-2017-0025

Brandt, M. R. (2016). *Exploring elementary students' agricultural and scientific knowledge using evidence centered design* [Master's thesis, University of Nebraska-Lincoln]. DigitalCommons @ University of Nebraska-Lincoln. http://digitalcommons.unl.edu/natresdiss/131

Broome, G. (2019, May 22). *Neighbors suing over pig fumes spur 'right-to-farm' push*. The PEW Charitable Trusts. https://www.pewtrusts.org/en/research-and-analysis/blogs/stateline/2019/05/22/neighbors-suing-over-pig-fumes-spur-right-to-farm-push

Colbath, S. A., & Morrish, D. G. (2010). What do college freshmen know about agriculture?: An evaluation of agricultural literacy. *NACTA Journal, 54*(3), 14-17. http://www.nactateachers.org/attachments/article/414/Colbath_September_2010_NACTA_JOURNAL-5.pdf

Crawford, D. P. (1998). *A study of the effects of the Food and Fiber Literacy project on participating teachers* [Master's thesis, Montana State University-Bozeman]. ScholarWorks. http://scholarworks.montana.edu/xmlui/handle/1/8500

Dimock, M. (2019). *Defining generations: Where Millennials end and Generation Z begins*. Retrieved from Pew Research Center: https://www.pewresearch.org/fact-tank/2019/01/17/where-millennials-end-and-generation-z-begins/

Doerfert, D. L. (Ed.) (2011). *National research agenda: American Association for Agricultural Education's research priority areas for 2011-2015*. http://aaaeonline.org/resources/Documents/AAAE%20National%20Research%20Agenda.pdf

Extension. (n.d.). National Institute of Food and Agriculture. https://nifa.usda.gov/extension

Food Business News. (2018, March 27). *Transparency critical for the future of food*. Food Business News. https://www.foodbusinessnews.net/articles/11532-transparency-critical-for-the-future-of-food

Frick, M. J. (1990). A definition and the concepts of agricultural: A national study [Doctoral dissertation, Iowa State University]. Digital Repository @ Iowa State University. https://doi.org/10.31274/rtd-180813-9133

Frick, M. J., Kahler, A. A., & Miller, W. W. (1991). A definition and the concepts of agricultural literacy. *Journal of Agricultural Education, 32*(2), 49-57. doi:10.5032/jae.1991.02049

Frick, M., Birkenholz, R., & Machtmes, K. (1995). Rural and urban adult knowledge and perceptions of agriculture. *Journal of Agriculture Education, 36*(2), 44-53. doi:10.5032/jae.1995.02044

Georgia Department of Economic Development. (n.d.). *Agribusiness*. https://www.georgia.org/industries/agribusiness

Georgia Farm Bureau. (n.d.). *About Georgia Agriculture*. https://www.gfb.org/education-and-outreach/about-ga-agriculture.cms

Goecker, A. D., Smith, E., Fernandez, J. M., Ali, R., & Theller, R. (2015). *Employment oportunities for college graduates in food, agriculture, renewable natural resources, and the environment.* United States Department of Agriculture. https://www.purdue.edu/usda/employment//wp-content/uploads/2015/04/2-Page-USDA-Employ.pdf

Hess, A. J., & Trexler, C. J. (2011). A qualitative study of agricultural literacy in urban youth: Understanding for democratic participation in renewing the agri-food system. *Journal of Agricultural Education, 52*(2), 151-162. doi:10.5032/jae.2011.02151

Howell, K. F. (1995). *Agricultural literacy of radio station news reporters in Oklahoma* [Master's thesis, Oklahoma State University]. SHAREOK. https://shareok.org/handle/11244/12761

Hubert, D., Frank, A., & & Igo, C. (2000). Environmental and agricultural literacy education. *Water, Air, and Soil Pollution, 123*(1-4), 525-532. https://doi.org/10.1023/A:1005260816483

Iowa Agriculture Literacy Foundation. (n.d.). *Iowa Agriculture in the Classroom*. https://www.iowaagliteracy.org/agriculture-in-the-classroom

Jones, C. (2013, May). *An assessment of agricultural literacy: What incoming freshmen at Oklahoma State University know about the food and fiber system.* [Master's Thesis, Oklahoma State University]. SHAREOK. https://hdl.handle.net/11244/11096

Judd-Murray, M. R. (2019). *Development and Validation of an Agricultural Literacy Instrument Using the National Agricultural Literacy Outcomes* [Doctoral dissertation, Utah State University]. Digital Commons @ USU. https://digitalcommons.usu.edu/cgi/viewcontent.cgi?article=8695&context=etd

Kahan, D. M. (2014). Ordinary science intelligence: A science comprehension measure for use in the study of risk perception and science communication. Yale Law & Economics Research Paper No. 504; The Cultural Cognition Project Working Paper No. 112. *SSRN*. https://dx.doi.org/10.2139/ssrn.2466715

Klobuchar, A. (2013). *The economic contribution of America's farmers and the importance of agricultural exports.* Joint Economic Committee, United States Congress. https://www.jec.senate.gov/public/index.cfm/democrats/2013/9/the-economic-contribution-of-america-s-farmers-and-the-importance-of-agricultural-exports

Knutson, J. (2017, December 11). *Consumers who don't know agriculture aren't stupid. They're just misinformed.* https://www.agweek.com/opinion/columns/4371860-consumers-who-dont-know-agriculture-arent-stupid-theyre-just-misinformed

Kovar, K. A., & Henry, A. L. (2013). Two decades of agricultural literacy research: A synthesis of the literature. *Journal of Agriculture Education, 54*(1), 167-178. doi:10.5032/jae.2013.01167

Leising, J. G., & Zilbert, E. E. (1994). Validation of the California agricultural literacy framework. *Proceedings of the National Agricultural Education Research Meeting*, USA, 21, 112-119.

Leising, J. G., Igo, C. G., Heald, A., Hubert, D., & Yamamoto, J. (1998). *A guide to food and fiber systems literacy*. Stillwater, Oklahoma: W. K. Kellogg Foundation and Oklahoma State University.

Leising, J. G., Pense, S. L., & Portillo, M. T. (2003). *The impact of selected Agriculture in the Classroom teachers on student agricultural literacy.* https://www.agliteracy.org/research/doc/evaluation/impact2003.pdf

Lewis, M. L. (2018). *Agricultural literacy among the generations: A national study.* [Master's thesis, Tennessee State University]. Digital Scholarship @ Tennessee State University. https://digitalscholarship.tnstate.edu/dissertations/AAI10751140

Longhurst, M. L., Judd-Murray, R., & Spielmaker, D. M. (2019). *Longhurst Murray agricultural literacy instrument.* National Center for Agricultural Literacy. https://www.agliteracy.org/research/assessment.cfm

Lusk, J. L., & McCluskey, J. (2018). Understanding the impacts of food consumer choice and food policy outcomes. *Applied Economic Perspectives and Policy, 40*(1), 5-21. doi:10.1093/aepp/ppx054

Luthman, S., Ewing, J. C., & Whittington, M. S. (2007). *Impact of agricultural literacy efforts on elementary students' knowledge of production agriculture.* [Undergraduate honors thesis, The Ohio State University]. Knowledge Bank. https://kb.osu.edu/handle/1811/28357

Mabie, R. (1996). The influence of experiential instruction on urban elementary students' knowledge of the food and fiber system. *Journal of Extension, 34*(6). https://www.joe.org/joe/1996december/rb1.php

Meischen, D. L., & Trexler, C. J. (2003). Rural elementary students' understandings of science and agricultural education benchmarks related to meat and livestock. *Journal of Agricultural Education, 44*(1), 43-55. doi:10.5032/jae.2003.01043

Mercier, S. (2018, September 20). *How to Address Agricultural Literacy--Start Young*. AgWeb. https://www.agweb.com/blog/straight-from-dc-agricultural-perspectives/how-to-address-agricultural-literacy-start-young

Meyers, C., & Abrams, K. (2010). Feeding the debate: A qualitative framing analysis of organic food news media coverage. *Journal of Applied Communications, 94*(3 & 4), 22-36. https://doi.org/10.4148/1051-0834.1190

National Agriculture in the Classroom. (2013). *National Agricultural Literacy Curriculum Matrix*. https://www.agclassroom.org/teacher/matrix/

National Agriculture in the Classroom. (2018). *Annual Report.* https://www.agclassroom.org/get/doc/annual_report2018_web.pdf

National Agriculture in the Classroom. (n.d.). *History of Agriculture in the Classroom*. https://www.agclassroom.org/get/history.cfm

National Research Council. (1988). *Understanding agriculture: New directions for education.* Board on Agriculture. Washington, DC: National Academy Press. https://doi.org/10.17226/766

Nunnery, S. (1996). Systematic educational efforts teaching about agriculture and the effect on fourth-grade students' knowledge of animal agriculture in Ohio. *Proceedings of the National Agricultural Education Research Meeting*, USA, 23, 163-172.

Pense, S. L., Leising, J. G., Portillo, M. T., & Igo, C. G. (2005). Comparative assessment of student agricultual literacy in selected Agriculture in the Classroom programs. *Journal of Agricultural Education, 46*(3), 107-118. doi:https://doi.org/10.5032/jae.2005.03107

Pope, J. (1990). Agricultural literacy: A basic American need. *The Agricultural Education Magazine, 62*(9), p. 8.

Powell, D. V., & Agnew, D. M. (2011). Assessing agricultural literacy elements of Project Food Land and People in K-5 using the Food and Fiber Systems Literacy Standards. *Journal of Agricultural Education, 52*(1), 155-170. doi:https://doi.org/10.5032/jae.2011

Powell, D., Agnew, D., & Trexler, C. (2008). Agricultural literacy: clarifying a vision for practical application. *Journal of Agricultural Education, 49*(1), 85-98. doi:10.5032/jae.2008.01085

Qualtrics. (2020). *Online Sample*. https://www.qualtrics.com/research-services/online-sample/

Roberts, T. G.; Harder, A.; Brashears, M. T. (Eds). (2016). *American Association for Agricultural Education national research agenda: 2016-2020*. http://aaaeonline.org/resources/Documents/AAAE_National_Research_Agenda_2016-2020.pdf

Rotenberk, L. (2013, November 22). *Blogging the farm: The new rural writers and their urban fans*. Modern Farmer. https://modernfarmer.com/2013/11/blogging-farm-new-rural-writers-urban-fans/

Sadler, P. M. (2011). *About MOSART*. MOSART Self-Service Site. https://www.cfa.harvard.edu/smgphp/mosart/index.html

Spielmaker, D. M., & Leising, J. G. (2013). National agricultural literacy outcomes. Logan, UT: Utah State University, School of Applied Sciences & Technology. https://www.agclassroom.org/get/doc/NALObooklet.pdf

Spielmaker, D. M., Pastor, M., & Stewardson, D. M. (2014). A logic model for agricultural literacy programming. Proceedings of the 41st annual meeting of the American Association for Agricultural Education. Snowbird, UT. https://agliteracy.org/research/logic.cfm

Terry Jr., R., Herring, D. R., & Larke Jr., A. (1992). Assistance needed for elementary teachers in Texas to implement programs of agricultural literacy. *Journal of Agricultural Education, 33*(2), 51-60. doi: 10.5032/jae.1992.02051

Trexler, C. J. (2000). A qualitative study of urban and suburban elementary student understandings of pest-related science and agricultural education benchmarks. *Journal of Agricultural Education, 41*(3), 89-102. https://pdfs.semanticscholar.org/2679/ab12550482c70c6d9d8044a16286664af87e.pdf?_ga=2.238141443.2089924091.1584994709-365394799.1580919004

United States Department of Agriculture (n.d.). Agriculture. In National Agricultural Library Glossary. https://agclass.nal.usda.gov/mtwdk.exe?k=glossary&l=60&w=434&s=5&t=2

Verbeke, W. (2005). Agriculture and the food industry in the information age. *European Review of Agricultural Economics, 32*(3), 347-368. https://doi.org/10.1093/eurrag/jbi017

Warnick, B. (Administrative Advisor). (2014-2019). W2006: *Multistate agricultural literacy research*. (Project No. W2006) [Multistate Research Project]. https://www.nimss.org/projects/view/mrp/outline/16496

Wearley, M., Frick, M., & Shelhamer, C. V. (1999). Montana legislators' knowledge and perception of agriculture. *NACTA Journal*, 31-37. https://www.nactateachers.org/attachments/article/636/Milford_Wearley_NACTA_Journal_March_1999-3.pdf

APPENDIX A

University of Georgia Institutional Review Board Approval

Validation of the Judd-Murray Agricultural Literacy Instrument in Georgia

Institutional Review Board
UNIVERSITY OF GEORGIA

Hello, Sara Hand

» My Inbox Library

View Project
Print Project
View Differences

Progress Report

Create Version
Add Public Comment

Validation of the Judd-Murray Agricultural Literacy Instrument in Georgia

ID: PROJECT00000983

Principal Investigator:	Yopp	**Contacts:**	Hand
Reviewer:	Pavich	**Review Level:**	Exempt
Determination:	Approved	**Approved Date:**	9/4/2019
Funding Source:		**Expiration Date:**	
Committee:	IRB 1	**Project Status:**	Approved
Review Category:			

Documents

Draft	Category	Date Modified
Revised Validation of the JMALI-Consent Letter.docx	Consent Form	9/2/2019 11:31 AM
Survey _ Validation of the Judd-Murray Agricultural Literacy Instrument in Georgia.docx	Materials for Data Collection	8/23/2019 9:49 AM

Final Document	Category	Last Finalized
No Documents Found		

History | Meetings | Versions | Progress Reports | Reviews | •••

Filter by Activity | Enter text to search for | + Add Filter | Clear All

Activity	Author	Activity Date
Take Snapshot Snapshot: 1.5	Fowler, Kimberly C	9/4/2019 12:57 PM
Send Letter	Fowler, Kimberly C	9/4/2019 12:57 PM
Submit Clarifications	Yopp, Ashley M	9/3/2019 12:31 PM
Re-assign	Pavich, Kassia V	8/27/2019 12:36 PM
Request Clarifications 1. You do not need submit the recruitment materials for review, but since you are collecting the data online, do not use the word "anonymous" in the recruitment messages. 2. Incentives have to be described in the consent document. You will either need a di... read more	Pavich, Kassia V	8/27/2019 12:34 PM
Re-assign	Fowler, Kimberly C	8/27/2019 12:01 PM
Re-assign	Fowler, Kimberly C	8/27/2019 12:01 PM
Re-assign	Fowler, Kimberly C	8/27/2019 12:01 PM
Re-assign	Fowler, Kimberly C	8/27/2019 11:16 AM
Submit	Yopp, Ashley M	8/26/2019 4:21 PM
Notify PI to Submit	Hand, Sara Spinks	8/23/2019 9:49 AM

APPENDIX B

Qualtrics Questionnaire

Qualtrics Survey Software

Demographic Question Block

Q1 Please read this statement carefully before proceeding with the survey.

We are conducting a study to understand agricultural literacy. Research studies help us learn more about people and develop better curriculum for students. No identifiable information will be collected from research participants and it should take you approximately 15 minutes to complete. We would appreciate your participation.

Q2 Do you agree to participate?

- Yes, I agree to participate in the study.
- No, I do not agree to participate in the study.

Q3 We care about the quality of our survey data and hope to receive the most accurate measures of your opinions, so it is important to us that you thoughtfully provide your best answer to each question in the survey.

Do you commit to providing thoughtful and honest answers to the questions in this survey?

- ○ I will provide my best answers
- ○ I will not provide my best answers
- ○ I can't promise either way

Q4 In which state do you currently reside?

[▾]

Q5 Please enter your zip code:

[ ]

Block 2

Q6 What year were you born? (YYYY)

Q7 What is your gender?

- Male
- Female

Q8 What is your ethnicity?

- White
- Black or African American
- Hispanic, Latino, or Spanish origin
- American Indian or Alaska Native
- Asian
- Native Hawaiian or Pacific Islander
- Other

Q9 What is your highest level of education?

- Less than high school diploma
- High school diploma or equivalent (e.g., GED) Some
- college, but no degree
- Trade/ technical/ vocational training
- Associate's degree
- Bachelor's degree
- Master's degree
- Professional degree
- Doctorate degree

Q10 Please mark all of the options that best describe the geography and location of the town you live in.

- Urban area, many people living in apartments and using public transit for travel.
- Urban area with designated open spaces for public use (e.g., parks, zoos, lakefront, walking trails, or gardens).
- Suburban area, many people travel by car or public transit (e.g., bus, subway, train) to their home, from more urban areas where they work.
- Suburban area, some designated open space areas mixed with businesses and service providers.
- Suburban area, relatively few people have a home with a yard or acreage.
- Suburban area, many people have a home with a yard or acreage.
- Suburban area, many students are bused/travel to school from more rural, open areas.
- Rural area, many fields and agricultural businesses (including nurseries or greenhouses) are present.

Q11 On a scale from 0-5, please rate your level of exposure to agriculture.

	A great deal	A lot	A moderate amount	A little	None at all
How much do you know or understand about agriculture?	○	○	○	○	○

Q12 Please indicate which of the following activities or events you have experienced.

- ☐ Working on a farm/ranch, greenhouse, timber, or other agricultural industry
- ☐ Traveling to a farm or touring a farm
- ☐ Farm-related events at school
- ☐ Attending a state or county fair
- ☐ Taking an agricultural education course such as animal science, plant science, etc.
- ☐ Participating in 4-H or FFA
- ☐ Listening to guest speakers who spoke about an agricultural topic (e.g., a farmer or landscaper)
- ☐ School or home/family gardening
- ☐ Traveling to a garden or botanical event
- ☐ Farm to School or Community Food programs
- ☐ Listening to volunteers or being a volunteer who shares agricultural information
- ☐ Reading books about agriculture

- ☐ Involvement in local food programs
- ☐ Other
- ☐ None of these choices

Q13 Rank your perception of your **own level** of agricultural literacy. For example, an agriculturally literate person understands and can communicate the source and value of agriculture in their every day life.

	Excellent	Good	Average	Poor	Terrible
My own level of agricultural literacy.	○	○	○	○	○

Form 1

Q14 Determine if the statement is true or false: *Sustainable agriculture is the practice of producing food, fiber, and fuel in a way that is profitable to the producer, supports quality of life, and protects natural resources.*

- ○ The statement is true
- ○ The statement is false

Q15 Determine if the statement is true or false: *There are few incentives for agriculturists to protect the environment and natural resources.*

- ◯ The statement is true
- ◯ The statement is false

Q16 **Select all** the potential outcomes of practicing sustainable agriculture.

- ☐ Reduction of world hunger
- ☐ Protection of food supply
- ☐ Wildlife habitat loss
- ☐ Conservation of natural resources

Q17 **Select all** the examples of organic nutrients.

- ☐ Dead/decaying animals
- ☐ Synthetic nitrogen
- ☐ Lawn/grass clippings
- ☐ Manure
- ☐ Silt

Q18 **Select all** of the factors that affect food choices for people.

- ☐ Cost
- ☐ Culture
- ☐ Convenience
- ☐ Access and/or availability
- ☐ Taste

Q19 **Select all** the following practices that provide the best balance for agricultural production, while maintaining balance with natural resources.

- ☐ Integrated pest management
- ☐ Using robots, drones, and global positioning systems
- ☐ Using radio frequency identification chips
- ☐ Using advertising strategies

Q20 Interpret the information provided on this food label. Match the value with the correct description.

INGREDIENTS: WHOLE CORN, VEGETABLE OIL (CONTAINS ONE OR MORE OF THE FOLLOWING: CORN, SOYBEAN, AND/OR SUNFLOWER OIL), SALT, CHEDDAR CHEESE (MILK, CHEESE CULTURES, SALT, ENZYMES), MALTODEXTRIN, WHEAT FLOUR, WHEY, MONOSODIUM GLUTAMATE, BUTTERMILK SOLIDS, ROMANO CHEESE FROM COW'S MILK (PART-SKIM COW'S MILK, CHEESE CULTURES, SALT, ENZYMES), WHEY PROTEIN CONCENTRATE, ONION POWDER, PARTIALLY HYDROGENATED SOYBEAN AND COTTONSEED OIL, CORN FLOUR, DISODIUM PHOSPHATE, LACTOSE, NATURAL AND ARTIFICIAL FLAVOR, DEXTROSE, TOMATO POWDER, SPICES, LACTIC ACID, ARTIFICIAL COLOR (INCLUDING YELLOW 6, YELLOW 5, RED 40), CITRIC ACID, SUGAR, GARLIC POWDER, RED AND GREEN BELL PEPPER POWDER, SODIUM CASEINATE, DISODIUM INOSINATE, DISODIUM GUANYLATE, NONFAT MILK SOLIDS, WHEY PROTEIN ISOLATE, AND CORN SYRUP SOLIDS.
CONTAINS MILK AND WHEAT INGREDIENTS.

Nutrition Facts

Serving Size 1 package

Amount Per Serving	
Calories 150	Calories from Fat 70
	% Daily Value*
Total Fat 8g	**12%**
Saturated Fat 1.5g	**7%**
Trans Fat 0g	
Cholesterol 0mg	**0%**
Sodium 180mg	**7%**
Total Carbohydrate 17g	**6%**
Dietary Fiber 1g	**6%**
Sugars 1g	
Protein 2g	

Vitamin A 0%	Vitamin C 0%
Calcium 2%	Iron 0%
Thiamin 4%	Vitamin B6 2%
Phosphorus 6%	

* Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs:

	Calories:	2,000	2,500
Total Fat	Less than	65g	80g
Sat Fat	Less than	20g	25g
Cholesterol	Less than	300mg	300mg
Sodium	Less than	2,400mg	2,400mg
Total Carbohydrate		300g	375g
Dietary Fiber		25g	30g

Calories per gram:
Fat 9 • Carbohydrate 4 • Protein 4

Items

150

2%

4

1

Grams of protein in two servings

Percent of the daily requirement of Calcium per serving

Number of calories per serving

Number of servings in this package

Q21 **Select all** the ways that consumers can prevent food-borne illness.

- ☐ Washing hands
- ☐ Cooking meat thoroughly
- ☐ Keeping most food products at room temperature
- ☐ Using the same knife for cutting meat and vegetables
- ☐ Thawing frozen meat on the kitchen counter

Q22 Determine if the statement is true or false: *The American food supply is among the safest in the world.*

- ○ The statement is true
- ○ The statement is false

Q23 Determine if the statement is true or false: *An adequate global food supply is dependent upon the continued development and appropriate use of science, technology, and engineering.*

- ○ This statement is true
- ○ This statement is false

Q24 Determine if the statement is true or false: *All types of scientific discoveries and applications of technology are accepted by consumers if they increase food production.*

- ◯ This statement is true
- ◯ This statement is false

Q25 **Select all** the technological advancements in agriculture that contribute to the ability to feed a growing population with a smaller number of producers.

- ☐ Biotechnology
- ☐ Availability of organic labeling
- ☐ Genetic engineering
- ☐ Animal-powered equipment
- ☐ Refrigeration
- ☐ Mechanization of equipment and implements
- ☐ Reduction of conservation practices

Q26 Determine if the statement is true or false: *The geographic location of your food source plays a part in determining the price of the food.*

- ◯ This statement is true
- ◯ This statement is false

Q27 **Select all** factors that affect a country's production and distribution of food.

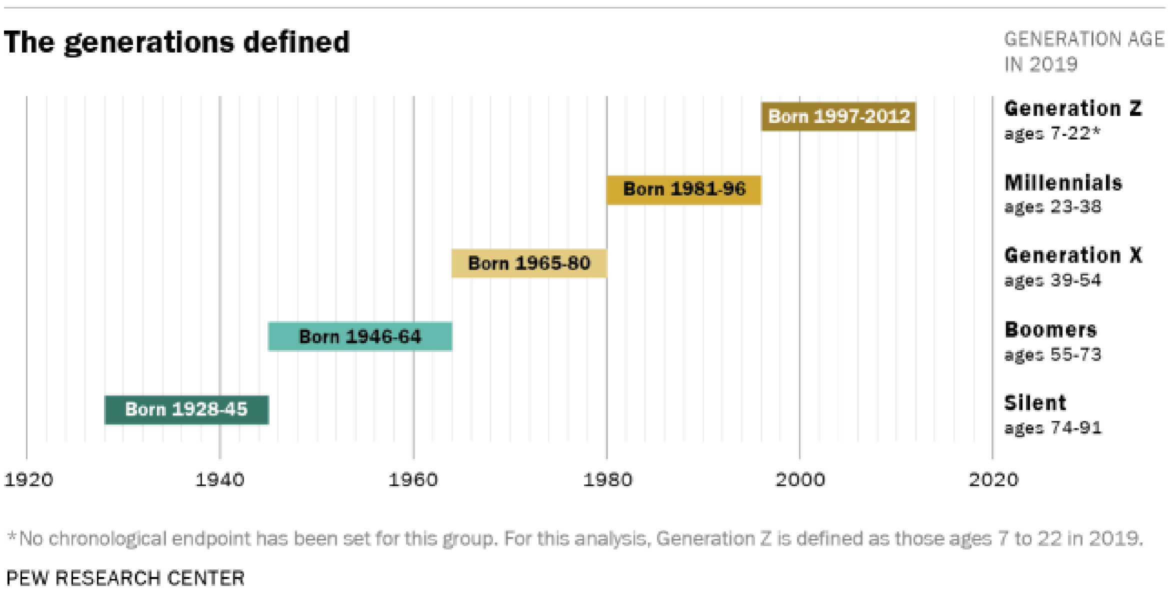
- [ ] Economics
- [ ] Geography
- [ ] Population size

Q28 A farmer has 50 acres of land to grow a crop; which factors would need to be considered before making a choice about what to plant? **Select all** of the correct choices.

- [ ] Geographic location
- [ ] Soil composition
- [ ] Consumer demand
- [ ] Climate change

APPENDIX C

The Generations Defined Graph



From Defining generations: Where Millennials end and Generation Z begins, by M. Dimock, 2019, https://www.pewresearch.org/fact-tank/2019/01/17/where-millennials-end-and-generation-z-begins/. Copyright 2020 by the Pew Research Center.