

AGRICULTURAL LITERACY IN MONTANA PRESERVICE
ELEMENTARY EDUCATORS

by

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DEDICATION

This thesis is dedicated to my parents, Lisa and Bruce Rianda for always motivating me to keep going and never give up; my grandparents for always believing in me; and in the memory of my great aunt and uncle, Carol and Jim Shade whose dream was to see all of their grandchildren and grandnieces and nephew receive a college education. Without the guidance, love, and support from my family I would not be who I am or where I am today.

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DEFINITION OF TERMS

The following terms are defined as they are applied in this study:

1. **Agricultural Education:** Education about agriculture, food, and natural resources, in grades 7-12. Through these subjects, agricultural teachers educate students about a wide variety of skills, including leadership, communications, science, math, management and technology (NAAE, 2018).
2. **Agricultural Literacy:** 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 (Frick, 1990, p. 52).
3. **Preservice Teacher/Educator:** Student in teacher preparation program who has not received certification.
4. **Innovation:** A new method, idea or product (Rogers, 2003).

ABSTRACT

A major disconnect in a connected world has occurred, creating a knowledge deficiency in agriculture and its global issues. The purpose of this study was to determine Montana State University preservice elementary educators' perceptions toward agriculture, educating about agriculture, and incorporating agricultural topics within their lessons. Researchers used the diffusion of innovations theory and its five communication channels and five degrees of innovativeness along with the theory of planned behavior as a lens to analyze agricultural literacy awareness. Data included education students enrolled in one or more of the following 2019 spring K-8 methods courses: science, math, social studies, and language arts. Regarding barriers, respondents indicated *Time* and *Funding* were the most significant, however, *Personal Interest* and *Reward/Recognition* construct item were the most significant benefits. Math Methods students obtained the highest percentages out of all four subject areas regarding their comfort level of potentially utilizing the National Agriculture Literacy Outcomes (NALO), while Language Arts Methods course students had the lowest. Participants' overall confidence to potentially utilize agriculture as a context to teach core academics was low compared to their degree of innovativeness, tendency to adopt the innovation. Findings possess significant recommendations and implications for addressing agricultural literacy in nonagricultural educators to improve teachers' perceptions, and increase their awareness of agricultural concepts to successfully and efficiently utilize agriculture as a context. A variety of approaches can be drawn upon to achieve this goal. First, collaboration between elementary and agricultural education preservice education programs. Second, provide agriculturally-based workshops and professional development opportunities for nonagricultural education majors need to be provided. Third, expand efforts toward in-service educators. Fourth, create an agriculturally integrated K-8 curriculum and standards. Fifth, publish research utilizing specific agricultural literacy terminology in nonagricultural education

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INTRODUCTION

Need for Study

Societal disconnect from agriculture increases significantly as time progresses. Americans are becoming two to four generations removed from ranches and farms. Research has identified the majority of the general population as having no direct contact with agriculture, including rural agricultural states (Powell & Agnew, 2011), resulting in an overwhelming lack of knowledge and appreciation of the food, fuel, and fiber it demands (Brandt, Forbes, & Keshwani, 2017). According to Weiss (1999), this agricultural knowledge deficiency and its global issues could be due in part to a lack of societal interest in agriculture. A major disconnect in a connected world has occurred when America's economy, political culture, and society evolved from an agricultural-industrial to a technological-informational era; fewer citizens see the value and importance of agricultural food, fuel, and fiber systems (DeChristopher, 1993; Knobloch & Martin, 2002).

Ikerd (2001) discussed how the nation's agricultural disconnect is most evident in our systems of food and farming. Most consumers, mainly younger consumers, have no sense of where their food comes from. Consumers may have a general knowledge that farmers grow crops and livestock, then someone processes and packages them to then be delivered to their grocery stores and restaurants, but have little sense of what the process involves. According to Ikerd (2001), there is no sense of association concerning the people who eat and the agriculturalists who tend the soil to produce and deliver their food. Since the turn of the century and with the help of social media, there are increasing

numbers of consumers showcasing concerns about food safety, environmental conservations, and agricultural sustainability (Brandt et al., 2017; Hess & Trexler, 2011; Trexler & Meischen, 2002). Although consumers have shown an increasing interest in furthering their education in agriculture (Trexler & Meischen, 2002), many of these topics are related to production, not processing and distribution of agriculture.

In the United States, agriculture isn't a focus in most K-12 school curriculum (Brandt et al., 2017). As a result, students possess a restricted understanding and/or harbor misconceptions regarding food and environmental systems (Brandt et al., 2017; Hex & Trexler, 2011; Mabie & Baker, 1996) and associate agricultural education with basic farming practices (Osborne & Dyer, 2000; Talbert & Larke, 1995; Thompson & Russell). Prior research efforts have revealed that elementary school students know relatively little about agriculture (Trexler, Hess, & Hayes, 2013), its economic and social importance, and its links to human health and environmental quality (Brandt et al., 2017; Hess & Trexler, 2011; Mabie & Baker, 1996; Meischen & Trexler, 2003; Swortzel, 1997). Although most research indicates that urban citizens lack the most agricultural knowledge, rural nonfarm citizens also seem to struggle. It has been recommended that agricultural education should not only be directed to the adult public but also at primary school children, since they are future consumers and leaders (Brandt et al., 2017; Frick, Birkenholz, & Machtmes, 1995; Knobloch, Ball, & Allen, 2007; National Research Council, 1988; Trexler & Meischen, 2002; Powell et al., 2008). Research has shown that students can gain agricultural content knowledge through core subjects like math, science, social studies, and language arts, utilizing agriculture as a context (Balschweid,

Thompson, & Cole, 1998; Igo, 1998; Knobloch, Ball, & Allen, 2007; National Research Council, 1998; Vellera & Bodsine, 2016).

In the past, a close relationship with a common agrarian society and culture resulted in a mutual sense of agricultural literacy, ensuing from close familiarity with the production, distribution, and use of agricultural commodities (Powell et al., 2008).

Genetically modified crops, animal rights, and food safety issues have created controversy in agriculture over the years (Leising, Igo, Heald, Hubert, & Yamamoto, 1998). The agricultural industry has recently received scrutiny by organizations and special interest groups called the “informed public” (Kovar & Ball, 2013). An agriculturally literate society would be able to see beyond emotional pleas, instead making informed decisions on issues at hand. Overall, challenges facing agriculture would lessen if the population had an understanding of agriculture and current economic, social and environmental impacts. Agricultural education is too important a topic to be taught only at the secondary and higher education levels. Agricultural literacy is not age bound and should be offered to all students, regardless of their career goals or whether they are urban, suburban, or rural (National Research Council, 1988).

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

products, the processing of agricultural products, public agricultural policies, the global significance of agriculture, and the distribution of agricultural products (Frick, 1990, p. 52).

Teachings of agricultural literacy requirements need not involve major curriculum reform (National Research Council, 1998). Innovative, classroom-tested materials have been created to enhance the preexisting standard curriculum. In an elementary class, children can plant radishes one week and harvest them a few weeks later. A biology course at the middle school level that already includes lessons on genetics could readily be taught with some real-world agricultural examples. Students learning about business or plant systems could learn from examples dealing with production differences among major crops, such as wheat, soybeans, corn, and other vegetables. The study of agriculture and food encompasses production, processing, trade, distribution, and marketing. This provides opportunities to teach social science topics such as economics, civics, governmental operations, sociology, as well as issues that relate to nutrition, famine and obesity (National Research Council, 1998). Students in history classes can study not only the expeditions, treaties, voyages, and wars through which new lands were acquired, but they can also read about how pioneer families grew their first crops, transforming the new lands into a nation. Mathematics courses could include many interesting examples from agriculture, such as calculating food and nutrition in both humans and animals, processing and trading of commodities, and calculating the amount of fertilizer per field (National Research Council, 1998). The approach to implementing agriculture as a context is flexible to the varying needs and resources in individual

schools and states. A program in Kalispell, Montana, that focuses on forestry, trout fishing, and the lives of the introduced timber wolves may be less meaningful and less effective when used with children in any inner city, for example, Chicago, Illinois; Tampa, Florida; or Boston, Massachusetts.

The core concept of agricultural literacy has lasted two decades (Kovar & Ball, 2013); however, understanding agriculture in 1988 and understanding agriculture in 2019 are two completely different concepts. Changes within agriculture include international trade, buying local, organic farming, ethanol production, genetically modified organisms, environmental stewardship and climate, and many other trends in agriculture (Kovar & Ball, 2013). Although there have been many efforts to educate the public, society is still considered agriculturally illiterate (Kovar & Ball, 2013; Mercier, 2015). As individuals continue to become further removed from production agriculture, agricultural literacy continues to become a growing issue across the United States (Chapman & Lindner, 2018). The growing population, continual urbanization of towns, and aging of farmers intensifies the agricultural literacy problem (Clemons, Linder, Murray, Cook, Sams, & Williams, 2018). Understanding the difference between agricultural literacy and being agriculturally literate is vital to efforts promoting agricultural literacy (Clemons et al., 2018). Sandlin and Perez (2017) found that the public demonstrated the ability to read (literate) agricultural words and phrases but did not accurately exhibit knowledge (literacy) about purchasing local products in relation to the impact on the environment. If the concepts of agricultural literacy have evolved, how can we educate the public? Agricultural literacy is a current issue, not only in our society, but globally. Knowledge

and understanding of agriculture is needed as the global population increases, producing issues of feeding the world, while trying to establish and maintain a sustainable agricultural system.

Statement of the Problem

Agricultural Education is too important to only be accessible in secondary and higher education. A major disconnect in a connected world has occurred, creating a knowledge deficiency in agriculture and its global issues. With fewer people directly involved in production agriculture and the complexity of agricultural issues, the need for an agriculturally literate society is essential so that informed citizens are able to make educated decisions concerning agriculture (Pope, 1990). In order to achieve its vision and mission, the National Council for Agricultural Education (1999) recommended a global social agreement to serve the needs of society to improve the quality of the environment, build leadership and collaboration, and develop new approaches to challenges. Six percent of the school population successfully completes agricultural coursework; therefore, teachers, agricultural groups, and organizations must collaborate to implement and integrate agricultural-based curriculum for the other 94% of students (Myers & Dyer, 2004). Thus, the challenge facing educators is not a lack of available curriculum resources or how to successfully and seamlessly integrate agriculture into their existing curriculum; rather, before integration, educators should possess the content knowledge required for this successful implementation. What level of agricultural awareness should preservice elementary educators possess to be recognized as qualified and prepared potential graduates equipped to educate students within the context of agriculture?

Purpose of this Study

The purpose of this study was to determine Montana State University preservice elementary educators' perceptions toward agriculture, educating about agriculture, and incorporating agricultural topics within their lessons. Specific research objectives included:

1. Identify preservice elementary educators' perceived benefits and barriers to using agricultural content to teach core academics.
2. Identify preservice elementary educators' comfort levels about utilizing agriculture as a context to teach core subjects.

Limitations

Since Montana State University is not the only institution certifying elementary educators in the state, limitations of this study include the ability to generalize to all preservice elementary educators across Montana. Therefore, due to accessibility of information, the study will only examine one university in the state of Montana. The study cannot control for variability in course content across different professors.

Assumptions

It was assumed that respondents were truthful and honest in their answers during the data collection and that the preservice elementary educators would be going into the teaching profession after graduation.

REVIEW OF LITERATURE

Purpose of the Study

The purpose of this study was to determine Montana State University preservice elementary educators' perceptions toward agriculture, educating about agriculture, and incorporating agricultural topics within their lessons. Specific research objectives included:

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Educational Agricultural Programs

Extension – Adult Education.

In 1914, the Smith-Lever Act was created to educate the general public about agriculture. Although this act formalized Extension, its roots go back to agricultural clubs and societies in the early 1800s. Extension provides education to farmers and residents of rural communities and urban areas throughout the country through non-formal education and learning activities (National Institute of Food and Agriculture). Extension organizations involve the use of communication and adult education methods to assist individuals and communities in identifying potential improvements to their practices and providing the skills and resources to effectively incorporate those improvements (Black, 2000). Adult agricultural education programs transfer information by focusing on the

development of skills needed to advance efficiency in production agriculture or addressing topics related to the improving managerial skills (Birkenholz & Maricle, 1991). Traditional Extension operations (nationally) are represented in four broad categories: program area categorization, rural vs. urban delivery, in-person vs. electronic delivery, and educator vs. facilitator/capacity-builder role (Raison, 2014).

The program area categorization category refers to how most organizations categorize their programming outreach in any of the four traditional areas of Agriculture: 4-H Youth Development, Family & Consumer Science (FCS), and Community Development. Each category offers range, depth, and diversity of programming outreach (Raison, 2014). Although each program area has its main focus, programs often tend to overlap within Extension when they're applied in real-world situations.

Rural vs. urban delivery recognizes the distinguished differences between instructing rural versus urban participants. The original audiences of Extension programs were mostly rural. In the 1920s, around 40% of the population farmed (Dimitri, Effland, & Conklin, 2005) compared to the farm and ranch families comprising of 2% today. Although both are highly important, research from The Ohio State University has suggested that Extension's future must include a more focused look at urban areas (Raison, 2014). This may be true in Ohio; however, in 2017, about 65% of the Montanan population still resided in rural communities (USDA, 2019).

The in-person vs. electronic category focuses on how technology is continuing to change education pedagogy and teaching methods across the board. With the reexamination of all educational delivery systems, from traditional classrooms to non-

formal extension outreach, technological inputs and access methods are recommended in order to stay relevant (Robideau & Santl, 2011; Dromgoole & Boleman, 2006; Elbert & Alston, 2005). Today, with smart phone applications, simple weather forecasts, GPS navigational systems, and more complicated planting and financial tracking software, many farmers and ranchers are technologically savvy compared to their 1990 counterparts. This advance in technology allows extension workers to increase capacity and reach new audiences with less staff members (Raison, 2014).

Lastly, the educator vs. facilitator/capacity-builder role demonstrates how the extension worker should deliver information to the public. Today, educators serve as the expert source of information, but also play the role of facilitator by bringing together existing community resources, interpreting information and data and helping communities build a sustainable, healthy future (Raison, 2014). Scott Peters (2006) advocates for a co-construction or participatory outreach; meaning, if Extension serves only in the teacher/expert providing information, then there is no real need for Extension. With technology, information and expert knowledge is free and easily available everywhere.

In 2014, the National Institute of Food and Agriculture (NIFA) and their land-grant university partners celebrated 100 years of Cooperative Extension in the United States (Borden, Perkins, & Hawkey, 2014). Within the last century, Extension has adapted to changing times, continuing to address a wide range of human, animal, and plant needs in both urban and rural areas (National Institute for Food and Agriculture). As times change, Extension has been asked to reevaluate its future in order to stay

relevant (Bull, Cote, Warner, & McKinnie, 2004; Reed, Swanson, & Schlutt, 2015). However, Extension agencies are not the sole-source provider in the information and outreach market for adult education anymore (King, Boehlje, 2000). Technology has created the opportunity for other sources, such as other universities, private education developers, commercially based education and training organizations, to become more accessible to the public. Access to information at the tips of our fingers has created competition due to learners no longer being dependent on Extension as a sole-source education provider. Adult education in agriculture through Extension is on a steadfast decline due to the factors of participation not being mandatory, the information being overwhelming during the clinics or events, and the easy accessibility of vast information provided on the internet.

Extension – 4-H Programs

From ages eight to eighteen, students create life skills through hands-on projects, helping them grow confidence, independence, resilience, and compassion through science, health, civic engagements, and agriculture (Kids Build Life Skills Through Hands-On Learning, 2019). Cooperative Extension programs encompass a community of more than 100 public universities and 3,000 local offices, reaching nearly six million young people. Over 3,500 4-H professionals and more than 500,000 volunteers deliver and educate the nation's largest youth-serving organization. 4-H programs are available through local 4-H clubs, camps, and after-school programs. Youth can select from a diverse group of hands-on projects taught by adult mentors in formal and non-formal teaching settings. For ages five to seven, 4-H offers Cloverbud programs. Although the

foundation of all Extension programs remain based in agriculture, today's 4-H program has evolved into a complex and forward-thinking system, offering important opportunities for learning skills related to science, math, technology, and socialization.

Astroth (1996) found that 4-H effectively develops life skills within its members. 4-H programs are grounded in the belief that students learn best by doing. Research showcased that 4-H clubs efficiently helped youth develop critical life skills, such as decision-making, interpersonal skills, a service ethic, communication skills, and responsibility (Borden, Perkins, & Hawkey, 2014). Throughout the research, members noted the hands-on learning opportunities available through the experience were vital to their development (Astroth 1996; Borden et al., 2014; Eccles & Gootman, 2002; Hamilton & Hamilton, 2004). In 1991, Boyd found that 4-H club members rated their skill development higher on the scales of working with groups, social skills, decision-making, and understanding of self. Fox, Schroeder, and Lodl (2003) also found the value that 4-H programs have on youth life and skill development.

Benefits of 4-H only accrue to youth who participate; building and sustaining participation is highly important for all youth organizations (Anderson-Butcher, 2005, p. 6; Hamilton, Northern, & Neff, 2014). Participation is not mandatory; as students get older, more conflicts with sports and other functions may occur. Although Extension educators manage 4-H programs, adult volunteers lead the clubs. Similar to many volunteer-based organizations, 4-H programs are struggling with maintaining enough adult/parent volunteers (Borden et al., 2014). Volunteers are the backbone of 4-H

programs and play an important role in their success. However, the need to recruit, train and retain volunteers has become a major challenge (Borden et al., 2014).

Agricultural Education Grades 7-12

When the U. S. Congress passed the Smith-Hughes Act in 1917, school-based agricultural education (SBAE) became a part of the public education system. Today, over 800,000 students participate in formal agricultural education instructional programs offered in grades seven through adult throughout the 50 states and three U.S. territories (NAAE, 2018). Agricultural education in grades 7-12 teaches about agriculture, food, and natural resources. Through these subjects, agricultural teachers educate students about a wide variety of skills, including leadership, communications, science, math, management and technology (NAAE, 2018).

The Hughes and Barrick (1993) Agricultural Education Program Model showcases the role of SBAE within the context of the school and community. The Agricultural Education Program Model is comprised of four components: 1) classroom and laboratory instruction, 2) application, 3) employment and/or higher education, and 4) career (Hughes & Barrick, 1993; Barrick, Arlington, Herrernan, Hughes, Moody, Ogline, & Whaley, 1992). The model shows the interrelationship between the components of SBAE.

The model reflects the response of agricultural education to recent recommendations for education and to the needs of today's agriculture student as dictated by changes in the agricultural industry, student population, society, workplace, and education system. As indicated by the model, the aims of a SBAE program include: a)

increasing agricultural knowledge; b) developing employability, leadership, and personal skills; c) promoting life-long learning; and d) effectively integrating all individuals into the community as productive citizens. In the following sections, components of the model are described in terms of how they meet these aims and address student needs and recommended changes in the education system.

Classroom and laboratory instruction focuses on technical agriculture, leadership and personal development through activities that enable students to gain knowledge concerning agricultural concepts and problems (Hughes & Barrick, 1993; Phipps, Osborne, Dyer, & Ball, 2008). A considerable amount of an agricultural educator's reputation among students, administrators, parents and community stems from their qualities as a classroom/laboratory instructor (Larsen, 1992; Luft & Thompson, 1995; Roberts & Dyer, 2004). Therefore, instruction is identified as the foundational role of the agricultural educator and program (Terry & Briers, 2010).

The application component emphasizes applied learning, personal development and work-related instruction through FFA and Supervised Agricultural Experiences (SAE) (Hughes & Barrick, 1993). Both activities are varied enough to provide opportunities to students, exploring personal interests as well as participation in occupation-related experiences (Carnegie Corporation, 1989; McEwin & Thomason, 1989). Students are able to apply knowledge learned within the classroom to real-life situations through work-based learning experiences during their supervised agricultural experience (SAE) (Phipps et al., 2008; Talbert, Vaughn, Croom, & Lee, 2007). FFA is dedicated to the individual students, providing a path to success in premier leadership,

personal growth, and career achievement through agricultural education (National FFA Organization, 2019). Members develop their own unique talents and explore their interests through a diverse range of agricultural career pathways. The wide range of activities and individual instruction provided in the application component allows students of differing ability levels, backgrounds and ambitions to productively participate in SBAE programs (Hughes & Barrick, 1993).

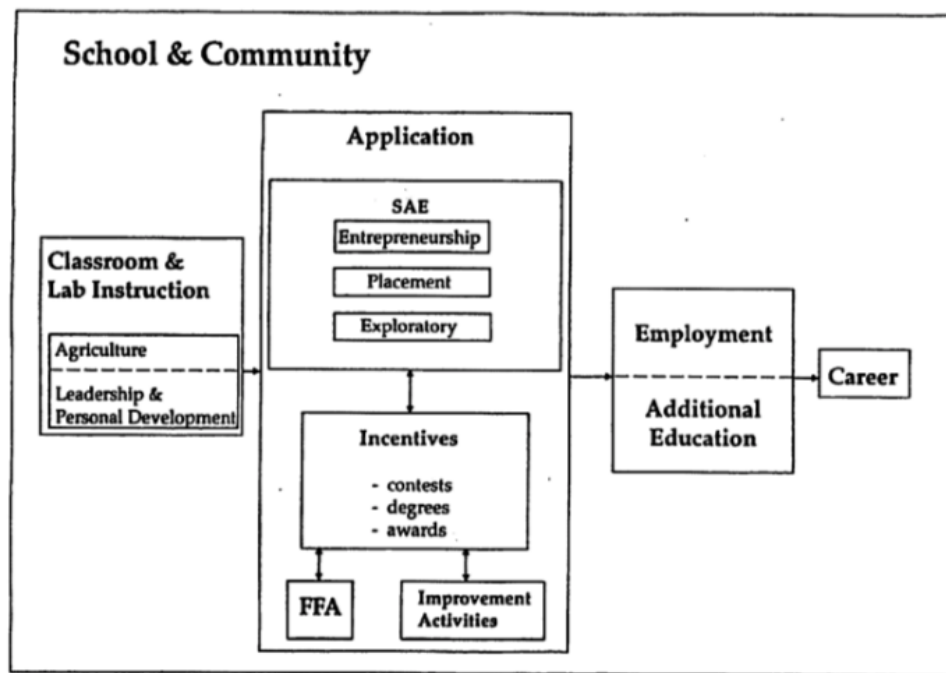


Figure 2.1. Hughes & Barrick's Agricultural Education Program Model (1993)

The final two components, employment/additional education and career, indicate the commitment of agricultural education programs to providing the technical abilities, life-long learning, and personal qualities necessary for the workforce. Together, these components illustrate that SBAE provides benefits to students, regardless of whether they directly enter the workforce or carry on their education (Hughes & Barrick, 2008).

Agricultural education programs aim to develop the whole person through the use of instructional activities to provide the technical and personal skills and qualities needed to obtain employment and establish a rewarding career (Hughes & Barrick 1993).

Again, the many benefits of SBAE courses only accumulate through participation. Courses provided at the middle and high school level are identified as electives, and therefore, not mandatory. Although 800,000 students participate in agricultural education classes, only six percent of the school population successfully completes agricultural coursework. It has been well documented that agricultural colleges and universities across the United States have been struggling for the past 15 years to produce enough qualified graduates for food, agriculture, natural resource, and environmental job openings (Goecker et al., 2004; Goecker et al., 2010; Goecker et al., 2015). Within agricultural education, this gap has resulted in secondary agricultural education program closures when suitable candidates could not be found to fill the positions (Thieman, Rosch, & Suarez, 2016). Smith, Lawver, and Foster (2017) reported only 357 of the 1834 new hires (19.5%) in school-based agricultural education (SBAE) were newly licensed bachelors-degree earners. Therefore, teachers, agricultural groups, and organizations must collaborate to implement and integrate agricultural-based curriculum for the 94% of students who do not receive agricultural-based content (Myers & Dyer, 2004).

History of Agricultural Education at the Elementary Level

Agricultural education at the elementary level is marked throughout history frequently. During the decades when the majority of students grew up on farms, planting, cultivation and harvesting seasons dictated much of the school year. Agricultural

references and examples can be found in many old school books since farming and farm animals were a familiar part of nearly every student's life (Speilmaker & Mitsuoka, n.d.). Such instruction was documented as early as the 1900s. In 1911, Garland Bricker reported on the popularity of agricultural education in the classroom (Hillison, 1998). By 1915, it was reported that 21 states required teachings of agriculture in rural schools and half required such instruction in urban schools (Hillison, 1998). The farm population began to shrink by the 1920s, '30s and '40s; the agricultural emphasis decreased in school books and educational materials (Speilmaker & Mitsuoka, n.d.).

For many years, agricultural educators have discussed the need for instruction in agriculture in the elementary grades (Fox, 1932; Shively, 1936; Herr, 1968; Wolfson, 1970; Keenan, 1970; Shepard, 1970; Swan & Donaldson, 1970; Peterson & Batson, 1973; Snowden & Shoemake, 1973; National Research Council, 1988; Birkenholz, Harris, & Pry, 1994; Frick et al., 1995; Knobloch & Martin, 2002; Knobloch et al., 2007). After some time, change initiated. In 1981, the Agriculture in the Classroom (AIRC) program was created (Hillison, 1998). AIRC programs were implemented and operated by stationed persons at the state level. The National AIRC program, located in Utah, supports state programs by providing a system that seeks to improve agricultural literacy among PreK-12 teachers and students (Speilmaker & Mitsuoka, n.d.).

Elementary and Middle School Teacher Preparation in Agricultural Content

Teacher preparation programs emphasizing blended current curriculum in the context of agricultural content do exist within individual programs, organizations, workshops, and case studies. Some of these programs purchased materials and combined

kits to support the curriculum for each teacher participant in order to enhance curriculum use, promote hands-on learning, and make adoption less problematic (Trexler & Suvedi (1998). Participants within these programs ranged from prekindergarten teachers to advanced placement teachers in high schools and had from one to thirty-five years of teaching experience. Research has suggested that students can gain agricultural content knowledge through core subjects like math, science, social studies, and language arts when educators utilize agriculture as a context (Balschweid, Thompson, & Cole, 1998; Igo, 1998; Knobloch, Ball, & Allen, 2007; McReynolds, 1985; National Research Council, 1998; Vellera & Bodzin, 2016). Each workshop and program differs according to individual state and area. These differences may be due to cost, duration, content coverage, location, design, etc.

The AITC program nationally serves nearly five million students and 60,000 educators annually through workshops, conferences, farm tours, field trips, and other educational activities. In 1981, the U.S. Department of Agriculture (USDA) congregated representatives of agricultural groups and educators in Washington, D.C. to discuss agricultural literacy (Spielmaker & Mitsuoka, n.d.). A task force was created from this group consisting of representatives from agriculture, business, education, and governmental agencies. It was recommended by the task force that the USDA be the coordinator for national agricultural classroom literacy and sponsor regional meetings to assist states with organizing their own programs (Spielmaker & Mitsuoka, n.d.). AITC Programs can be found in many states throughout the nation and each is organized and staffed differently. State programs may be affiliated with departments of agriculture,

universities, agricultural organizations or private non-profit foundations. Some programs have full-time staff while others operate solely on volunteers. Although Montana's AITC affiliated website states that it also offers workshops for teachers year round, there are no dates listed of any upcoming workshops in 2019. There are however, a few lesson plans geared toward elementary education curriculum (AITC, n.d.). On the other hand, Oklahoma's AITC website provides detailed lessons in English and Spanish, which as of 2018, are all aligned with their Oklahoma Academic Standards (Harmon & Mitsuoka, 2018), grant opportunities, and classroom resources. Many countries around the world and other organizations have left requests for information regarding AITC and indicated wanting to learn how to properly deliver their programs with equal success (Spielmaker & Mitsuoka, n.d.).

The Arizona AITC program has provided a Summer Agricultural Institute (SAI). This workshop is a five-day, traveling tour designed to educate K-12 educators about food and fiber production, combining hands-on learning about agriculture with practical curriculum development, helping them incorporate the new knowledge gained into their individual classroom curriculums (SAI, 2019). This program is traditionally held annually in Phoenix, Arizona, through the University of Arizona's Extensions program with support from AITC. Tours are conducted in various locations around the state (SAI, 2019) and participants have indicated that the weeklong tours are "educationally jam-packed weeks," "amazing, fast-paced, and informative," and "packed with interesting info, extremely valuable, exhausting, [but] not to be missed!" (SAI, 2019). Participants do not pay to apply but must be accepted to participate; if accepted, participants only pay

\$125. Once participants complete the SAI, they receive a certificate indicating the earning of forty-eight professional development hours. The University of Arizona College of Agriculture and Life Sciences will also grant the option for participants to earn up to three graduate level credits. However, this is not included within the designated price.

In Oregon, another SAI project was offered, but through the Farm Bureau. Similar to the one in Arizona, this institute is a weeklong class that educates K-12 teachers with little or no background in agriculture (SAI, 2019). Participants are also taught how to utilize agriculture as a context within standard subjects like social studies, science, math and language arts. All participants receive educational materials to help them incorporate what they've learned into their classrooms and receive three graduate-level college credits. However, the graduate-level credits are mandatory and come at a total cost of \$600 for the weeklong experience. A major highlight of the week for the participants is an overnight stay on a working farm providing the opportunity for K-12 educators to meet and converse with a local farm family (SAI, 2019). Since 1989, SAI has enrolled around 1,200 Oregon educators.

The Texas Farm Bureau AITC program has one-day workshops that focus on science. Resource material is free and professional development credits are offered to participants. Online lesson plans for AITC are provided and educators can apply for a school visit program where the farm is brought to your classroom. The bureau also provides ten teacher scholarships to first-time attendees to the SAI to attend the National AITC Conference.

Intervention programs regarding agricultural literacy with elementary educators (K-8) have shown positive results. Research has revealed that educators are aware of the opportunity to use agriculture as a context for math, science, social studies, and language arts but lack knowledge of agricultural concepts (Balschweid et al., 1998; Trexler & Suvedi, 1998). Through participation, educators enrolled within these programs showcased an increase in agricultural literacy (Anderson, Velez, & Thompson, 2014). However, despite the in-depth content provided at these workshops and programs, participants did not display more than a basic understanding of agriculture. The majority of participants' understanding consisted of animals and plant production, while soils, agricultural mechanics, and economics showcased the least amount of understanding (Anderson et al., 2014; Balschweid et al., 1998). Further, majority of participants indicated agriculture provided connections for their students, stating that agriculture benefited students' learning, connecting them to the bigger world (Balschweid et al., 1998; Knobloch et al., 2007; Knobloch & Martin, 2002; Trexler & Suvedi, 1998 Swortzel, 1997). Although research indicates that some elementary and middle school educators have a positive attitude toward the agricultural industry, language arts and mathematics teachers were less knowledgeable and had a less positive attitudes compared to other majors (Harris & Birkenholz, 1996).

Rationale for Preparing Preservice Elementary Educators in Agricultural Education

Teacher preparation programs are the foundation for preparing preservice teachers, students in teacher preparation program who have not received certification, in knowledge and expertise of their content areas. Many agricultural students, parents, teachers, and industry leaders believe that agricultural education provides a context-rich environment that facilitates and creates concrete learning. According to agricultural educators and the National Resource Council (1998; 1999; 2012), agriculture should be integrated into existing K-12 math, science, literature, engineering, and technology curricula (Balschweid, Thompson, & Cole, 2000; Trexler et al., 2000). Agricultural education has been documented through research to positively influence students' understanding of reading, writing, and math (Park & Osborne, 2005; Parr, Edwards, & Leising 2006; Young, Edwards, & Leising, 2009; McKim, Sorensen & Valez, 2016). However, an educator's background and experience plays a significant role in teaching students within any subject matter, including agriculture. Non-agricultural educators possessing genuine agricultural experience have been documented to showcase more knowledge and accurate perceptions of the topic (Terry, Herring, & Larke, 1992; Humphrey, Stewart, & Linhardt, 1994). Yet, preservice elementary educators were recorded to be the most confident in teaching agriculture (Terry et al., 1992).

An educator's knowledge, attitude, and expectations of potentially teaching a new curriculum possess correlating predictors of the amount of new curriculum actually taught (Rudd & Hillison, 1995; Stripling & Roberts, 2000). Several agriculturally based curriculum materials have been created and dispersed to elementary teachers since the

1988 report from the National Research Council (Committee on Agricultural Education in Secondary Schools, 1988). Curriculum packages have been produced by projects such as AITC; Project Food, Land, and People (1998); Project Learning Tree (2002); Project WET (2005); and Project WILD (2005) to assist educators in integrating agricultural concepts and experienced-based learning for students. Even though organizations and workshops are available to assist educators and studies have found that educators favor impressions of agriculture, acknowledge it would enhance their curriculum, and believe agriculture could be integrated, it is still not present in classrooms (Bellah & Dyer, 2009; Vallera & Bodzin, 2016). Is this why our nation is still considered to be agriculturally illiterate? By determining commonly held conceptions among groups, curriculum and educational programs can be tailored to meet the needs of learners (Trexler & Meischen, 2002). Thus, the challenge facing educators is not a lack of available curriculum resources; rather, how to successfully and seamlessly integrate agriculture into their existing curriculum. Though, before integration, educators should possess the content knowledge required for successful implementation.

Theoretical Framework

Diffusion of Innovation: Innovation Decision Process

The process of adopting new innovations or projects has been studied for over 40 years; Rogers' book, *Diffusion of Innovations*, is one of the most popular adoption models (Sahin, 2006; Sherry & Gibson, 2002) and has been used as a lens for investigating the adoption of agricultural literacy within elementary classrooms. According to Rogers (2003), "adoption is a decision of full use of an innovation, and

rejection is a decision not to adopt the innovation” (p. 177). Diffusion is how an innovation is communicated among a social system over time (Rogers, 2003). Successful innovation integration starts first with knowledge of the innovation, then persuasion based on the perceived characteristics, then the decisions of either to accept or reject the innovations, and finally, implementations and confirmation. These stages typically follow each other in order.

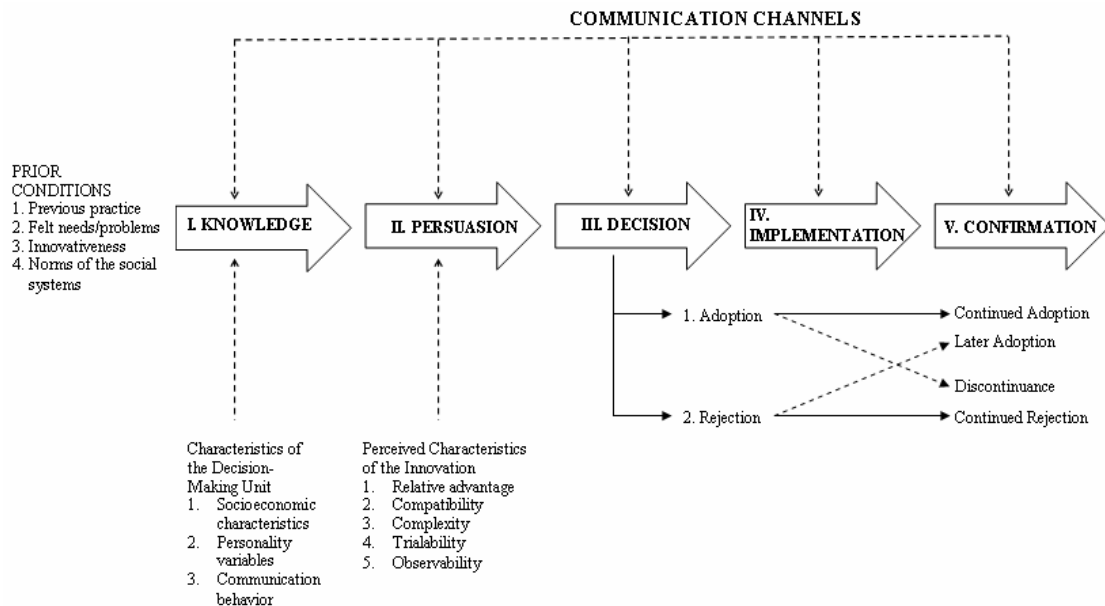


Figure 2.2. A model of Rogers (2003) Five Stages in the Innovation-Decision Process

Positive innovation adoption starts with the knowledge stage. Within this step, an individual first learns about existence and then seeks information about innovation, the “what?,” “how?,” and “why?” questions (Sahin, 2006). According to Rogers (2003), there are three subcategories: (1) awareness knowledge, (2) how-to knowledge, and (3) principles knowledge. Awareness knowledge represents the individual’s knowledge of its existence. This type can provide motivation to learn more about the innovation and

potentially accept it. Further, it may inspire the individual to learn about the other two types of knowledge (Sahin, 2006). How-to-knowledge contains information on how to correctly utilize the new innovation. This knowledge was seen as an essential variable in the innovation-decision process as noted by Rogers (2003). To increase the acceptance rate of an innovation or program, an individual should have a sufficient level of how-to knowledge prior to integration (Sahin, 2006). Lastly, principles knowledge contains the principles describing how and why an innovation works. Without this knowledge, an innovation can be accepted, but the misuse of it may cause its inevitable rejection. Therefore, to create a positive application of a new innovation, a how-to experience and a know-why experience should be implemented (Seamann, 2003). An individual may have all the necessary content knowledge, but an individual's attitude also shapes the acceptance or rejection of a potential innovation.

Persuasion to either accept or reject the innovation is based on the individual's negative or positive attitude toward it. After knowledge is developed, either true or false understandings, is when the persuasion stage occurs in the innovation-decision process. If a degree of uncertainty exists, opinions from others affect the individual's opinions. According to Sherry (1997), close peers' evaluations of an innovation are usually more credible to the individual compared to experts and educators. Search for innovation evaluations information is continued through the decision stage (Sahin, 2006).

The decision stage is where the individual decides whether to accept or reject the program. Adoption refers to professing "full use;" rejection means to "not adopt" (Rogers, 2003, p. 177). There are two types of rejection: active rejection and passive

rejection. If an individual tries an innovation, thinks about accepting it, but later decides not to, it is active rejection. Therefore, with a passive rejection, the individual never thought about accepting the innovation (Sahin, 2006).

The last two stages are implementation and confirmation. Within these stages, the innovation-decision has already been made. Implementation is when an innovation is put into practice. Uncertainty of outcomes may still arise within this stage. Therefore, reinforcement may be needed from agents, experts or educators. At the confirmation stage, the individual looks for support for their decision. Attitudes are crucial within this stage. A change in their attitude may be the result of the support the individual receives after acceptance, and later continuing acceptance or discontinuance may occur (Sahin, 2006).

Rogers (2003) defined the adopter categories as innovators, early adopters, early majority, late majority, and laggards. According to Rogers's Adopter Categorization on the Basis of Innovativeness model (2003), each adopter category represents the degree of a participant's innovativeness, an individual's degree of adoption. Innovators, early adopters, and early majority individuals are relatively quicker in accepting new ideas than other members (Rogers, 2003). Individual innovativeness helps researchers understand the desired behavior in the innovation-decision process. See Figure 2.3 for more detail.

Innovators, according to Rogers (2003), are early adopters who are willing to experience new ideas. The conversation expands further to suggest innovators are the gatekeepers bringing the innovation in from the outside. Innovators' adventurous behavior requires them to have a complex technical knowledge (Rogers, 2003).

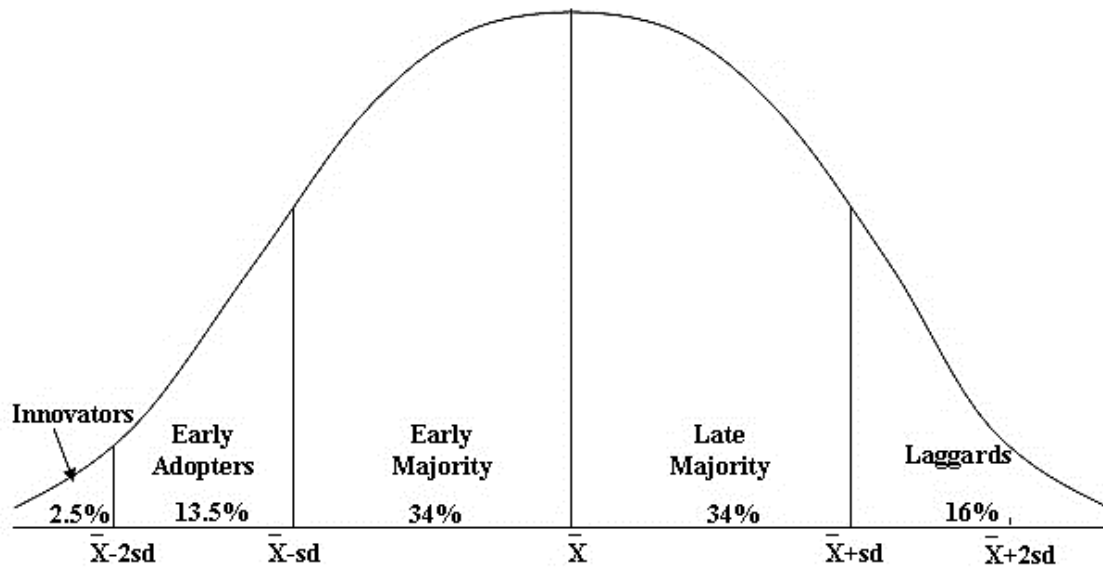


Figure 2.3. Rogers (2003) Adopter Categorization on the Basis of Innovativeness

Early adopters, compared to innovators, limit themselves with more boundaries of the social system. However, according to Rogers (2003), early adopters are more likely to hold leadership roles where others seek advice or information about the innovation. As role models, early adopters' attitudes toward a new innovation are highly important. Having an early adopter's stamp of approval on a new idea enhances the opportunity for others to adopt it (Rogers, 2003, p. 283).

Early majority persons tend to have a good relationship with others of the social system but do not have the leadership role in which early adopters possess. Yet, their relational interactions are still important. Figure 2.3 shows, the early majority adopts just before the other half of their peers will. Rogers (2003) states that although the early majority are cautious in adopting an innovation, they are neither the first nor the last to do so.

Late majority are similar to early majority, but include one-third of all members who wait until most of their peers have chosen to adopt the innovation (Rogers, 2003). Peer pressure and economic necessity may lead them to the adoption process even though they are skeptical of its outcomes. According to Rogers (2003), persuasion to adopt from interpersonal networks can reduce uncertainty in the late majority.

Laggards have a traditional view and are more skeptical about innovations and change compared to the late majority (Rogers, 2003). Their interpersonal networks mainly consist of members within the laggard's category. According to Rogers (2003), they do not have a leadership role due to their limited resources and lack of awareness-knowledge. Before they potentially adopt the innovation, they need to see if it works first by their peers.

Rogers further describes his five categories of adopters into two main groups: early adopters and later adopters. Innovators, early adopters, and early majority reside in the early adopters, while late majority and laggards comprise later adopters (Rogers, 2003).

Theory of Planned Behavior

An educator's attitudes toward potentially teaching a new topic or curriculum are important to consider; attitudes possess correlating predictors of the amount of new curriculum actually taught (Rudd and Hillison, 1995). Introduced by Fishbein and Ajzen (1975), the Theory of Reasoned Action (TRA) states that an understanding of attitudes would increase the predictability of behaviors. According to Fishbein (1967), attitude alone is not enough for behavior prediction; it must be utilized in conjunction with other

variables such as attitude toward behavior, personal norms, and motivation to comply with societal norms. The theory of planned behavior covers the boundary condition of pure volitional control indicated by the theory of reasoned action (Ajzen, 1985). This is accomplished by including beliefs concerning the possession of necessary resources and opportunities for performing a given behavior. The greater their perceived behavioral control over the behavior, the more resources and opportunities individuals think they possess (Madden et al., 1992). As illustrated in Figure 2.4, behavioral and normative beliefs can be seen as separate beliefs and treated as partly independent determinants of behavior. Sheppard, Hartwick and Warshaw (1988) stated that the model predicts behavioral intentions and is beneficial for identifying where and how to target strategies for altering behavior.

Figure 2.4 presents the theory of planned behavior. Included as an exogenous variable, perceived behavioral control has both a direct and indirect effect on behavior through intentions (Madden et al., 1992). The direct effect on behavior through intentions is assumed to reflect the actual control an individual has over performing the behavior. The indirect path from perceived behavioral control to behavior is based on the assumption that perceived behavioral control has motivational implication. When individuals believe they have little control over performing the behavior due to a lack of necessary resources, their intentions to perform the behavior are lowered even if they have favorable attitudes and/or subjective norms regarding the performance of the behavior (Madden et al., 1992; Proshansky & Seidenberg, 1965). There is first-hand

evidence that an individuals' behavior is strongly influenced by the confidence they have in their capability to perform the behavior (Bandura, Adams, Hardy, & Howells, 1980).

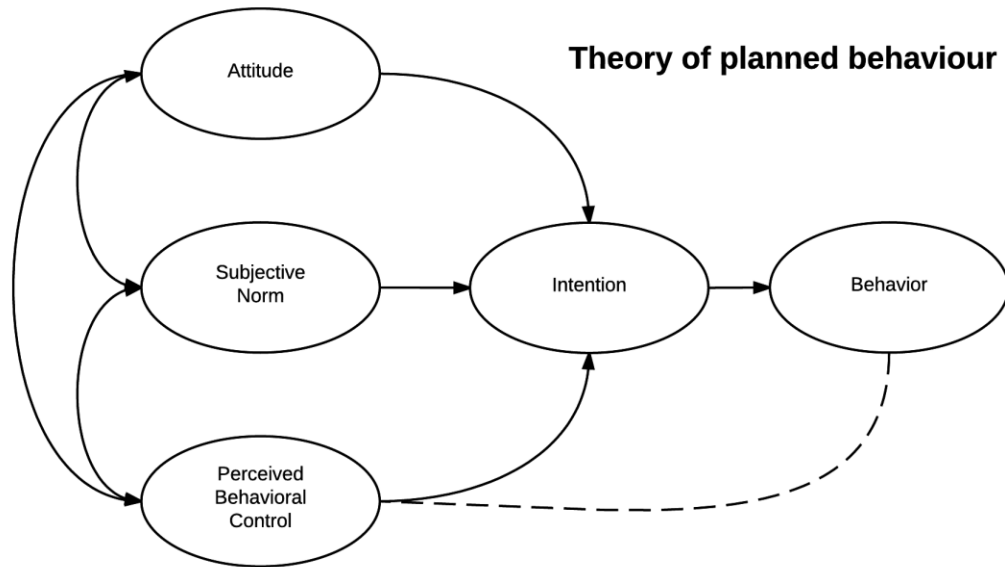


Figure 2.4. Ajzen's Theory of Planned Behavior (Ajzen, 1991)

The behavioral beliefs are suggested to be the underlying influence of an individual's attitude toward performing the behavior, and the normative belief influences the individual's subjective norm about performing the behavior (Madden et al., 1992). Thus, information or salient beliefs affect intentions and consequent behavior either through attitudes and/or through subjective norms (Fishbein & Ajzen, 1975). Attitudes about performing a behavior would predict behavioral intentions to enact the behavior, which in turn would predict the behavior. Fishbein and Ajzen (1974) stated that the inconsistency between attitudes and behaviors could be improved by measuring attitudes and behaviors at the same level of specificity.

Both of these theories were utilized as a lens to construct questions, analyze data, and provide applicable recommendations. According to the theory of planned behavior, rather than using global attitudes (e.g., attitudes toward agricultural content in the classroom) to predict specific behaviors (e.g., number of implemented lessons utilizing agriculture as a context), Fishbein and Ajzen (1975) suggested that researchers should focus on the specific antecedents of specific behaviors (e.g., attitudes toward implementing agriculture as a context within their core subjects). However, having the proper understandings and knowledge about agriculture may influence preservice elementary educators' perceived comfort levels in potentially utilizing it and finally, adopting it. Understanding where participants reside on the innovativeness spectrum will help researchers understand the next generations' willingness and attitude toward adopting agriculture within their lessons.

Chapter Summary

Many agricultural and nonagricultural students, parents, teachers, and industry leaders believe that agricultural education provides a context-rich environment that facilitates and creates concrete learning. Although the future of agriculture is considered highly important, agricultural education only reaches to the relatively small percentage of students considering a career in agriculture, pursuing vocational agricultural studies, or affiliated with 4-H (National Research Council, 1988). Agricultural education within the secondary level educates grades seven through twelve, while 4-H is only offered outside of school. Therefore, the majority of the student population in grades six and under are not receiving any form of agricultural education. In 1988, the National Research Council,

along with many agricultural educators, recommended that systematic instruction about agriculture should start in kindergarten and continue through twelfth grade. The challenge facing educators is not a lack of available curriculum resources or how to successfully and seamlessly integrate agriculture into their existing curriculum; rather, before integration, educators should possess the content knowledge required for this successful implementation. An educator's attitude toward potentially teaching a new topic or curriculum is important to consider; attitudes possess correlating predictors of the amount of new curriculum actually taught (Rudd & Hillison, 1995). Rogers (2003) stated that the first step in adopting an innovation is acquiring knowledge of the innovation. Even when information, ideas, or innovations do reach educators or other intended users, and even if they profess that they accept and intend to use them, the effective application tends to fade, straying from the intended use, or taking on new forms (Green, Ottoson, García, & Hiatt, 2009) without the proper understandings, knowledge, and attitude.

METHODOLOGY

The purpose of this study was to determine Montana State University preservice elementary educators' perceptions toward agriculture, educating about agriculture, and incorporating agricultural topics within their lessons. Specific research objectives included:

1. Identify preservice elementary educators' perceived benefits and barriers to using agricultural content to teach core academics.
2. Identify preservice elementary educators' comfort levels about utilizing agriculture as a context to teach core subjects.

Population and Sample

The target population for this study was Montana State University (MSU) preservice elementary education students enrolled in one or more of the following 2019 spring K-8 methods courses: science, math, social studies, and language arts (N = 75). Students enrolled in these courses explore methods of teaching content, skills and attitudes in the elementary classroom and learn best practices for teaching in each content area. Students enrolled in the previously listed 2019 method courses completed their student teaching between August 2019 and May 2020.

Five MSU elementary education faculty members dispersed a survey link to their students, which was provided by researchers. Following the recommendations of Dillman, Smyth and Christian (2009), the list was created and checked utilizing the following guidelines:

1. The list contained everyone in the survey population.
2. The list did not include names of people who were not in the study population.
3. The list was well maintained and updated.
4. Each member of the population on the master list was assigned a researcher-generated personal code.

Participants were incentivized to partake by having the option to receive a gift card to the MSU Bookstore, which, according to Dillman et al. (2009), should increase response rate.

Out of the seventy-five ($N=75$) students enrolled across all eight methods courses (two of each: Language Arts, Math, Science and Social Studies), $n = 22$ responded to the survey. When solely looking at the number of students enrolled within all methods courses, it accumulated for a sum of 122 students. In our survey, 22 responded, which accounted for 50 out of 122 enrolled students (40.98%). Within the 22 participants, two students were enrolled in only one methods course ($n=2$, 9.09 %), twelve were enrolled in two methods courses ($n=12$, 54.54%), and eight were enrolled in three methods courses ($n=8$, 36.36%). Data collection efforts yielded $n = 22$ responses, accounting for a 29.33% response rate, yielding a representative distribution of the population ($N=75$) of students in the various methods courses. For further detail, see Tables 3.1 and 3.2.

Table 3.1. Total Population ($N=75$)

Methods Course	<i>f</i>	%
Language Arts	28	22.95
Math	27	22.13
Science	23	18.85
Social Studies	44	36.07
Total	122	100

Table 3.2. Sample Population ($n=22$)

Methods Course	f	%
Language Arts	13	26
Math	10	20
Science	16	32
Social Studies	11	22
Total	50	100

Nonresponse Error

When utilizing a voluntary survey, planning for nonresponse error within a population is highly important. Nonresponse errors can occur when individuals in the sample or population fail to provide usable responses for the study (Linder, Murphy, and Briers, 2001). Due to the anonymity and the limitations of the IRB, nonresponse error could not be addressed.

Research Design

This study utilized both quantitative and qualitative data collected through a researcher-designed Qualtrics survey. The survey instrument was closely edited and checked for content validity and reliability. Validity was evaluated based on the use of the verbiage contained in the National Agriculture Literacy Outcomes (NALO) document (Spielmaker & Leising, 2019). Reliability was evaluated through a pilot test to undergraduate preservice teachers in agricultural education. Researchers ensured that the instrument would address the objectives, as well as provide meaningful data that could then be analyzed to address the topic. The instruments included a general demographics

section, multiple choice and open-ended questions, and a Likert-type section. See Appendix B for a full list of survey questions.

For objective one, respondents categorized and ranked each of the following as a potential barrier or benefit: time, funding, resources/materials, content knowledge, standard alignment, curriculum alignment, commitment, support/guidance, reward/recognition, and personal interest. Based on the literature review these barriers and benefits were created based on previous studies (Bellah & Dyer, 2009; Hess & Trexler, 2011; Osborne & Dyer, 2000; Talbert & Larke, 1995; Thompson & Russell, 1993; Stripling & Roberts, 2013; Swortzel 1997;). They then rated their knowledge and attitude toward Montana agriculture based on a scale of 1 to 10 (10 being very knowledgeable and positive). Lastly, they were asked to provide a short answer explaining their attitude rating.

For objective two, each item in the Likert-type section asked respondents to identify their perceived comfort level in utilizing the NALOs (Spielmaker & Leising, 2019) within four subject areas (math, science, social studies, and language arts). Participants responded to 10 Likert-type items as part of the survey instrument and indicated whether they were very comfortable, comfortable, uncomfortable, or very uncomfortable in utilizing the NALOs within the four common core subjects. Then, they were asked to rate their level of confidence to successfully utilize and implement agricultural literacy resources and materials through a multiple choice question (highly confident, confident, unconfident, or highly unconfident). Lastly, respondents were asked to choose the following likeness toward their tendency in adopting the innovative

educational approach through a multiple choice question (Change is good; I'll go first [Innovators], I want to see the research first [Early Adopters], I'll do it once I see it working for a few others [Early Majority], If it works for most others, it will work for me [Late Majority], or I really don't like new stuff [Laggards]). Rogers's (2003) five identified adopter categories were not utilized in the multiple choice question on the survey in order to rule out any nuisance variables/questions from participants.

Data Collection and Analysis Procedures

Institutional Review Board approval was received (April 12, 2019) before the data collection began on April 23, 2019. The five elementary education methods course instructors were first contacted on April 22, 2019 and provided a link to share with their students. Dillman et al. (2009) suggests that a follow-up request be sent at least twice, being sent every week or every other week. The instructors were sent a follow up invitation on April 29 and May 2, 2019. See Table 3.3 for more detail.

Table 3.3. Time Schedule

Date	Activity
April 22, 2019	Pre-notice email
April 23, 2019	Formal request for participation in study
April 29, 2019	Reminder email
May 2, 2019	Reminder email

After two weeks, responses were analyzed utilizing both Qualtrics analysis methods and exporting data to Excel to determine frequencies, means, and standard deviations. With respect to methods outlined by Patton (2002), qualitative data gathered during the workshop was analyzed using a content analysis approach. Emergent codes

were organized into themes to represent “several codes aggregated to form a common idea” (Creswell, 2013, p.186). Data analysis debriefing sessions were conducted between researchers to reduce bias and establish inter-rater reliability (Denzin, Lincoln, and Giardina, 2006; Guba, 1981).

Protection of Human Rights

All respondent involvement in this study was voluntary and participants were made aware of their right to withdraw from the study at any time. Respondents were coded to minimize risk (Dillman et al., 2009) to address subject security. Upon request, subjects can view copies of the completed study.

Chapter Summary

Targeting preservice elementary education students registered in the science, social studies, math, and language arts methods courses at MSU, this study utilized an online, researcher-designed survey to gather information to explore agricultural literacy. The survey included multiple-choice questions, open-ended responses, and Likert-type items to gauge respondents’ thoughts toward implementing agricultural education into their potential classrooms. Twenty-two students completed the survey over the course of two weeks, yielding a representative distribution of the population (N=75). Excel was used for descriptive statistics. Means, percentages, and frequencies were used to summarize and categorize the information gathered. The Theory of Diffusion of Innovations Process (Rogers, 2003) and Theory of Planned Behavior (Fishbein & Ajzen, 1974; 1975) were utilized as a lens to construct questions and analyze data

RESULTS

The purpose of this study was to determine Montana State University preservice elementary educators' perceptions toward agriculture, educating about agriculture, and incorporating agricultural topics within their lessons. Specific research objectives included:

1. Identify preservice elementary educators' perceived benefits and barriers to using agricultural content to teach core academics.
2. Identify preservice elementary educators' comfort levels about utilizing agriculture as a context to teach core subjects.

Demographics

As a collective group ($n=22$), respondents were asked to self-identify age, sex, and ethnicity. The average respondent was a twenty-one-year-old ($n=15$, 68.18%) white ($n=22$, 100%) female ($n=21$, 95.45%), from a suburban area ($n=9$, 40.91%) with a population between 5,000 – 20,000. Although eight participants responded *yes* ($n=8$, 36.36%) and three responded *not sure* ($n=3$, 13.64%) to having an agricultural education program at their high school, the majority did not partake in either 4-H ($n=18$, 81.81%) or FFA ($n=21$, 95.54%) growing up. The majority of the preservice elementary educators indicated wanting a job teaching either third ($n=18$, 81.81%), second ($n=16$, 72.72%), fourth ($n=16$, 72.72%) or fifth grade ($n=14$, 63.63%). For full results see Table 4.1.

Table 4.1 Preservice Elementary Educators Descriptive Information (n=22)

	<i>f</i>	%
Age		
20	2	9.09
21	15	68.18
22	4	18.18
38	1	4.55
Gender		
Female	21	95.45
Male	1	4.55
Ethnicity		
White	22	100
Population of Hometown		
Rural (< 5,000)	6	27.27
Suburban (5,000 - 20,000)	9	40.91
Urban (20,000 <)	7	31.82
Participated in 4-H		
Yes	4	18.18
No	18	81.82
If yes, years in 4-H		
1-3	4	18.18
Ag Ed Program in HS		
Yes	8	36.36
No	11	50
Not sure	3	13.64
Participated in FFA		
Yes	1	4.55
No	21	95.45

Objective One

Objective one sought to identify potential benefits and barriers to utilizing agriculture as a context in teaching core academics. From a list, respondents categorized and ranked each word either in the benefit or barrier box. Words from the list consisted of time, content knowledge, standard alignment, curriculum alignment, reward/recognition, support/guidance, commitment, resources/materials, funding, and personal interest. In

addition to the categorizing and ranking item, respondents had the opportunity to provide ratings on their self-identified knowledge and attitude toward Montana agriculture and, further, provided a short response to elaborate where applicable.

Respondents indicated *Time* and *Funding* ($n=21$, 95.45%) construct items were the most significant barriers to potentially utilizing agriculture as a context to teach core academics. Following closely behind were *Resources/Materials* ($n=19$, 86.36%) and personal *Content Knowledge* ($n=16$, 72.73%). Preservice elementary educators' perceived barriers to utilizing agriculture as a context in teaching core academics are presented in Table 4.2.

Table 4.2 Preservice Elementary Educators' Perceived Barriers ($n=22$)

Barriers	<i>f</i>	%
Time	21	95.45
Funding	21	95.45
Resources/Materials	19	86.36
Content Knowledge	16	72.73
Standard Alignment	10	45.45
Curriculum Alignment	10	45.45
Commitment	10	45.45
Support/Guidance	9	40.91
Reward/Recognition	6	27.27
Personal Interest	5	22.73

Respondents indicated *Personal Interest* ($n=17$, 77.27%) and *Reward/Recognition* ($n=16$, 72.73%) construct items were the most significant advantages to potentially utilizing agriculture as a context to teach core academics. *Support/Guidance* ($n=13$, 59.09%) was the third most prominent advantage ranked. Preservice elementary

educators' perceived advantages to utilizing agriculture as a context in teaching core academics are presented in Table 4.3.

Table 4.3 Preservice Elementary Educators' Perceived Benefits (n=22)

Benefits	<i>f</i>	%
Personal Interest	17	77.27
Reward/Recognition	16	72.73
Support/Guidance	13	59.09
Standard Alignment	12	54.55
Curriculum Alignment	12	54.55
Commitment	12	54.55
Content Knowledge	6	27.27
Resources/Materials	3	13.64
Funding	1	4.55
Time	1	4.55

Respondents had the opportunity to provide a short response to elaborate their overall awareness and attitude about Montanan agriculture. First, respondents were asked to define agriculture in their own words. Recurring themes among respondents included farmers and/or ranchers working with plants and/or animals in order to effectively provide and produce agricultural commodities for consumers. A respondent enrolled in both a Social Studies and Math Methods course stated that, agriculture is *“Anything to do with plants and animals that humans use for any form of resource.”* A Math Methods course student stated, *“Farming. Producing consumable(s) through growing of crops and raising of animals.”* A student enrolled in both a Language Arts and Science Methods course responded that *“Agriculture has to do with crop production as well as livestock, working toward sustaining these things in order to protect the planet while efficiently and*

effectively provide (and) produce for people.” One Science Methods course student stated “*Agriculture is the production and harvest of animals and crops.*”

Second, respondents were asked to rate their knowledge of and attitudes toward Montana agriculture based on a scale of 1 to 10 (10 being very knowledgeable and positive). Respondents were also asked to provide a short answer explaining their attitude rating. Although preservice elementary educators rated their overall knowledge of Montana agriculture on average as a 3.5, they had a positive attitude toward Montana agriculture ($M=7.4$).

Objective Two

The purpose of objective two was to identify participants’ comfort level in potentially utilizing agriculture as a context to teach core academics (language arts, math, science, and social studies). Participants responded to 10 Likert-type items as part of the survey instrument and indicated whether they were very comfortable, comfortable, uncomfortable or very uncomfortable in utilizing the National Agriculture in the Literacy Outcomes (NALOs) within the four common core subjects.

Members of the *Math Methods* course ($n=10$) indicated they were very comfortable to comfortable utilizing the following learning outcomes: *Estimate the size and weight of pumpkins, sprouting pumpkin seeds and making pumpkin pie in a bag* ($n=9$, 90%); *Explain the costs associated with producing and purchasing food* ($n=9$, 90%); *Using tomatoes as a theme, the students will practice their math and science skills of estimating, measuring, counting, graphing and sequencing* ($n=8$, 80%); and *Evaluate serving size related to nutritional needs* ($n=8$, 80%). The learning outcomes identified as

very uncomfortable to uncomfortable to utilize were: *Explain how prices for agricultural goods are determined* (n=8, 80%); *Determine the relationship between producers and consumers and how agricultural supply and demand affects commodity prices* (n=7, 70%); *Identify terms solutes, solvents and parts per million, and learn how fertilizer solution is properly calculated and applied* (n=7, 70%); and *Describe how technology helps farmer/ranchers increase their outputs (crops and livestock yields) with fewer inputs (less water, fertilizer and land) while using the same amount of space* (n=5, 50%). For full results see Table 4.4.

Members of the *Science Methods* course (n=16) responded to 10 Likert-type items and indicated whether they were very comfortable, comfortable, uncomfortable or very uncomfortable in utilizing science based NALOs. Preservice elementary educators responded they were very comfortable to comfortable utilizing the following learning outcomes: *Identify natural resources* (n=13, 81.25%); *Identify the types of plants and animals found on farms and compare with plants and animals found in wild landscapes* (n=12, 75%); *Describe how farmers/ranchers use land to grow crops and support livestock* (n=10, 62.5%); and *Recognize and identify examples of simple tools and machines used in agricultural settings (e.g., levers, screws, pulley, wedge, auger, grinder, gears, etc.)* (n=10, 62.5%). The learning outcomes identified as very uncomfortable to uncomfortable to utilize were: *Understand the concept of stewardship and identify ways farmers/ranchers care for soil, water, plants and animals* (n=10, 62.5%) and *Explain the harmful and beneficial impacts of various organisms related to agricultural production*

and processing (e.g., harmful/beneficial insects) and the technology developed to influence these organisms (n=10, 62.5%). For full results see Table 4.5.

Table 4.4 Preservice Elementary Educators' Indicated Comfort Level about NALOs within Math ($n=10$)

Learning Outcomes	Highly Uncomfortable		Uncomfortable		Comfortable		Highly Comfortable	
	<i>f</i>	%	<i>f</i>	%	<i>f</i>	%	<i>f</i>	%
Estimate the size and weight of pumpkins, sprouting pumpkin seeds, and making pumpkin pie in a bag.	-	-	1	10.0	7	70.0	2	20.0
Using tomatoes as a theme, the students will practice their math and science skills of estimating, measuring, counting, graphing, and sequencing.	1	10.0	1	10.0	6	60.0	2	20.0
Explain the costs associated with producing and purchasing food.	-	-	1	10.0	7	70.0	2	20.0
Describe how technology helps farmers/ranchers increase their outputs (crop and livestock yields) with fewer inputs (less water, fertilizer, and land) while using the same amount of space.	-	-	5	50.0	4	40.0	1	10.0
Describe how supply and demand impact the price of agricultural goods.	-	-	3	30.0	5	50.0	2	20.0
Compare growth and production of citrus fruits and participate in an activity where they use skills of observation and mathematical computation to compare and contrast grapefruits and lemons.	-	-	4	40.0	6	60.0	-	-
Create, read, and interpret graphs relating to the economic importance of the dairy industry and be challenged to understand the economic consequences of a day without dairy.	1	10.0	2	20.0	6	60.0	1	10.0
Evaluate serving size related to nutritional needs.	1	10.0	1	10.0	6	60.0	2	20.0
Explain how prices for agricultural goods are determined.	1	10.0	7	70.0	1	10.0	1	10.0

Table 4.4 Continued

Learning Outcomes	Highly Uncomfortable		Uncomfortable		Comfortable		Highly Comfortable	
	<i>f</i>	%	<i>f</i>	%	<i>f</i>	%	<i>f</i>	%
Determine the relationship between producers and consumers and how agricultural supply and demand affects commodity prices.	2	20.0	5	50.0	2	20.0	1	10.0
Identify terms solutes, solvents, and parts per million, and learn how fertilizer solution is properly calculated and applied.	2	20	5	50	2	20	1	10

Table 4.5 Preservice Elementary Educators' Indicated Comfort Level about NALOs within Science (*n*=16)

Learning Outcomes	Highly Uncomfortable		Uncomfortable		Comfortable		Highly Comfortable	
	<i>f</i>	%	<i>f</i>	%	<i>f</i>	%	<i>f</i>	%
Describe how farmers/ranchers use land to grow crops and support livestock.	2	12.5	4	25	9	56.25	1	6.25
Identify the types of plants and animals found on farms and compare with plants and animals found in wild landscapes.	-	-	4	25	9	56.25	3	18.75
Recognize and identify examples of simple tools and machines used in agricultural settings (e.g., levers, pulley, wedge, grinder, gears, etc.).	1	6.25	5	31.25	8	50	2	12.5
Identify natural resources.	-	-	3	18.75	11	68.75	2	12.5
Understand the concept of stewardship and identify ways farmers/ranchers care for soil, water, plants, and animals.	1	6.25	9	56.25	4	25	2	12.5

Table 4.5 Continued

Learning Outcomes	Highly Uncomfortable		Uncomfortable		Comfortable		Highly Comfortable	
	<i>f</i>	%	<i>f</i>	%	<i>f</i>	%	<i>f</i>	%
Identify examples of how the knowledge of inherited traits is applied to farmed plants and animals in order to meet specific objectives (i.e., increased yields, better nutrition, etc.).	1	6.25	7	43.75	7	43.75	1	6.25
Recognize how climate and natural resources determine the types of crops and livestock that can be grown and raised for consumption.	-	-	7	43.75	6	37.5	3	18.75
Identify farm practices for plant protection (e.g., using a pesticide, integrated pest management, cultural practices) and the harvest of safe products for consumers.	1	6.25	7	43.75	6	37.5	2	12.5
Explain the harmful and beneficial impacts of various organisms related to agricultural production and processing (e.g., harmful bacteria/beneficial bacteria, harmful/beneficial insects) and the technology developed to influence these organisms.	2	12.5	8	50	4	25	2	12.5
Provide examples of science and technology used in agricultural systems (e.g. GPS, artificial insemination, biotechnology, soil testing, ethanol production, etc.); explain how they meet our basic needs; and detail their social, economic and environmental impacts.	2	12.5	7	43.75	6	37.5	1	6.25

Members of the *Language Arts Methods* course ($n=13$) responded to 10 Likert-type items and indicated whether they were very comfortable, comfortable, uncomfortable or very uncomfortable in utilizing the language arts based NALOs. Preservice elementary educators responded they were very comfortable to comfortable utilizing the following learning outcomes: *Students learn about the wide scope of agriculture, explore the variety of agricultural products in their daily lives and discuss the difference between needs and wants* ($n=9$, 69.23%); *Describe a plant life cycle (i.e., almond tree) including tree dormancy, pollination, bloom and kernel development of the plant through a poem* ($n=9$, 69.23%); *Create, read and interpret graphs relating to the economic importance of the dairy industry and be challenged to understand the economic consequences of a day without dairy* ($n=9$, 69.23%); and *Using the context of apples, students will apply their knowledge of heredity and genetics to explain how new varieties are developed and propagated to meet the demand for a tasty, uniform and consistent product* ($n=9$, 69.23%). The learning outcomes identified as very uncomfortable to uncomfortable to utilize were: *Students will understand how agriculture influenced and shaped culture, class and society during the Middle Ages* ($n=7$, 53.85%) and *Explore heredity concepts by comparing observable traits of apples and onions, collecting data on the traits of different apple varieties and learning about apple production.* ($n=7$, 53.85%). For full results see Table 4.6.

Members of the *Social Studies Methods* course ($n=11$) responded to 10 Likert-type items and indicated whether they were very comfortable, comfortable, uncomfortable or very uncomfortable in utilizing the NALOs within the subject of

science. Preservice elementary educators responded they were very comfortable to comfortable utilizing the following learning outcomes: *Recognize that agriculture provides our most basic necessities: food, fiber (fabric or clothing), energy and shelter* (n=11, 100%); *Identify animals and plants that are raised locally that are used for food, clothing, shelter and landscapes* (n=10, 90.9%); *Discuss similarities and differences in food, clothing, shelter and fuel sources among world cultures* (n=9, 81.82%); and *Explain and discuss why people migrate and change environments to meet their basic needs* (n=9, 81.82%). The learning outcomes identified as very uncomfortable to uncomfortable to utilize were *Distinguish the economic value of agriculture in America compared to other countries* (n=5, 45.45%) and *Compare and contrast historical and current food processing and systems* (n=5, 45.45%). For full results see Table 4.7.

When asked to rate their level of confidence to successfully utilize and implement agricultural literacy resources and materials, none of the respondents were highly confident (n=0, 0%), six were confident (n=6, 27.27%), thirteen were unconfident (n=13, 59.09%), and three were highly unconfident (n=3, 13.63%). However, when asked to choose one adopter category toward their potential tendency in accepting the innovative educational approach, eight participants responded as Innovators – *Change is good; I'll go first* (n=8, 36.36%); nine were Early Adopters – *I want to see the research first* (n=9, 40.9%); three were Early Majority – *I'll do it once I see it working for a few others* (n=3, 13.63%); two were Late Majority – *If it works for most others, it will work for me* (n=2, 9.09%); and none identified as Laggards – *I really don't like new stuff* (n=0, 0%).

Table 4.6 Preservice Elementary Educators' Indicated Comfort Level about NALOs within Language Arts (n=13)

Learning Outcomes	Highly Uncomfortable		Uncomfortable		Comfortable		Highly Comfortable	
	<i>f</i>	%	<i>f</i>	%	<i>f</i>	%	<i>f</i>	%
Students learn about the wide scope of agriculture, explore variety of ag. products and discuss the difference between needs and wants.	-	-	4	30.77	6	46.15	3	23.08
Describe a plant life cycle (i.e., almond tree) including tree dormancy, pollination, bloom and kernel development of the plant through a poem.	-	-	4	30.77	5	38.46	4	30.77
Utilizing the visual representation of a web to explore the role of agriculture in their daily lives.	-	-	6	46.15	4	30.77	3	23.08
Identify foods grown in a garden, observe types of seeds and grow “milk jug” garden.	-	-	5	38.46	6	46.15	2	15.38
Explore heredity concepts by comparing observable traits of apples and onions, collecting data on the traits of different apple varieties and learning about apple production.	-	-	7	53.85	5	38.46	1	7.69
Create, read, and interpret graphs relating to the economic importance of the dairy industry.	-	-	4	30.77	6	46.15	3	23.08
Gather and analyze information on the production of one specific commodity grown in Montana. The purpose of this lesson is for students to appreciate that Montana is a major agricultural state.	1	7.79	4	30.77	4	30.77	4	30.77
Students will understand how agriculture influenced and shaped culture, class and society during the Middle Ages.	-	-	7	53.85	3	23.08	3	23.08
Students will develop and apply an understanding of plant anatomy and physiology related to plant growth and ultimately discuss the possibilities and limitations of using vertical farming to produce our food.	-	-	5	38.46	5	38.46	3	23.08

Table 4.6 Continued

Learning Outcomes	Highly Uncomfortable		Uncomfortable		Comfortable		Highly Comfortable	
	<i>f</i>	%	<i>f</i>	%	<i>f</i>	%	<i>f</i>	%
Using the context of apples, students will apply their knowledge of heredity and genetics to explain how new varieties are developed and propagated to meet the demand for a tasty, uniform and consistent product.	-	-	4	30.77	7	53.85	2	15.38

Table 4.7 Preservice Elementary Educators' Indicated Comfort Level about NALOs within Social Studies (n=11)

Learning Outcomes	Highly Uncomfortable		Uncomfortable		Comfortable		Highly Comfortable	
	<i>f</i>	%	<i>f</i>	%	<i>f</i>	%	<i>f</i>	%
Recognize that agriculture provides our most basic necessities: food, fiber (fabric or clothing), energy and shelter.	-	-	-	-	7	63.64	4	36.36
Identify animals and plants that are raised locally that are used for food, clothing, shelter and landscapes.	-	-	1	9.09	7	63.64	3	27.27
Identify the major ecosystems and agro-ecosystems in their community or region (e.g., hardwood forests, conifers, grasslands, deserts) with agro-ecosystems (e.g., grazing areas and crop growing regions).	-	-	5	45.45	3	27.27	3	27.27
Discuss similarities and differences in food, clothing, shelter and fuel sources among world cultures.	-	-	2	18.18	7	63.64	2	18.18
Diagram the path of production for a processed product, from farm to table.	-	-	5	45.45	5	45.45	1	9.09
Provide examples of agricultural products available, but not produced in their local area and state.	-	-	4	36.36	5	45.45	2	18.18

Table 4.7 Continued

Learning Outcomes	Highly Uncomfortable		Uncomfortable		Comfortable		Highly Comfortable	
	<i>f</i>	%	<i>f</i>	%	<i>f</i>	%	<i>f</i>	%
Explain and discuss why people migrate and change environments to meet their basic needs.	-	-	2	18.18	5	45.45	4	36.36
Identify where labeling indicates the origin of food and fiber (fabric and clothing).	-	-	5	45.45	3	27.27	3	27.27
Identify sources of agricultural products that provide food, fuel, clothing, shelter, medical and other nonfood products for their community, state, and/or nation.	-	-	3	27.27	6	54.55	2	18.18
Compare and contrast historical and current food processing and systems.	1	9.09	4	36.36	4	36.36	2	18.18
Distinguish the economic value of agriculture in America compared to other countries.	1	9.09	4	36.36	5	45.45	1	9.09

Chapter Summary

The purpose of this study was to determine the perceptions of preservice elementary educators toward agriculture, educating about agriculture, and potentially incorporating agricultural topics within their lessons. Respondents indicated *Time* and *Funding* construct items were the most significant barriers to potentially utilizing agriculture as a context to teach core academics. Following closely behind were *Resources/Materials* and personal *Content Knowledge*. Respondents indicated *Personal Interest* and *Reward/Recognition* construct items were the most significant benefits to potentially utilizing agriculture as a context to teach core academics. *Support/Guidance* was the third most prominent advantage ranked. Although participants rated their overall knowledge of Montana agriculture low, their perceived attitude toward Montana agriculture was high. Participants' overall confidence to potentially utilize agriculture as a context to teach core academics was low compared to their tendency to adopt the innovation.

CONCLUSIONS, RECOMMENDATIONS, AND IMPLICATIONS

The purpose of this study was to determine Montana State University preservice elementary educators' perceptions toward agriculture, educating about agriculture, and incorporating agricultural topics within their lessons. Specific research objectives included:

1. Identify preservice elementary educators' perceived benefits and barriers to using agricultural content to teach core academics.
2. Identify preservice elementary educators' comfort levels about utilizing agriculture as a context to teach core subjects.

Objective one

Objective one sought to identify potential benefits and barriers to utilizing agriculture as a context in teaching core academics. Respondents categorized and ranked each word in the benefit or barrier box. Similar to previous research, *Time*, *Resources/Materials*, and personal *Content Knowledge* were the most significant barriers to potentially utilizing agriculture as a context. Swortzel (1997) reported lack of time, interest and knowledge as primary reasons for not using an agricultural context even though teacher attitudes and perceptions were also favorable (Bellah & Dyer, 2009) in their studies. Agricultural literacy instructional resources are available, but educators' lack of knowledge, lack of time, awareness, and associating agriculture with basic farming practices may have a negative impact toward their interest (Hess & Trexler,

2011; Osborne & Dyer, 2000; Talbert & Larke, 1995; Thompson & Russell, 1993) and potential adoption of utilizing agriculture as a context (McReynolds, 1985).

Respondents indicated *Personal Interest* and *Reward/Recognition* construct items were the most significant advantages to potentially utilizing agriculture as a context to teach core academics. *Support/Guidance* was the third most prominent advantage ranked. Although preservice elementary educators rated their general knowledge of Montana agriculture as low, overall they had a positive attitude toward Montana agriculture. Positive innovation adoption starts with the knowledge stage. With this step, an individual first learns about the existence and then seeks further information about the innovation (Sahin, 2006). According to Rogers (2003), there are three subcategories: awareness knowledge, how-to knowledge, and principles knowledge.

During this study, participants were categorized into the awareness knowledge due to the individual's awareness of the innovation's existence. However, being in the awareness knowledge category can provide motivation to learn more about the innovation and potentially accept it. An individual may have all the necessary content knowledge, but an individual's attitude also shapes the acceptance or rejection of a potential innovation. The issue then becomes how to target the desired attitude toward potentially adopting teaching core academics within the context of agriculture.

Objective Two

The purpose of objective two was to identify participants' comfort levels in potentially utilizing agriculture as a context to teach core academics (language arts, math, science, and social studies). Participants responded to 10 Likert-type items as part of the

survey instrument and indicated whether they were very comfortable, comfortable, uncomfortable or very uncomfortable in utilizing the NALOs within the four common core subjects.

Agricultural education holds the potential to positively influence students' understanding of reading, writing, and math (Park & Osborne, 2005; Parr et al., 2006; Young et al., 2009; McKim, Sorensen, & Valez, 2016). However, previous research indicates that language arts and mathematics in-service educators are less knowledgeable and have a less positive attitude compared to other majors (Harris & Birkenholz, 1996; Stripling & Roberts, 2013). Within the current study of preservice educators, language arts had the lowest percentages overall compared to the other subject areas, while the math methods participants had some of the highest percentages in potentially utilizing the NALOs to teach with agriculture as a context.

Math Methods course individuals selected learning outcomes that utilized estimation, weighing, measuring, counting, and graphing as an area of comfortability. While learning outcomes they were most uncomfortable with, utilized more agriculturally-based topics that the individual would need to possess more knowledge within the subject area, such as: agricultural technology, relationship between producer and consumer, fertilizer calculations, and crop and livestock yields.

Science Methods course individuals selected learning outcomes that utilized the comparing of animals and plants, utilization of land, and discussion about simple tools (levers, screws, pulley, wedge, auger, grinder, and gears) as areas of comfortability. While learning outcomes they were most uncomfortable with, utilized topics of

stewardship between the rancher/farmer and the land and harmful and beneficial impacts of various organisms related to agricultural production and processing.

Language Arts Methods course individuals selected learning outcomes that applied needs and wants, poems, and consequences and challenges within the context of agricultural as areas of most comfortability. However, learning outcomes they were most uncomfortable with, applied more agriculturally-based knowledge in order to thoroughly explain, compare and contrast, identify recurring themes.

Social Studies Methods course individuals selected learning outcomes that applied the discussion of similarities and differences between local and world cultures in food, fiber, fuel, and shelter or animals and plants. However, learning outcomes they were most uncomfortable potentially teaching required more in-depth knowledge within agriculture such as distinguishing the economic value of agriculture, and food processing techniques.

When asked to rate their level of confidence to successfully utilize and implement agricultural literacy resources and materials, respondents' answers varied. Out of the 22 participants, none responded to be highly confident but there were eight participants that indicated *Change is good; I'll go first [Innovator]*. Then six were confident, but nine selected *I want to see the research first [Early Adopter]* and three *I'll do it once I see it working for a few others [Early Majority]*. Lastly, 13 were unconfident and three were highly unconfident, but only two indicated *If it works for most others, it will work for me [Late Majority]* and zero chose the statement *I really don't like new stuff [Laggards]*. Although participants did not showcase a high confidence level in implementation, they

were still curious and had a positive outlook (Swortzel, 1997; Bellah & Dyer, 2009) on the innovation as a whole.

According to Rogers (2003), when individuals receive initial contact with a new innovation the normal distribution of degree of innovativeness generally characterizes as Innovators 2.5%, Early Adopters 13.5 %, Early Majority 34%, Late Majority 34%, and Laggards 16%. These five categories are divided into two main groups: early adopters and later adopters (Innovators, Early Adopters, and Early Majority reside in the early adopters; Late majority and Laggards comprise later adopters). However, within this study participants identified more so as early adopters by selecting Innovators 36.36%, Early Adopters, 40.9%, and Early Majority 13.63% over Late Majority 9.09%, and 0% Laggards. Therefore, participants showcased a high probability of adopting agriculture into their potential classrooms.

Persuasion to either accept or reject the innovation is based on the individual's negative or positive attitude toward it. After knowledge is developed, either true or false understandings, the persuasion stage occurs in the innovation-decision process. If a degree of uncertainty exists, opinions from others affect the individual's opinions. The decision stage is where the individual decides whether to accept or reject the program. Adoption refers to professing "full use"; rejection means to "not adopt" (Rogers, 2003, p. 177). There is first-hand evidence that individuals' behavior is strongly influenced by the confidence they have in their capability to perform the behavior (Bandura, Adams, Hardy, & Howells, 1980). Attitudes about teaching agriculturally-based core academic

lessons would predict behavioral intentions to enact the behavior, which in turn would predict the behavior.

Recommendations and Implications

Conclusions from this research provide information for those in teacher preparation, professional organizations that help with training, professional development and advocacy for teachers, and for future academic research. This study provides a university-wide view of agricultural literacy within preservice elementary educators toward agriculture, educating about agriculture, and potentially incorporating agricultural topics within their lessons. Stakeholders at all levels of Montana agricultural and elementary education, including current educators, administrators, state staff, teacher educators, and representatives of professional organizations, should continue to examine the reasons presented in this study to effectively recruit, train, and retain elementary education teachers who desire to educate common core academics within the context of agriculture.

Provided the lack of knowledge of and comfort with agriculture, it is recommended that an organized capacity-building process be established. Its goal should be: (1) improving teachers' perceptions and (2) increasing their awareness of agricultural concepts to (3) successfully and efficiently utilize agriculture as a context. A variety of approaches can be drawn upon to achieve this goal, such as summer organizations in local community settings, guest speakers, quarterly in-services with a designated focus group, newsletters, teacher/peer mentoring, and teacher-curriculum development activities. The inclusion and identification of authentic agricultural experience would

address stereotypes and misconceptions, improving educators' and students' agricultural literacy in the process. Agriculturally-based workshops for nonagricultural education majors needs to be resurrected and professional development opportunities need to be provided either through Extension agencies, Montana State University, Montana Agriculture in the Classroom, or another designated organization.

Due to the 90% of participants who identified as Early Adopters (Innovators, Early Adopters, and Early Majority) and only two as Late Adopters (Late Majority and Laggards), implications for professional organizations/programs like Montana's Agriculture in the Classroom, Farm Bureau, and Montana State University include taking an active role in educating, advocating, and continued development of preservice teachers. Preservice educators' exposure to the agriculturally-based curriculum standards in a collegiate course may contribute to the motivation to use it as a context within the classroom and move more toward the collaborative stages. In order to implement new curricula, teacher professional development should be designed to integrate agriculture as an integral piece of educators' pedagogical content knowledge (Balschweid et al., 2000). A need for collaboration between elementary and agricultural education preservice education programs exists at Montana State University. Preservice elementary educators need to be educated on how to utilize relevant agricultural context to deliver standardized content beginning in practicum courses and continuing through the student teaching experience.

Based on this study participants were comfortable utilizing the learning outcomes that resided more within their major and had minimal need of in-depth agriculturally-

based knowledge. Therefore, these organized professional development opportunities should address topics and provide resources to help individuals navigate and understand these more in-depth areas within agriculture. This study identified that each major requires more how-to-knowledge in the following, these areas include but are not subject to the topics addressed in this study: math majors – crop and livestock yields, fertilizer calculations, relationship between consumer and producer, and agricultural technology; science majors – stewardship responsibilities of ranchers and farmers as well as harmful and beneficial impacts of insects on farm and ranchland; language arts majors – agricultural influences on culture, class, and society, heredity concepts through observable traits, and crop production; social studies – distinguishing the economic value of agriculture, and food processing techniques.

Identifying degrees of innovativeness toward agricultural education with other universities students and teacher educators as well as in-service educators would showcase a positive trend of curiosity. Identifying potential early adopters (Innovators, Early Adopters, and Early majority) would assist organizations, programs, and future researchers to establish focus areas for potential development. Having an early adopter's stamp of approval on teaching core academics through the context of agriculture enhances the opportunity for others to adopt it. The first step in successfully implementing agriculture in the classroom is creating a focus group of early adopters to demonstrate its effectiveness in enhancing standard curricula.

There is a significant importance of having an individual or organization within every state to educate, advocate, and provide professional development for educators

within the context of agriculture. Every state should have at least one group or organization to take on this responsibility. Organizations need to examine avenues and platforms for elementary educators to find resources and/or guidance to help educate and assist in teaching core academics in the context of agriculture within their classrooms.

In the development of the next generation of curriculum and standards, it is important that developers design programs to integrate agriculture in a coherent, organized fashion rather than leaving it to agriculturally based organizations alone. Encouragement toward agricultural educators and experts within each core academic subject must work together to build a more agriculturally integrated K-8 curriculum. Further research should include deeper investigation within each core academic field to support findings regarding agriculture's absence in elementary curricula.

Further research recommendations include conducting more prominent, in-depth studies to track how these new teachers would progress through the stages of communication (knowledge, persuasion, decision, implementation, and confirmation) if provided professional development with utilizing agriculture as a context in their classrooms. For high success rates, professional development opportunities would need to exist with a quarterly check to address any concerns with the content.

A lack of research on agricultural literacy prevents educational programs from expanding. In order to reach a broader audience, it is recommended that agricultural education researchers place a high priority on publishing research utilizing specific agricultural literacy terminology in nonagricultural education sites to increase awareness of agricultural literacy outside the field of agricultural education and to promote their

findings (Kovar & Ball, 2013; Mercier, 2015). Also, according to Fishbein and Ajzen (1975), when creating questions researchers should focus on explicit antecedents of specific behaviors (e.g., attitudes toward implementing agriculture as a context within their core subjects) in order to receive sufficient and relative data.

Chapter Summary

The purpose of this study was to determine Montana State University preservice elementary educators' perceptions toward agriculture, educating about agriculture, and incorporating agricultural topics within their lessons. Aligning with previous research, this study found similar perceived barriers to using agricultural content to teach core academics by preservice elementary educators. A need for future research by teacher educators regarding curriculum alignment and developmental needs for preservice teachers was identified. Additionally, implications for professional organizations to examine avenues and platforms for elementary educators to find resources and guidance to help educate, improve confidence, and assist in teaching core academics in the context of agriculture within their classrooms were suggested.

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APPENDICES

APPENDIX A

INSTITUTIONAL REVIEW BOARD APPROVAL LETTER



INSTITUTIONAL REVIEW BOARD
For the Protection of Human Subjects
FWA 00000165

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MEMORANDUM

TO: Jondie Rianda and Carl Igo
FROM: Mark Quinn *Mark Quinn CJ*
 Chair, Institutional Review Board for the Protection of Human Subjects
DATE: April 12, 2019
RE: "Agricultural Literacy in Preservice Elementary Educators" [JR041219-EX]

The above research, described in your submission of April 12, 2019, is exempt from the requirement of review by the Institutional Review Board in accordance with the Code of Federal regulations, Part 46, section 101. The specific paragraph which applies to your research is:

- ☐ (b) (1) Research conducted in established or commonly accepted educational settings, involving normal educational practices such as (i) research on regular and special education instructional strategies, or (ii) research on the effectiveness of or the comparison among instructional techniques, curricula, or classroom management methods.
- ☒ (b) (2) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior, unless: (i) information obtained is recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects; and (ii) any disclosure of the human subjects' responses outside the research could reasonably place the subjects at risk of criminal or civil liability, or be damaging to the subjects' financial standing, employability, or reputation.
- ☐ (b) (3) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior that is not exempt under paragraph (b)(2) of this section, if: (i) the human subjects are elected or appointed public officials or candidates for public office; or (ii) federal statute(s) without exception that the confidentiality of the personally identifiable information will be maintained throughout the research and thereafter.
- ☐ (b) (4) Research involving the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens, if these sources are publicly available, or if the information is recorded by the investigator in such a manner that the subjects cannot be identified, directly or through identifiers linked to the subjects.
- ☐ (b) (5) Research and demonstration projects, which are conducted by or subject to the approval of department or agency heads, and which are designed to study, evaluate, or otherwise examine: (i) public benefit or service programs; (ii) procedures for obtaining benefits or services under those programs; (iii) possible changes in or alternatives to those programs or procedures; or (iv) possible changes in methods or levels of payment for benefits or services under those programs.
- ☐ (b) (6) Taste and food quality evaluation and consumer acceptance studies, (i) if wholesome foods without additives are consumed, or (ii) if a food is consumed that contains a food ingredient at or below the level and for a use found to be safe, or agricultural chemical or environmental contaminant at or below the level found to be safe, by the FDA, or approved by the EPA, or the Food Safety and Inspection Service of the USDA.

Although review by the Institutional Review Board is not required for the above research, the Committee will be glad to review it. If you wish a review and committee approval, please submit 3 copies of the usual application form and it will be processed by expedited review.

APPENDIX B

SURVEY INSTRUMENT

Agricultural Literacy in Preservice Elementary Educators

Agricultural Literacy in Preservice Elementary Educators Survey

You are being asked to participate in a research study examining agricultural literacy in preservice elementary educators at Montana State University (MSU). The primary reason for this research project is to gain a better understanding of agricultural awareness at MSU and identify preservice elementary educators comfort levels to potentially utilize agriculture as a context within core subject curriculum. The more we understand about these awareness levels, the better we can serve preservice teachers at MSU who potentially want to utilize agriculture as a context. You were identified as a potential participant in this study because of your registration within the identified elementary educator method(s) course(s) at MSU in the spring of 2019. If you do proceed to participate you will be entered to win a gift card for the MSU Bookstore.

Participation is voluntary. If you decide not to participate, it will not affect your current or future relationship with MSU. If you have any questions about your voluntary participation, please feel free to ask them. If you agree to be in this study, you will be tasked with completing a survey instrument. The survey will include questions about your perceived comfort levels to potentially utilize agriculture as a context within core subject curriculum, questions about your personal demographic characteristics, and a few questions about your agricultural education program and resource awareness. The survey will take about 10 - 20 minutes to complete.

The records of this study will be kept private. In any sort of report made public, we will not include any information that will make it possible to identify you. Research records will be kept in a locked file; only the researchers will have access to the records. You will be provided an access code to get into the online survey. This information will be kept confidential. Only those directly involved in conducting this research project will have access to this information. Once your access code number is no longer needed, it will be removed from records so that no personal identification can be made.

If you have questions about the research, you can contact either Jondie L. Rianda with the Department of Agricultural Education at Montana State University by phone at (406) 994-7463 or by email at jondierianda@montana.edu or Dr. Carl Igo with the Department of Agricultural Education at Montana State University by phone at (406) 994-3693 or by email at cigo@montana.edu. If you have additional questions about the rights of human subjects, you can contact the Chair of the Institutional Review Board, Mark Quinn, by phone at (406) 994-4707 or by email at mquinn@montana.edu.

Y/N Do you agree to proceed

☐ Yes

☐ No

Skip To: If Do you agree to proceed = Yes

Skip To: End of Survey If Do you agree to proceed = No

Please indicate your gender.

☐ Female

☐ Male

☐ Other

What is your age?

What kind of area were you raised in?

☐ Rural (population under 5,000)

☐ Suburban (5,000 - 20,000)

☐ Urban (20,000 +)

Please specify your ethnicity.

☐ White

☐ Hispanic or Latino

☐ Black or African American

☐ Native American or American Indian

☐ Asian/Pacific Islander

☐ Other

Were you ever part of a 4-H program growing up?

- ☐ Yes
- ☐ No
- ☐ Not sure

If yes, how many years and what kinds of projects were you involved in?

Did your high school have an agricultural education course/program?

- ☐ Yes
- ☐ No
- ☐ Not sure

If yes, please answer this following question.

How many courses in your education were agricultural education courses? (i.e., welding, animal science, plant science, construction, Ag 1/2/3/4, agricultural business, etc. (course titles may vary)).

0 1 2 3 4 5 6 7 8 9 10

Grades 6-8	
Grades 9-12	
College	

Where you ever part of an FFA program growing up?

- ☐ Yes
- ☐ No
- ☐ Not sure

If yes, how many years and what was your SAE project(s)?

What grade levels are you interested in potentially teaching? (Select all that apply)

☐ Kindergarten

☐ 1st

☐ 2nd

☐ 3rd

☐ 4th

☐ 5th

☐ 6th

☐ 7th

☐ 8th

In your own words, define the word agriculture and what it means to you.

Please rank the following potential barriers and advantages to utilizing agriculture as a context in teaching core academics.(Top/first being the most significant barrier or advantage)

Barriers	Advantages
_____ Time	_____ Time
_____ Content Knowledge	_____ Content Knowledge
_____ Standard Alignment	_____ Standard Alignment

_____ Curriculum Alignment
 _____ Reward and Recognition
 _____ Support/Guidance
 _____ Commitment
 _____ Resources/Materials

_____ Curriculum Alignment
 _____ Reward and Recognition
 _____ Support/Guidance
 _____ Commitment
 _____ Resources/Materials

Please drag and rank the top five (5) Montana agricultural commodities. (Top/first being number 1)

Montanan Commodities

_____ Cattle
 _____ Sheep
 _____ Hay
 _____ Wheat
 _____ Production of Farm Machinery
 _____ Lentils
 _____ Logging
 _____ Barley
 _____ Dry Peas

Please drag and rank the top three (3) industries found in Montana? (Top/first being number 1)

Top 3 Industries in Montana

_____ Real Estate
 _____ Mining
 _____ Tourism
 _____ Biotechnology
 _____ Agriculture
 _____ Education
 _____ Timber
 _____ Construction

Are you currently enrolled in the Math Methods course?

☐ Yes

☐ No

Skip To: If Are you currently enrolled in the Math Methods course? = Yes

Skip To: If Are you currently enrolled in the Math Methods course? = No

Preservice Elementary Educators' Indicated Comfort Level about NALOs within Math.

Learning Outcomes	Very Uncomfortable	Uncomfortable	Comfortable	Very Comfortable
Estimate the size and weight of pumpkins, sprouting pumpkin seeds, and making pumpkin pie in a bag.				
Using tomatoes as a theme, the students will practice their math and science skills of estimating, measuring, counting, graphing and sequencing.				
Explain the costs associated with producing and purchasing food.				
Describe how technology helps farmers/ranchers increase their outputs (crop and livestock yields) with fewer inputs (less water, fertilizer, and land) while using the same amount of space.				
Describe how supply and demand impact the price of agricultural goods.				
Compare growth and production of citrus fruits and participate in an activity where they use skills of observation and mathematical computation to compare and contrast grapefruits and lemons.				
Create, read, and interpret graphs relating to the economic importance of the dairy industry and be challenged to understand the economic consequences of a day without dairy.				
Evaluate serving size related to nutritional needs.				
Explain how prices for agricultural goods are determined.				
Determine the relationship between producers and consumers and how agricultural supply and demand affects commodity prices.				
Identify terms solutes, solvents, and parts per millions and learn how fertilizer solution is properly calculated and applied.				

Are you currently enrolled in the Social Studies Methods course?

☐ Yes (1)

☐ No (2)

Skip To: If Are you currently enrolled in the Social Studies Methods course? = Yes

Skip To: If Are you currently enrolled in the Social Studies Methods course? = No

Preservice Elementary Educators' Indicated Comfort Level about NALOs within Social Studies.

Learning Outcomes	Very Uncomfortable	Uncomfortable	Comfortable	Very Comfortable
Recognize that agriculture provides our most basic necessities: food, fiber (fabric or clothing), energy, and shelter				
Identify animals and plants that are raised locally that are used for food, clothing, shelter, and landscapes				
Identify the major ecosystems and agro-ecosystems in their community or region (e.g., hardwood forests, conifers, grasslands, deserts) with agro-ecosystems (e.g., grazing areas and crop growing regions).				
Discuss similarities and differences in food, clothing, shelter, and fuel sources among world cultures.				
Diagram the path of production for a processed product, from farm to table				
Provide examples of agricultural products available, but not produced in their local area and state				
Explain and discuss why people migrate and change environments to meet their basic needs.				
Identify where labeling indicates the origin of food and fiber (fabric and clothing)				
Identify sources of agricultural products that provide food, fuel, clothing, shelter, medical, and other non-food products for their community, state, and/or nation				
Compare and contrast historical and current food processing and systems				
Distinguish the economic value of agriculture in America compared to other countries				

Are you currently enrolled in the Science Methods course?

☐ Yes

☐ No

Skip To: If Are you currently enrolled in the Science Methods course? = Yes

Skip To: If Are you currently enrolled in the Science Methods course? = No

Preservice Elementary Educators' Indicated Comfort Level about NALOs within Science

Learning Outcomes	Very Uncomfortable	Uncomfortable	Comfortable	Very Comfortable
Describe how farmers/rangers use land to grow crops and support livestock	☐	☐	☐	☐
Identify the types of plants and animals found on farms and compare with plants and animals found in wild landscapes	☐	☐	☐	☐
Recognize and identify examples of simple tools and machines used in agricultural settings (e.g., levers, screws, pulley, wedge, auger, grinder, gears, etc.)	☐	☐	☐	☐
Identify natural resources	☐	☐	☐	☐
Understand the concept of stewardship and identify ways farmers/ranchers care for soil, water, plants, and animals	☐	☐	☐	☐
Identify examples of how the knowledge of inherited traits is applied to farmed plants and animals in order to meet specific objectives (i.e., increased yields, better nutrition, etc.)	☐	☐	☐	☐
Recognize how climate and natural resources determine the types of crops and livestock that can be grown and raised for consumption.	☐	☐	☐	☐
Identify farm practices for plant protection (e.g., using a pesticide, integrated pest management, cultural practices) and the harvest of safe products for consumers	☐	☐	☐	☐
Explain the harmful and beneficial impacts of various organisms related to agricultural production and processing (e.g., harmful bacteria/beneficial bacteria, harmful/beneficial insects) and the technology developed to influence these organisms	☐	☐	☐	☐
Provide examples of science and technology used in agricultural systems (e.g., GPS, artificial insemination, biotechnology, soil testing, ethanol production, etc.); explain how they meet our basic needs; and detail their social economic, and environmental impacts	☐	☐	☐	☐

Are you currently enrolled in the Language Arts Methods course?

☐ Yes

☐ No

Skip To: If Are you currently enrolled in the Language Arts Methods course? = Yes

Skip To: If Are you currently enrolled in the Language Arts Methods course? = No

Preservice Elementary Educators' Indicated Comfort Level about NALOs within Language Arts

Learning Outcomes	Very Uncomfortable	Uncomfortable	Comfortable	Very Comfortable
Students learn about the wide scope of agriculture, explore the variety of agricultural products in their daily lives, and discuss the difference between needs and wants.				
Utilizing the visual representation of a web to explore the role of agriculture in their daily lives and understand how most of the necessities of life can be traced back to the farm.				
Identify foods grown in a garden, observe various types of seed, and grow their own "milk jug" garden. Students will hear the Tale of Peter Rabbit, by Beatrix Potter and learn about produce that is grown in gardens or on farms.				
Describe a plant life cycle (i.e., almond tree) including tree dormancy, pollination, bloom and kernel development of the plant through a poem.				
Explore heredity concepts by comparing observable traits of apples and onions, collecting data on the traits of different apple varieties, and learning about apple production. Additional activities include hands-on methods for testing apple ripeness.				
Create, read, and interpret graphs relating to the economic importance of the dairy industry and be challenged to understand the economic consequences of a day without dairy.				
Gather and analyze information on the production of one specific commodity grown in Montana. The purpose of this lesson is for students to appreciate that Montana is a major agricultural state.				
Students will understand how agriculture influenced and shaped culture, class, and society during the Middle Ages.				
Students will develop and apply an understanding of plant anatomy and physiology related to plant growth and ultimately discuss the possibilities and limitations of using vertical farming to produce our food.				
Using the context of apples, students will apply their knowledge of heredity and genetics to explain how new varieties are developed and propagated to meet the demand for a tasty, uniform, consistent product.				

Are you currently aware of any organizations and/or resources that help educators like you teach within the context of agriculture? If yes, please list them to the best of your ability.

If teaching within the context of agriculture interests you, do you feel as if you have the how-to-knowledge to successfully utilize and implement the resources and materials (lesson plans and activities) if provided?

- ☐ Strongly Agree
- ☐ Agree
- ☐ Disagree
- ☐ Strongly Disagree
-

Would you like to know more about teaching within the context of agriculture? How it works? Why it works?

- ☐ Yes, if I had more information, I definitely see myself potentially implementing this.
- ☐ Yes, if I had more information, I could consider seeing myself potentially implementing this.
- ☐ Probably, it might make a difference whether or not I could see myself utilizing this.
- ☐ Definitely not.

End of Block: Default Question Block

End of Survey