BARRIERS, ROLES, AND INFORMATION SOURCE PREFERENCES FOR

UTILIZING AGRICULTURAL SCIENCE PROJECTS AMONG

UTAH 4-H EXTENSION PROFESSIONALS

by

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ABSTRACT

Barriers, Roles, and Information Source Preferences for Utilizing Agricultural Science Projects Among Utah 4-H Extension Professionals

by

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This study examined the perceptions of Utah 4-H extension personnel related to the implementation of 4-H Agriscience projects. The study evaluated the barriers, roles, and information source preferences of the Extension personnel in Utah with a 40% or more assignment in 4-H Youth Development. Results indicated that Science, Technology, Engineering, and Mathematics (STEM) had the highest level of importance, while leadership had the highest perceived ability to teach the concept. A needs assessment of the 4-H Extension personnel revealed topics in Robotics, Biotechnology, STEM, and Agriscience were the highest area of training. Barriers to implementing Agriscience project areas included time and volunteers. The Extension personnel in this study felt they their role in developing youth projects was to educate, involve, and encourage the youth. The number one source of information included internet followed by face-to-face workshops. Through guidance of similar programs in career readiness, FFA Agriscience programs, and other Extension programs, the Agriscience program can improve with continued in-service training of 4-H Extension personnel.

(77 pages)

PUBLIC ABSTRACT

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Aleigh Aurin

Agriscience is the growing study of biotechnology, business, and economics within the agriculture industry. Through 4-H, youth can experience hands on learning through different program areas. The purpose of this study was to identify the barriers, roles, and how Utah 4-H personnel preferred to learn about new programs. The study showed time and available volunteers were a barrier for 4-H Extension personnel to implement Agriscience projects. Other results included internet and workshops as the top choices for training programs. The Extension personnel agreed it was their job to involve and educate youth. Yet, need training in how to integrate Robotics; Biotechnology; Science, Technology, Engineering, and Mathematics (STEM), and Agriscience into their existing program areas.

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CHAPTER I

INTRODUCTION

The goal of 4-H is to give youth the experiences to learn by doing (What is 4-H?, 2018). 4-H utilizes a variety of projects to engage students in experiential learning. Projects include family, home and healthy living; citizenship and leadership; agriculture, environmental and animal science; creative and expressive arts; and science, technology, engineering, and mathematics (STEM; Utah 4-H, n.d.). Each state offers multiple 4-H programs and clubs are available in every state with the help of land-grant or public universities (What is 4-H?, 2018). This widely renowned program gives youth the opportunity to make new friends, gain valuable leadership experience, and learn about hundreds of topics at little to no cost.

4-H began to develop in the late 1800s when researchers identified that adults in the farming community were not open to new agricultural developments but found that young people would experiment with new ideas and share their experiences with adults (4-H History, 2018). This provided universities and researchers with a unique way to deliver new and innovative information to the members of the agriculture community (4-H History, 2018). Working with and educating youth, researchers could share the new advances and technology, which the youth would share with their families and relatives (4-H History, 2018). In 1902, youth clubs began to form in Ohio and Minnesota (4-H History, 2018). With the passing of the Smith-Lever Act in 1914, Cooperative 4-H Extension was established through the U.S. Department of Agriculture and began its partnership with 4-H (4-H History, 2018). This youth development program has a long history and deep foundation.

To identify the importance of science in agriculture, you must first start with the Hatch Act which became a federal law in 1939. The Hatch Act was passed as a culminating even of the scientific revolution that occurred in agriculture in the late 1800s (Hillison, 1996). Farmers were calling for scientific research that provided an accurate analysis of the fertilizer that they were purchasing (Marcus, 1985). The development of 4-H and the call for research gave rise to the importance of research and agriculture and the development the Hatch Act, which provided funds for scientific research, experimentation and the establishment of cooperative 4-H Extension service (Hillison, 1996).

Today, 4-H serves youth in rural, urban and suburban communities in every state across the nation (4-H History, 2018). 4-H provides education on current issues in global food security, climate change, sustainable energy, childhood obesity, and food safety. In addition to out-of-school programs and in-school programs, many 4-H clubs offer a variety of STEM opportunities from animal science to computer science (4-H History, 2018).

One way that 4-H supports science in agriculture is through STEM. One-way youth in 4-H are engaged in STEM and agriculture, is through Agriscience education and projects. According to 4-H.org, Agriscience “cultivates the emerging study of biotechnology and business/economics in the agriculture industry through hands-on experiential learning activities and online learning courses for youth” (Agriscience, 2018, para. 1). Other concepts covered through Agriscience include agricultural literacy, global food security, sustainability, and various career paths that relate to these fields (Agriscience, 2018). The FFA (formerly known as Future Farmers of America) defines Agriscience as “the application of agricultural scientific principles and emerging technologies in agricultural enterprises” (National FFA Organization, 2018). The National FFA rewards students utilizing Agriscience Fair projects, many of these students who are in grades 7 – 12 are selected as their state winner and have the opportunity to compete at the national level (National FFA Organization, 2018). The student participants must conduct a scientific research project pertaining to the agriculture and food science industries and present their findings to a panel of judges with a display and a report in animal systems, environmental services/natural resource systems, plant systems, power, structural and technical systems or social science (National FFA Organization, 2018). Agricultural education and FFA have identified Agriscience as an important component of their programs and have designed state and national competitions, the question remains, why is 4-H not doing the same?

Research priority area 7 of the American Association for Agricultural Education (Andenoro, Baker, Stedman, & Pennington Weeks, 2016) states education must extend beyond the classroom. In fact, informal education opportunities can allow educators to create and deliver content to its learners in a form that best meets their needs (Batsleer, 2015). Utilizing Agriscience projects with 4-H youth may become an opportunity to deliver Agriscience education to youth in a place and in a space that is good for them thus adding to the impact of STEM education. In order to better understand the impact of science in agriculture much of the research conducted in agricultural education has been in biotechnology. Merriam-Webster's online dictionary defines Biotechnology as the manipulation of organisms or components of the organisms to produce products. Biotechnology is thought to be one of the most innovative agricultural science technologies in the last 100 years, however, in order to be successful in educating others, it is important to have the materials and resources available (Mowen, Wingenbach, Roberts, & Harlin, 2007). The history of biotechnology goes back to as early as 3200 B.C. with the making of bread and cheese and on to the creation and production of explosives (National 4-H Council, 2016). It is currently used in food products, production agriculture, chemicals, and crime solving (National 4-H Council, 2016). Mowen et al. found that the equipment availability and teacher knowledge or ability are major barriers school-based agriculture teachers faced when asked to teach Agriscience topics, including biotechnology. In addition, 4-H professionals recognize a significant value in working with partners in biotechnology to assist with program planning, curriculum, equipment, and resources (Ripberger & Blalock, 2013). This could be shown by the limited number of Agriscience projects within the state. Perhaps 4-H Extension personnel in Utah face similar barriers to participation in Agriscience programming.

Statement of the Problem

The National 4-H website, states that guidance for both professionals and volunteers is necessary for Agriscience programs to grow (Agriscience, 2018). The material created by the National 4-H Organization and United Soybean Board allows for a strong science-based set of presentations, discussions, and hands-on learning activities on Agriscience or biotechnology (Agriscience, 2018).

Although differences exist between school-based agricultural science teachers and 4-H Extension personnel, there is the common theme of the leadership and educational development of the youth (Ricketts & Place, 2005). Through a study by Mowen et al. (2007) it was found that school-based agriculture science teachers agreed a portion of their job included teaching and educating about biotechnology. Research has been conducted in agricultural education regarding the resources, knowledge, and attitudes to teach Agriscience and more specifically, biotechnology (Boone, Boone, Gartin, & Hughes, 2006). Boone et al. found in school-based agriculture programs Agriscience should include biotechnology, where topics can include support for environmental processes, human medicine, genetic engineering of food crops, genetic engineering of animals, and genetic engineering of food crops. Biotechnology is a topic that school-based agriculture teachers tend to have limited education and experience with (Boone et al., 2006).

School-based agriculture teachers frequently work with students to develop Agriscience fair projects. The National FFA Agriscience Fair recognizes student researchers studying the application of agricultural scientific principles and emerging technologies in agricultural enterprises (National FFA Organization, 2018). The National FFA Agriscience Fair includes six categories, and six divisions for student members in grades 7-12. The six categories include animal science; environmental services/natural resource systems; food products and processing systems; plant systems; power, structural, and technical systems; and social science (National FFA Organization, 2018). These students conduct a scientific research project pertaining to agriculture and food and present findings to a judge (National FFA Organization, 2018).

While, 4-H program leaders have identified promising practices to teach 4-H youth agricultural Agriscience projects, a general search of Utah 4-H Agriscience projects, provides very little information (Ripberger & Blalock, 2013). The Agriscience projects, specifically biotechnology-based projects, included 4-H science core principles and program design, partnering with afterschool and summer program providers, engaging content rich partners, and staffing with teens as cross-age teachers. A search of the Utah 4-H website resulted in few Agriscience related projects in the Utah 4-H program. The search found projects that include Plant Energy Club, Kitchen Science Club, Robotics Club, and Forces of Nature Club (Utah State University 4-H Extension, 2017).

It seems that Agriscience programs are behind where they could be. Through searches of The Journal of 4-H Extension, Google Scholar, and the Utah State University Library, the term 4-H Agriscience had few results. Other terms searched included Agriscience, STEM, biotechnology, agricultural science, agricultural education, and science in agriculture. A study from Bayer (2018b) one fifth of teachers said they had some Agriscience material in their classes. Teachers are feeling unqualified in teaching Agriscience topics and many students are not familiar with all the career options within Agriscience (Bayer, 2018b).

Purpose Statement

The purpose of this descriptive research was to evaluate Utah 4-H Extension personnel perceptions related to the implementation of 4-H Agriscience projects.

Research Objectives

1. Describe Utah 4-H Extension personnel's perceived level of importance and perceived level of ability to deliver various Agriscience project areas.
2. Identify and prioritize the training needs of Utah 4-H Extension personnel in Agriscience project areas.
3. Describe Utah 4-H Extension personnel's perceived barriers to implement agricultural science projects.
4. Determine Utah 4-H Extension personnel's perception of their role in developing agricultural science projects.
5. Determine Utah 4-H Extension personnel's preference for gathering information related to agricultural science projects.
6. Describe the characteristics of the Utah 4-H Extension personnel (age, gender, highest degree, etc.)

Limitations

1. The results are only generalizable to the specific population of Utah 4-H Extension personnel who responded to the survey.
2. The differences in the counties and the numbers of active 4-H members may

influence of the results of this research.

3. Promotion of the types of projects and availability of resources may vary depending on location of the 4-H Extension personnel.

4. Lack of a clear definition of Agriscience project in 4-H.

Basic Assumptions

The basic assumptions of this study were as follows.

1. Every participant will answer the survey completely and truthfully.

2. Each participant has at least a 40% or more involvement with 4-H youth development.

Significance of the Problem

Science in agriculture creates a foundation to support the growing challenge of creating enough food for the number of people (Keatinge, 2014). Technology and the revolution behind it have helped lead to agricultural production tripling between 1960 and 2015 (Food and Agriculture Organization of the United Nations, 2017). This growth needs to keep up with the population growth, which is expected to be at almost 10 billion people by 2050 (Food and Agriculture Organization of the United Nations, 2017).

A study by Bayer and the National 4-H Council found around 48% of the teachers surveyed felt there is less emphasis on learning about the STEM industry then 15 years ago (Bayer, 2018a). Bayer (2018b) found that there needs to be more time dedicated to the curriculum. Parents and teachers both felt there needed to be more time spent on

Agriscience education. Countless youth are unaware of the opportunities and careers offered through Agriscience. When compared to 15 years ago, there has been a decline in the emphasis put on teaching Agriscience (Bayer, 2018b).

It has been found that many administrators, students, and members of the community still hold onto the idea that agriculture education in not an academic program (Shelley-Tolbert, Conroy, & Dailey, 2000). This idea that they have has led to less support and low enrollment rates (Shelley-Tolbert et al., 2000).

Definitions of Terms

Agriscience: the application of agricultural scientific principles and emerging technologies in agricultural enterprises (National FFA Organization, 2018), cultivates the emerging study of biotechnology and business/economics in the agriculture industry through hands-on experiential learning activities and online learning courses for youth (Agriscience, 2018, para. 1).

Program: includes the four main project areas, the category the project falls under (“4-H program at a glance,” 2018).

Project: a topic that interests a 4-H member, something the member wants to learn and do as they explore the topic (University of Illinois 4-H Extension, 2018).

CHAPTER II

REVIEW OF LITERATURE

4-H Extension professionals are expected to know more, educate more, and meet the increasing demands of a diverse population of students. One way to do this is through Agriscience projects. This will require that 4-H Extension professionals obtain the ability and skills to meet the demands of their clientele. Training to better prepare 4-H Extension professionals can be done through in-service activities. This literature review documents the need for more research related to the barriers, educator roles, and preference for gathering information for Agriscience projects for 4-H Agriscience youth programming.

Theoretical Frameworks

Diffusion of Innovations

The Diffusion of Innovation Theory was developed by E. M. Rogers in 1962 and is one of the oldest social science theories (Rogers, 2003) and serves as the conceptual framework of this study. The Diffusion of Innovation theory is the process that occurs as people learn and implement a new idea, object, or way of doing something (Kaminski, 2011). It helps explain how, over time, an idea gains momentum and diffuses through a specific population or social system (Rogers, 2003). The end result is that people, as part of the social system, adopt the new idea or behavior (Rogers, 2003).

The Diffusion of Innovation Theory includes five stages, knowledge, persuasion, decision to adopt/reject, implementation, and confirmation (Rogers, 2003). Individuals move through these stages seeking additional information, weighing the pros and cons, and eventually adopting the new idea or behavior (Rogers, 2003).

The theory further breaks the adopters down into five categories (Kaminski, 2011), innovators, early adopters, early majority, late majority, and laggards. The first adopters to welcome an innovation and become a change agent is the innovator or technology enthusiast, these individuals are the first to try an innovation and are adventurous and interested in new ideas (Kaminski, 2011). Early adopters or visionaries are people who are opinion leaders and embrace change opportunities, they are aware of the need to change and are comfortable doing so (Kaminski, 2011). The early majority tend to adopt new ideas before the average person, but need to see evidence of the innovation's worth before adoption (Kaminski, 2011). The late majority are skeptical of change, and only adopt after an innovation has been tried and tested and the laggards are bound to tradition and are very conservative, skeptical of change and are hardest to bring on board (Kaminski, 2011, LaMorte, 2018). Each of these groups have various traits that allow them to be change agents for the new innovation and serve a purpose in allowing the information to spread (Kaminski, 2011) (Figure 1).

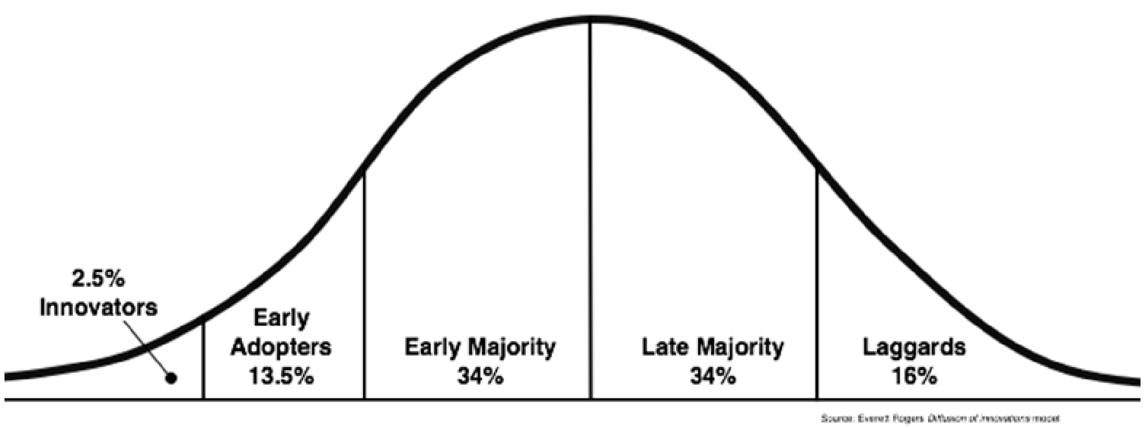

Figure 1. Diffusion of Innovation Theory (LaMorte, 2018).

An important time characteristic of this theory is the rate of adoption (Kaminski, 2011). This includes how long it takes from start to finish to move through an organization and how much of the total population has adopted the innovation (Kaminski, 2011). The main factors that influence the adoption of an innovation includes advantage or is it better than the idea or program it replaces; compatibility, how the innovation matches the values or needs; complexity, how difficult it is to use; trialibility, the extent which it can be tested before a commitment to adopt it is made; and finally, observability, the extent to which the innovation provides tangible results (Kaminski, 2011; LaMorte, 2018). The design of the NIFA 4-H science program is to employ youth as change agents (U.S. Department of Agriculture, n.d.), allowing them to share the information they learn with those around them, including parents. This is vital for the success of Agriscience projects.

Borich Needs Assessment

The definition of training needs proposed by Borich (1980) serves as the model for the design and analysis of this study. According to Borich, a need is described as a discrepancy between “what is and what should be.” The Borich (1980) needs assessment is the process of identifying the needs and placing them in an order based off of priority (Abdel-Maksoud & Saknidy, 2016). It is designed for evaluation of the degree of importance and the level of knowledge respondents have to various subjects (Abdel-Maksoud & Saknidy, 2016). Borich considered the importance of a competency in relation to the knowledge of, ability to perform, or the ability to teach the respective competency, which results in a discrepancy score. The resulting discrepancy scores can be considered unique assessments to measure the ability to accurately execute a behavior (Borich, 1980). The Borich needs assessment model is frequently used in evaluating 4-H programs and provides for specific in-service training opportunities.

Relevant Literature

The importance communicating the impact of agricultural and scientific research is vital to address the needs of society (Doerfert, 2011; Roberts, Harder, & Brashears, 2016). Agriculture and science have experienced comprehensive changes over the last 60 years. Including the demand for STEM qualified professionals in the U.S. (Brown, Concannon, Marx, Donaldson, & Black, 2016). In fact, there will be an estimated 3.5 million STEM jobs to be filled and as many as 2 million left unfilled in 2025 due to a lack of qualified professionals (Emerson, 2018). Research conducted by Freeman, Adams Becker, and Cummins (2016) identify a multitude of technology experiences that 4-H Extension professionals can use including makerspaces, mobile learning, online learnings, 3D printing, drones and robotics, etc. Further, Freeman et al. supports that technology can be used to leverage social networks and to build communities of practice and reach new audiences. While 4-H Extension is addressing a shortage of scientists, engineers, and other related professionals throughout the United States by promoting STEM (Sallee & Peek, 2014), there seems to be a disconnect between agriculture and science. Crayton (2018) stated 4-H Extension has an obligation to influence this trend through the implementation of STEM and educational programming. Perhaps the integration of Agriscience projects with 4-H youth could potentially be one way to influence the development of potential employees in STEM fields.

Knowledge and Attitudes

Because of the limited scope of 4-H Extension program research in this area, the National FFA Organization and their utilization of Agriscience fair projects and school-based agriculture teachers will be used to better understand the nature of Agriscience in education and youth development. It seems that school-based agriculture teachers attitude towards teaching science and biotechnology is positive (Boone et al., 2006; Myers et al., 2009). This is similar to 4-H Extension personnel with biotechnology. In addition, there is a large body of research that has been conducted on school-based agricultural education Agriscience programs.

In a study conducted by Boone et al. (2006) school-based agricultural teachers stated the majority of teachers felt they had applied knowledge of animal science yet only one-third of educators indicated they had applied knowledge of growth hormones, hybridization, resistant plant species, and plant tissue culture and even less had applied knowledge on biotechnology ethics, cloning, genetically modified foods, genetic engineering, microbial biotechnology, electrophoresis, food biotechnology, and environmental biotechnology (Boone et al., 2006). Boone et al. found the topics with the least amount of applied knowledge were gene splicing, recumbent DNA, transgenic species, human genomics, and bioremediation. Further, many school-based agriculture teachers reported average scientific knowledge and minimal additional coursework in science and biotechnology Mowen et al. (2007).

Myers and Washburn (2008) found the majority of school-based agriculture teachers felt students learned science concepts better when integrating science into agricultural education courses. Further, the majority of teachers felt incorporating science increased the ability to teach problem solving. Myers, Thoron, and Thompson (2009) found that school-based agriculture teachers felt science can be easier for students to learn when it has been integrated into agricultural science curriculum compared to being taught on its own. Further, there was unanimous support to integrating science into the agricultural education classroom (Myers et al., 2009).

Additionally, Extension personnel have positive attitudes of biotechnology research, including reduction of pesticide use, benefits of the environment, food safety, environmental care, nutrition, and pesticide risks were important or extremely important (Fritz, Ward, Byrne, Harms, & Namuth, 2004). Agriscience research in 4-H is limited. However, both 4-H Extension personnel and school-based agricultural education teachers find motivation in improving their worth to the youth, improving their subject area, and cultivating their whole education potential (Ricketts & Place, 2005). Currently, there is an interdisciplinary cooperation between both school-based agriculture teachers and 4-H Extension personnel (Ricketts & Place, 2005). A group of teachers surveyed in West Virginia on their role in educating students on biotechnology topics and all of them agreed that teaching biotechnology it is part of their job responsibilities (Boone et al., 2006). They have a responsibility as educators to include biotechnology in their work (Boone et al., 2006). But, many of these teachers have limited knowledge of biotechnology and its topics (Boone et al., 2006).

Barriers to Implementing Agriscience Projects

Barriers, as defined by Merriam Webster's online dictionary, are "something immaterial that impedes or separates." In the study by Mowen et al. (2007), found the major barrier to implementing Agriscience concepts in the classroom was access to equipment. Moderate barriers included classroom/lab space, time, instructional materials, textbooks, teacher knowledge, and students' academic availability (Mowen et al. 2007). In a similar study the majority of teachers felt insufficient planning time, support from science teachers and administrators and the lack of materials as barriers to implementing Agriscience (Myers et al., 2009; Meyers & Washburn, 2008; Warnick & Thompson, 2007). Additional studies identify the lack of science experience as a major barrier (Myers et al, 2009; Thompson & Warnick, 2007). Both the science programs and the agricultural education programs felt that they had something to offer the other and working together could be quite beneficial (Warnick & Thompson, 2007).

One study focused on overcoming barriers to the innovations in the food and agricultural biotechnology industries (Dahabieh, Brorng, & Maine, 2018). Barriers they identified in their study included high capital requirements, technology readiness timeframes, need for co-innovation for adoption, interdisciplinary knowledge, technology uncertainty, and market/adoption uncertainty (as cited in Dahabieh et al., 2018). The food and agricultural biotechnology sector have seen incredible growth over the last five years, while it still remains juvenile as a whole (Dahabieh et al., 2018). The food and agricultural biotechnology sector have seen some uncertainty and needed to have good innovation management to continue improving as a whole (Dahabieh et al., 2018).

Roles

Roles and responsibilities of agricultural science teachers were considered one in the same in other research (Mowen et al., 2007). Many of the roles they agreed with included educating consumers about biotechnology, educating farmers and agriculturists about biotechnology, involving students in Supervised Agricultural Experience (SAE) biotechnology related projects, and teaching high school students about biotechnology (Mowen et al., 2007). Respondents of Mowen et al.'s research did not agree with the following roles; educating policy makers about biotechnology, sponsoring various meetings related to biotechnology, creating instructional material or lessons on biotechnology, distributing published materials on biotechnology, conducting research on biotechnology, and developing publications or material to be published on biotechnology. Mowen et al. found that teachers are not feeling the need to be proactive in educating on biotechnology topics, many are not including and teaching the biotechnology topics into their current curriculum.

When science and school-based agricultural education teachers were asked the best ways to integrate more science into agricultural education, the main common theme was teaming up or working together (Warnick & Thompson, 2007). Other common themes between the two types of teachers included funding, faculty or administrative support, and curriculum adjustments (Warnick & Thompson, 2007). They believed that by working together the programs could be integrated (Warnick & Thompson, 2007).

Information Sources

Mowen et al. (2007) examined the agreement level of Texas teachers' preferences of information sources for receiving biotechnology resources. Of the 14 information sources, all of them were agreed upon as an information source preference (Mowen et al., 2007). The highest-ranking information source was workshops, while newspapers and slide sets were the least agreed upon (Mowen et al., 2007). Mowen et al. did not find any significantly greater preferences for one type of source over another, but as an older study, modern technologies were not surveyed.

It was found in another study that the common information sources used included newspapers, internet, and magazines (Fritz et al., 2004). In the last six months, 93.0% of the respondents had read or learned about biotechnology, with 20.0% having gave a presentation on biotechnology (Fritz et al., 2004). Another important source they listed was university scientist and their work with biotechnology curriculum (Fritz et al., 2004). In comparison, a study by Bailey, Hill, and Arnold (2014) found that 4-H Extension personnel felt research journals, 4-H Extension publications, and university specialist were the most credible sources of information. The 4-H Extension personnel in Bailey et al.'s study also felt the internet was the least credible source. Those who responded to the survey used the same general information sources as the general public (Fritz et al., 2004).

Looking at agricultural information sources internationally, a study in China on knowledge and awareness of genetically modified foods, it was found that over half of the information came from television (Han et al., 2015). Other popular sources included print media, internet, family and friends at, store or street promotions, and work or study (Han et al., 2015).

Experience

Experience in other agriculture education programs is important to review to establish an understanding. A survey of female Agriscience teachers in Texas found those surveyed had nine years teaching experience on average (Edney & Elbert, 2009). Another survey found an average teaching experience of seven years (Myers et al., 2009). Edney and Elbert found was that 86.0% of the female Agriscience teachers had taken career and technical education (CTE) courses growing up. Many of the teachers surveyed were in their first teaching position (Edney & Elbert, 2009). Texas female Agriscience teachers responded that all but 10% had a bachelor's degree and most of the remaining had master's degrees (Edney & Elbert, 2009). The bachelor's degrees the teachers held consisted of 15.0% held a degree in agriculture development, 66.0% held a degree in agriculture education, and 10.0% in animal science (Edney & Elbert, 2009).

Majority of the survey respondents to Myers et al.'s (2009) study had a master's degree with a few additional graduate courses at 36.0% (Myers et al., 2009). The next highest education level was a master's degree, followed by a bachelor's plus some graduate courses, just a bachelor's degree, doctoral degrees. There were 40.0% of the teachers who had taught classes other than agricultural education at one point or another (Myers et al., 2009).

Historically, a few studies found similar information. Boone et al. (2006) found in his study that the teachers had an average of 16 years of experience. Another article by Myers and Washburn (2008) found that their sample has an average of 15 years of experience. In Texas, teaching experience ranged from 0 to 38 years, with an average teaching experience range of 12.3 years (Mowen et al., 2007). Another way Mowen et al. (2007) looked at experience was the participants with less than 15 years of experience at 62.4%, and those with more than 15 years of experience at 36.4%.

Warnick and Thompson (2007) surveyed two groups of respondents: science teachers and school-based agriculture education teachers. The science teachers had an average of 14.6 years of experience (Warnick & Thompson, 2007). A quarter had taken park in workshops or courses on integrating science into agriculture education and 28% had reported taking agriculture education courses growing up (Warnick & Thompson, 2007). In comparison, the school-based agricultural education teachers had an average of 13.5 years of teaching experience (Warnick & Thompson, 2007). The school-based agriculture education teacher's rates for workshops and courses taken was much higher at 79.2% compared to science teachers at 24.7% (Warnick & Thompson, 2007). They also had higher reports of taking agriculture courses in high school with 87.6% (Warnick & Thompson, 2007).

When evaluating education levels, half of the educators in the Boone et al. (2006) study had a bachelor's degree, 46.8% had a master's degree, and 1.6% had a doctorate degree. In other research the largest group of the population at 37.5% had a bachelor's degree (Myers & Washburn, 2008). Roughly 27% of the teachers had a master's degree, 20.3% had a bachelor's degree with some graduate level classes, 12.5% had a master's degree with some other graduate level classes, and lastly 3.2% had a doctorate degree in research completed by Myers and Washburn. With the population surveyed in the previous study being school-based agriculture education teachers, only 44.0% had undergraduate degrees in agriculture education, with the remaining degrees not listed (Myers & Washburn, 2008). Mowen et al. (2007) had 66.8% of his respondents with a bachelor's degree, 32.8% with a master's degree, and .40% had a doctorate degree.

Agriscience Programs

Agriscience is emerging outside of FFA and 4-H Extension a few programs. The programs teach similar ideas to Agriscience and STEM, including the Agriculture Awareness Days in Virginia (Campbell, Wilkinson, Shepherd, & Grey, 2015). This program has fifth-graders spend a day going through six different stations including Bread Making, Strawberry DNA, Animal Cells, Apple Earth, Oobeck, and Grain Chain (Campbell et al., 2015). Agriculture Education has the capability to connect STEM topics through hands on learning applications and become the leader in the field because of the STEM concepts (Campbell et al., 2015).

Makerspaces are a growing program within 4-H Extension that give opportunities to reach new audiences (Francis, Hill, Graham, Swadley, & Esplin, 2017). These spaces are defined as a "place where people can design and create together using tools and resources for production and learning." Research in Utah has shown makerspaces allow for less set up time for projects, a physical location, and increased sense of belonging. These types of locations allow for 4-H Extension to expand their networks in new ways (Francis et al., 2017).

CHAPTER III

METHODS

The purpose of this research study was to identify the barriers, roles, and information source preferences of 4-H Extension personnel in Utah. This study also identified demographics of the survey respondents. With a continually evolving society, current research allows Utah 4-H to have an understanding about the Agriscience programs within the state and the 4-H Extension personnel’s feelings towards it. The research objectives of this study were as follows.

1. Describe Utah 4-H Extension personnel’s perceived level of importance and perceived level of ability to deliver various Agriscience project areas.
2. Identify and prioritize the training needs of Utah 4-H Extension personnel in Agriscience project areas.
3. Describe Utah 4-H Extension personnel’s perceived barriers to implement agricultural science projects.
4. Determine Utah 4-H Extension personnel’s perception of their role in developing agricultural science projects.
5. Determine Utah 4-H Extension personnel’s preference for gathering information related to agricultural science projects.
6. Describe the characteristics of the Utah 4-H Extension personnel (age, gender, highest degree, etc.)

Research Design

This research study was a quantitative needs assessment of the perception and barriers of Agriscience project use by 4-H Extension personnel. The purpose of this study was to identify the barriers, roles, and information source preferences of 4-H Extension personnel in Utah. This study used an online survey administered through Qualtrics. Dillman (2007) identifies a shift from phone and mail surveys to online self-administered surveys (Dillman, 2007). Using Qualtrics and online survey research allows for easy survey completion due to the use of technology and allows for cost reduction and similar survey results (Dillman, 2016).

Population and Sample

There are approximately 166 4-H Extension personnel with 4-H roles in the state of Utah (D. Francis, personal communication, November 12, 2018) that served as the population of this study. The sample for this study was a purposive sample of 4-H Extension personnel with 40% or higher appointment in Youth Development. A purposive sample, is a type of non-probabilistic sample, which involves identifying and selecting individuals or groups of individuals that are especially knowledgeable about or experienced with a phenomenon of interest (Cresswell & Plano Clark, 2011). This is often accomplished by applying the expert knowledge of the population to select in a nonrandom manner a sample of elements that represents a cross-section of the population and is not representative of the entire population (Positive Sampling, 2018, para. 1). This purposive sample was considered an expert sample, used when researchers need to glean knowledge from individuals who have expertise in a particular area (Positive Sampling, 2018, para. 13), in this study 4-H Extension personnel's use of Agriscience youth projects. This involved identifying and selecting individuals or groups of individuals that were especially knowledgeable about or experienced with a phenomenon of interest

(Cresswell & Plano Clark, 2011). This sampling technique was used, as inference to the entire population was not the goal of the study. Each participant that meets the inclusion criteria was sent the anonymous survey by email.

Instrumentation

A researcher-developed instrument, adapted from previous literature (Mowen, et al., 2007), was administered online through Qualtrics. The online instrument began with a letter of participation acknowledging the risks, purpose, procedures, Institutional Review Board (IRB) approval, confidentiality, voluntary participation, and an offer to answer any questions. The participants were instructed to answer a question stating that they had read the letter of information and agree to complete the survey.

Section one asked a question to identify the types of Agriscience projects 4-H Extension personnel are currently conducting with 4-H youth. This was a multiple answer question with an answer labeled as “I do not do Agriscience.” Other answer options included biotechnology, agriculture literacy, STEM, robotics, and food and science technology. A skip logic was included in this question. The 4-H Extension personnel who indicated they do not participate in Agriscience projects with their youth were sent to section two to continue the survey. If they selected one or more Agriscience projects they continued to the needs assessment items to complete the survey.

The needs assessment questions began with a 5-point scale question on the level of importance and perceived ability of various subjects including biotechnology and Agriscience (Boone et al., 2006; Fritz et al., 2004; Han et al., 2015; Myers & Washburn, 2008; Myers et al., 2015). This was asked by a two-part, 5-point scale question. The level of importance ranged from 1 (*not important*) to 5 (*very important*), and the perceived ability ranged from 1 (*no competence*) to 5 (*very competent*).

The second section identified 11 barriers that 4-H Extension personnel may face with the incorporation or continuation of Agriscience projects (Dahabieh et al., 2018; Mowen et al., 2007; Myers & Washburn, 2008; Myers et al., 2009; Warnick & Thompson, 2007). The listed barriers included lack of equipment, time, accessibility to materials, accessibly to workbooks, lack of knowledge, ability of youth, acceptance by youth, community support, available volunteers, interest of youth, and available facilities. A text box entry space where additional barriers could be listed was an option. The 4-H Extension personnel were given a list of potential barriers and answered each barrier using a 5-point scale, ranging from 1 (*strongly disagree*) to 5 (*strongly agree*) (Mowen et al., 2007).

Section three had a list of roles and asked 4-H Extension personnel to rate what they felt they should be doing in relation to Agriscience with a 5-point scale from 1 (*strongly disagree*) to 5 (*strongly agree*). Mowen et al. (2007) and Warnick and Thompson (2007) identified various rolls educators felt they should be involved with or steer away from.

The fourth section asked about the sources of information used by 4-H Extension personnel for Agriscience resources using a ranking scale. Fritz et al. (2004), Han et al. (2015), and Mowen et al (2007) investigated the Agriscience sources of information. Many of the information sources found in their study were used in the survey questionnaire with the addition of YouTube and podcasts.

The fifth section identified participant demographics. There were four demographic questions following the information from Mowen et al. (2007), Myers et al. (2009), and Warnick and Thompson (2007). These questions asked participants to include their age, years in 4-H Extension, gender, and level of education. Education level coincided with research from Boone et al. (2006), Edney and Elbert (2009), Mowen et al. (2007), Myers and Washburn (2008), Myers et al. (2009), and Warnick and Thompson (2007). The demographics were identified through fill in the blank and check box answers. Following the questions there was a final screen that thanked the participants for their responses to the survey and addressed what to do with any more questions.

Validity

In quantitative research, “validity” is defined as how well a concept is accurately measured (Heale & Twycross, 2015). A panel of experts from Utah State University, which included Agricultural Education and 4-H Extension professionals, evaluated the instrument for face and content validity.

Reliability

The reliability in a quantitative study verifies the precision or accuracy of the instrument, in this case the survey (Heale & Twycross, 2015). The survey was administered following IRB approval to a pilot population to gather reliability data and make any necessary edits to the questions. A group of 19 4-H Extension personnel with 4-H youth development assignments, with and without Agriscience experience, from

Colorado were targeted for the pilot study. Nine responded to the invitation. This pilot resulted in a more refined survey. A Cronbach's alpha (Field, 2009) was used on item scores with a range of values, including Likert and bipolar attitude scales. Cronbach's alpha coefficients calculated the needs assessment scales of importance and ability, barriers, and responsibilities. The results from the pilot study were not included in the final sample (Table 1). While Cronbach's alpha for ability was low, Nunnally (1967) suggested .5 could be considered adequate during early research stages or with new instrument development.

Table 1

Pilot Study Results

Trait	Cronbach's alpha
Importance	.80
Ability	.69
Barriers	.82
Responsibilities	.78

Data Collection

After receiving Utah State University IRB approval, the survey was sent to 4-H Extension personnel in Utah who have an assignment of 40% or more involving 4-H youth development (Appendix E). This study used Dillman's (2007) Tailored Design Model. This model is designed to have multiple contact points and a survey that is easy to complete, allows for a higher response rate (Dillman, 2007). The first step of the administration of the survey was a prenotice email (Appendix A), sent out in January.

Step two, the questionnaire (Appendix B), was sent out 7 days following the prenotice email. The last three contacts were reminder emails (Appendix C). Each one was sent a week apart. A thank you email was sent out to those who completed the survey (Appendix D). Each step included a custom email invitation, contact information for questions, directions on how to complete the survey, and the survey link.

Data Analysis

The data were analyzed using the IBM SPSS Statistics 24 program and an excel-based MWDS calculator created by McKim and Saucier (2011). The MWDS calculator is a Microsoft Excel file that allows individuals to calculate discrepancy scores for importance/ability scores (McKim & Saucier, 2011).

. The first section, asking what projects the 4-H Extension personnel complete with their youth and the needs assessment, used means, standard deviation, frequencies, and range. Section two and three, identifying barriers and roles, analyzed the data through means, standard deviation, frequencies, and range. The fourth section, which covered sources of information, used frequencies to identify the information source preferences. To analyze the demographics, section five, frequencies and percentages were run.

Summary

The above chapter covers the study’s methodology. It identifies the design of the research, specific information regarding the population and sample, instrument, data collection and data analysis. This research was a descriptive study that also looked at relationships related to barriers, roles, and information sources of Utah 4-H Extension personnel with 40% or more assignment with 4-H youth development in the program area of Agriscience. Once the IRB approved the study, the instrument was emailed to a sample group of Colorado 4-H Extension personnel to the pilot the questionnaire for reliability. Once the pilot study was completed, the five steps of Dillman's (2007) Tailored Design Model were used to administer the survey to the selected population. The data was then analyzed through IBM SPSS 24.

CHAPTER IV

RESULTS AND FINDINGS

The purpose of this research study was to identify the barriers, roles, and the source preferences for gathering information on Agriscience projects by 4-H Extension personnel in Utah. The study also identified demographics of the 4-H Extension personnel in Utah surveyed. Research in this field allows for an understanding about the Agriscience programs within Utah and the feelings of the 4-H Extension personnel towards these programs.

The following seven objectives were used in the study.

1. Describe Utah 4-H Extension personnel's perceived level of importance and perceived level of ability to deliver various Agriscience project areas.
2. Identify and prioritize the training needs of Utah 4-H Extension personnel in Agriscience project areas.
3. Describe Utah 4-H Extension personnel's perceived barriers to implement agricultural science projects.
4. Determine Utah 4-H Extension personnel's perception of their role in developing agricultural science projects.
5. Determine Utah 4-H Extension personnel's preference for gathering information related to agricultural science projects.
6. Describe the characteristics of the Utah 4-H Extension personnel (age, gender, highest degree, etc.)

They survey prenotice email was sent out on January 16, 2019, to 62 Utah 4-H Extension personnel. The personnel each had 40% or more assignment with 4-H. The introduction email was sent out January 21, 2019. Three reminder emails were sent out on January 28, February 4, and February 11, 2019. The survey was closed on February 18, 2019. The response total was 24 people, giving a 38.7 % response rate. No attempt was made to contact nonrespondents, as the survey was anonymous.

The first question on the survey was a multi select question with the last option being “I do not do Ag Science projects.” If this question was answered the respondent was sent directly to the barriers section of the survey. A total of two people (8.3 %) stated they did not teach Ag Science projects (see Table 2).

Table 2

Types of 4-H Agriscience Projects Used in Utah (*n* = 24)

Item	*f*	%
STEM	16	66.70
Gardening	14	58.30
Food science and technology	10	41.60
Agriculture literacy	10	41.60
Healthy living	10	41.60
Water quality	9	37.50
Robotics	9	37.50
Sustainability	6	25.00
GIS and GPS	6	25.00
Biotechnology	2	8.30
I do not do Ag science projects	2	8.30
Global food security	1	4.20
Business or economics in agriculture	1	4.20
Agriculture engineering	0	0.00

Objective 1: Describe Utah 4-H Extension personnel’s perceived level of importance and perceived level of ability to deliver various Agriscience project areas.

Level of importance and perceived ability were measured in a two part, 5-point Likert scale question with seventeen projects listed. The level of importance was scaled from 1 (*not important*) to 5 (*very important*). Perceived ability ranged from 1 (*no ability*) to 5 (*able*).

Means and standard deviations were recorded for both objectives. Table 3 displays this data. STEM had the highest mean at 4.47 for level of importance, while Leadership had the highest perceived ability mean. While not directly related to agriscience Creative Arts, Expressive Arts, and Citizenship were included in the instrument as they are part of the project areas available to 4-H Extension personnel. Expressive Arts had the lowest level of importance and the lowest perceived ability was Expressive Arts (see Table 3).

Table 3

Mean Importance and Ability by Topic Area

	Level of importance			Perceived ability		
Topic	*n*	*M*	*SD*	*n*	*M*	*SD*
Biotechnology	16	3.69	1.01	18	3.17	1.43
Agriscience	16	4.25	0.93	18	3.94	1.39
STEM	17	4.47	0.62	19	4.11	1.10
Robotics	16	3.94	1.06	18	3.17	1.25
GIS and GPS	16	3.94	0.77	18	3.67	1.19
Healthy living	17	4.18	1.07	19	4.32	0.82
Creative arts	18	3.78	1.11	20	3.35	1.23
Expressive arts	16	3.56	1.09	18	2.94	1.43
Citizenship	18	4.50	0.77	19	4.16	0.77
Leadership	19	4.53	0.84	20	4.45	0.61
Horse	17	4.06	0.90	19	3.79	1.36
Livestock	17	4.24	0.75	19	4.11	1.33
Poultry	17	4.18	0.81	19	3.79	1.36
Dog	17	3.59	1.06	19	3.16	1.26
Junior master gardener and youth gardening	18	4.33	0.59	20	4.15	1.04
Special gardening project	17	4.00	0.70	19	3.68	1.38
Water quality	16	4.44	0.51	18	3.89	1.13

Note. Importance scales 1 = Not Important, 2 = Of Little Importance, 3 = Neutral, 4 = Important, 5 = Very Important; Ability Scales 1 = No Knowledge, 2 = Little Knowledge, 3 = Neutral, 4 = Some Knowledge, 5 = Knowledgeable.

Objective 2: Identify and prioritize the training needs of Utah 4-H Extension personnel in Agriscience project areas.

The Borich Needs Assessment Model and calculations were used to identify the training needs of 4-H Extension personnel. The mean weighted discrepancy scores (MWDS) was calculated with the data from objective one. The scores ranged from 2.95 to -0.77. Robotics and Expressive Arts indicated the largest discrepancy. The MWDS is the difference between the perceived importance and ability. Other positive discrepancy scores included Water Quality, Citizenship, Biotechnology, STEM, Creative Arts, Poultry, Dogs, Agriscience, Horse, Special Gardening Project, GIS and GPS, and Leadership. Livestock and Junior Master Gardener and Youth Gardening had even discrepancy scores. Healthy Living was the only topic with a negative discrepancy score (see Table 4). This suggests that Healthy Living is the only topic the 4-H Extension

Table 4

Mean Weighted Discrepancy Scores Between Importance and Ability (*n* = 16)

Project	*MWDS*
Robotics	2.95
Expressive arts	2.00
Water quality	1.94
Citizenship	1.69
Biotechnology	1.61
STEM	1.41
Creative arts	1.34
Poultry	1.29
Dog	0.88
Agriscience	0.80
Horse	0.77
Special gardening project	0.50
GIS and GPS	0.49
Leadership	0.28
Junior master gardener and youth gardening	0.00
Livestock	0.00
Healthy living	-0.77

personnel felt they had a higher perceived ability to teach compared to the level of importance of the project.

Objective 3: Describe Utah 4-H Extension personnel's perceived barriers to implement agricultural science projects.

The barriers were measured through a 5-point Likert scale question. Each barrier was evaluated from 1 (*strongly agree*) to 5 (*strongly disagree*) as a barrier to the 4-H youth Agriscience projects. Time (M = 1.8, SD = 0.83) and Available Volunteers (M = 1.81, SD = 0.81) were identified as the greatest barriers. The lowest barriers were ability of youth (M = 3.30, SD = 1.13) and Community Support (M = 3.25, SD = 0.85). The data is reported in Table 5.

Table 5

Barriers of Implementing Agriscience Projects (n = 24)

Barrier	*M*	*SD*
Ability of youth	3.30	1.13
Community support	3.25	0.85
Acceptance of youth	2.95	0.92
Acceptance of youth	2.95	0.92
Lack of knowledge	2.76	1.58
Accessibility of instructional materials	2.74	1.05
Interest of youth	2.70	0.98
Accessibility to workbook	2.65	0.88
Lack of equipment	2.05	0.97
Facilities	2.10	0.85
Available volunteers	1.81	0.81
Time	1.80	0.83

Note. 1 = Strongly Agree, 2 = Agree, 3 = Neutral, 4 = Disagree, 5 = Strongly Disagree.

Objective 4: Determine Utah 4-H Extension personnel's perception of their role in developing agricultural science projects.

Seven items related to the 4-H Extension professional responsibility with 4-H programs and topics were listed. Respondents identified their roles on a Likert scale from 1 (*strongly agree*) to 5 (*strongly disagree*). As seen in Table 6, the majority of the 4-H Extension personal (M = 1.14, SD = 0.36) strongly agreed that it was their responsibility to listen to youth. Educating farmers and agriculturist about Agriscience had the highest mean (M = 2.00, SD = 1.17) with 4-H Extension personal only agreeing it was their responsibility.

Table 6

Responsibilities of 4-H Extension Personnel

Role	*n*	*M*	*SD*
Educate farmers and agriculturist about Agriscience	20	2.00	1.17
Teach 4-H youth about Agriscience	21	1.67	0.73
Involve youth in Agriscience activities	20	1.65	0.75
Demonstrate understanding of 4-H programs and topics	21	1.24	0.44
Encourage youth to participate in 4-H programs	21	1.19	0.40
Help youth find programs that interest them	21	1.19	0.40
Listen to youth	21	1.14	0.36

Note. 1 = Strongly Agree, 2 = Agree, 3 = Neutral, 4 = Disagree, 5 = Strongly Disagree.

Objective 5: Determine Utah 4-H Extension personnel's preference for gathering information related to agricultural science projects.

Information source preferences for agricultural projects were identified through a drag and drop ranking scale question. The listed sources included workbooks, agricultural magazines, scientific journals, newspapers, YouTube, podcasts, internet, workshops, Agricultural Science Teachers, University Professors, University Courses, and other Cooperative 4-H Extension Services. The internet was the first choice as an information source preference (26.30%). Workshops (21.10%), workbooks, University Professors, and other Cooperative 4-H Extension Services followed ranked third at 10.50 percent. Podcasts (21.10%) were the last choice as a source of information.

Objective 6: Describe the characteristics of the Utah 4-H Extension personnel (age, gender, highest degree, etc.).

Four questions were asked to identify the gender, age, education level, and length of time working in 4-H Extension. The majority of the respondents were 21-30 years old (38.10%), and male (57.10%). Almost half (47.40%) of the respondents had completed a graduate degree, with only one person (5.30%) having a doctorate degree. Two respondents did not answer the education question. Of those who responded, three had less than a year of experience, six had 1-5 years of experience, three had 6-10 years of experience, three had 11-15 years of experience, and six had sixteen years or more experience. The results are detailed in Table 7.

Table 7

Demographic Characteristics of Respondents

Demographic characteristic	*f*	%
Age (n = 21)		
21-30	8	38.10
31-40	2	9.50
41-50	3	14.30
51-60	2	9.50
61 or older	6	28.60
Gender (n = 21)		
Male	12	57.10
Female	9	42.90
Education (n = 19)		
Bachelor degree	2	10.50
Bachelor degree with some graduate level classes	2	10.50
Graduate degree	9	47.40
Graduate degree with some other graduate classes	5	26.30
Doctorate degree	1	5.30
Years in 4-H Extension (n = 21)		
Less than 1 year	3	14.30
1-5 years	6	28.60
6-10 years	3	14.30
11-15 years	3	14.30
16 years or more	6	28.60

CHAPTER V

DISCUSSION

The purpose of this study was to gain an understanding of the barriers, roles and information source preferences for Agriscience projects among 4-H Extension personnel in Utah. Through this study, information gathered can help identify ways to allow growth in Agriscience projects throughout Utah 4-H.

Objectives

Objective 1: Describe Utah 4-H Extension personnel's perceived level of importance and perceived level of ability deliver various Agriscience project areas.

Research objective one sought to identify identified the "level of importance to deliver Agriscience project areas" to 4 H youth. On average 4-H Extension personnel felt the Agriscience project areas were important, as indicated by a mean of 4.25. This supports findings by Boone et al. (2006) and Myers et al. (2009) who found a positive attitude towards teaching science and biotechnology. 4-H Extension personnel in Utah find the agricultural science project areas important.

This objective also focused on perceived ability of Utah 4-H Extension personnel on the Agriscience areas. 4-H Extension personnel felt their perceived ability as neutral or having some ability to teach the Agriscience areas, leaving room for improvement. Further, a good portion of the 4-H Extension personnel feel they lack the ability to teach about agricultural science projects that are already in place.

Though the 4-H Extension personnel did not find their ability as high as the importance of the topic areas, the data shows the importance of improving the ability of the 4-H Extension personnel. Providing 4-H Extension personnel with training, may increase their ability to deliver appropriate Agriscience project programming to youth. Research in Extension shows face to face workshops tend to be more satisfactory for in-service learning when compared with minimally interactive online courses, but still felt that online courses were more favorable (McCann, 2007). The act of engaging Extension personnel in continued development and training is important for learning, behavior change, and continued development (Benge & Sowcik, 2018). Through continued training the 4-H Extension personnel can stay up to date on new information coming out on the Agriscience projects, continue to learn about the projects, and inquire with any questions they may have.

Objective 2: Identify and prioritize the training needs of Utah 4-H Extension personnel in Agriscience project areas.

The second objective was to "prioritize the training needs of 4-H Extension personnel in Agriscience project areas." The Borich Needs Assessment Model was used to identify and prioritize the training needs for 4-H Extension personnel in the Agriscience project areas.

Of the project areas with strong connections to agriscience Robotics, Water Quality, Biotechnology and STEM are project areas that need training and development for Utah 4-H Extension personnel. Training on these topics would allow 4-H Extension personnel to incorporate quality agricultural science connected content into their 4-H programs. The general term "Agriscience" was an additional topic 4-H Extension personnel found important but did not feel they had the ability to teach it. Perhaps there is a continued disconnect between what agriscience is and how it can be incorporated into a variety of project areas. Further, the connection between science and agriculture may be unclear. There is not always a clear line which direction projects should fall between science and agriculture. Many may know the definition of Agriscience but are unclear which projects qualify as an Agriscience type project.

Objective 3: Describe Utah 4-H Extension personnel's perceived barriers to implement agricultural science projects.

Objective three identified the perceived barriers in implementing agricultural science projects into 4-H programming. Time and volunteers were identified as the greatest barrier for 4-H Extension personnel. In agreeance with other research, the majority of 4-H Extension personnel felt time and lack of equipment were barriers in implementing Agriscience projects (Myers et al., 2009; Myers & Washburn, 2008; Warnick & Thompson, 2007). A study by Mowen et al. (2007) also found access to equipment as a major barrier in implementing new programs. More research can be done to identify ways to improve time management and assess the best way to gain access to better equipment.

Focused training in volunteer management and recruitment for 4-H Extension personnel could be used to address the time issue. In volunteer trainings researched by Fox, Hebert, Martin, and Bairnsfather (2009) volunteers were also able to learn about member and volunteer opportunities. The volunteer trainings help better prepare the volunteers, resulting in less questions for the 4-H Extension personnel. Casteel (2012) found that a formalized volunteer management program for 4-H Extension could allow for a uniform way to gain information and manage the volunteers. The volunteer management training for 4-H Extension personnel would allow for recruitment information, motivational tips, and ways to recognize the volunteers who help with Agriscience projects. Programs like these would allow for both 4-H Extension personnel and the volunteers to be more prepared and educated when it came time for the projects.

Objective 4: Determine Utah 4-H Extension personnel's perception of their role in developing agricultural science projects.

The fifth objective was to "determine the 4-H Extension personnel's perception of their role in developing agricultural science projects." 4-H Extension personnel agreed or strongly agreed with all of the roles they were asked, except for educating farmers and agriculturist about Agriscience. This was the only role in the list of responsibilities that did not include youth as part of the population in question. With this information we can gather that 4-H Extension personnel with 40% or more assignment in 4-H do consider their job role focused around the youth. This data is supported by Mowen et al. (2007), who stated that educators agreed with their roles of educating students about biotechnology related projects and teaching students about biotechnology. This focus on youth can continue to guide the 4-H Extension personnel to listen to their youth and focus on encouraging them.

Objective 5: Determine Utah 4-H Extension personnel's preference for gathering information related to agricultural science projects.

Research objective six used a drag and drop ranking scale question to identify information source preferences. 4-H Extension personnel indicate internet use as the first choice for obtaining their information, followed by workshops which is similar to the findings Mowen et al. (2007) and Fritz et al. (2004). Interestingly, podcasts were the least popular source of information. It is recommended that when developing professional development opportunities and information for 4-H Extension personnel regarding Agriscience projects that the internet and traditional workshop presentations be utilized as a delivery method.

Objective 6: Describe the characteristics of the Utah 4-H Extension personnel (age, gender, highest degree, etc.).

Objective seven identified the demographics of the 4-H Extension personnel, including age, gender, education, and years in 4-H Extension. As noted in Chapter IV, majority of the 4-H Extension personnel were 21- to 30-year-old males. This indicates that 4-H Extension programs in Utah have a younger group of personnel educating the youth. This can help to bring new ideas and input into program development. This also indicates a clear need for additional training for young 4-H Extension personnel.

Of the 21 4-H Extension personnel who responded to the demographic question on their years of experience almost one third of them have under 5 years of experience and the other 1/3 have 16 or more years of experience and more than half have a graduate degree. This is reinforced by Mowen et al. (2007), Myers and Washburn (2008), and Boone et al. (2006), educators had an average of 12.3 years of experience to 15 years of experience. The 4-H Extension personnel education levels reflects the hiring requirements within the state where many 4-H Extension positions require a Master degree in a related field. The experience of 4-H Extension personnel followed the other demographic responses will require that further training of the 4-H Extension personnel must match experience, age, and education levels.

Recommendations

The results from this study indicates that 4-H should develop a clear definition of Agriscience. An updated definition of what Agriscience is, what the project area should include, and any overlap there may be with other project areas. This clear definition should be passed down to the state level, county level, and club level. Other programs can be a guide to growing the programs and looking at career readiness. STEM programs could give a good direction to follow in expanding these programs.

4-H Extension personnel could greatly benefit from various trainings to help them develop the ability to deliver Agriscience projects to youth. With the internet being the choice of information sourcing, online trainings should be considered. This type of training would allow for 4-H Extension personnel to complete the training on their time schedule. Benge and Sowcik (2018) recommend that online delivery of in-service programs is appropriate and should be timely due to changes through 4-H Extension programs, especially considering time. Online training programs like this could be of great benefit to Utah 4-H Extension.

Further, it is also recommended that Utah 4-H Extension programs continue to promote Agriscience as a connection to STEM and are valued areas for project areas through online and social media sources. According to Anderson and Jiang (2018), 45% of youth feel they use internet on an “almost constantly” basis. Social media, including YouTube, Instagram, and Snapchat, are taking over the media use for youth (Anderson & Jiang, 2018). Through these platforms Utah 4-H could promote projects where the youth are likely to see and share the information. Other ways to improve interest in programs include meeting with the youth in person to answer any questions, inviting youth currently in the program to brainstorm ideas, and reevaluating the projects throughout the year. However, relevant Agriscience programs will need to be developed and leaders trained to retain youth engagement.

In Utah, makerspaces worked well to bring people together (Francis et al., 2017). These types of locations could allow for a great working environment, space to participate in activities, and a welcoming environment for the youth. It also could allow for more community involvement.

Future research should further examine the barriers 4-H Extension personnel face in implementing new Agriscience project areas and evaluate what suggestions they have to improve them. Further research should include a comparison of the breadth and depth of Agriscience projects in urban and urban programs.

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APPENDICES

Appendix A

Prenotice Email

SUBJECT: Agriscience Research Survey

To Whom It May Concern,

We are writing to invite you to participate in a survey on Agriscience projects in 4H. The purpose of this study is to identity the barriers 4-H Extension personnel face implementing Agriscience projects in their youth programs.

The survey will take 5 -10 minutes of your time. With your participation in this study we will be able to gain insight and work to improve the utilization of Agriscience projects in 4H. An email will be sent out on Monday January 21st with the link for the survey. If you have any questions or comments please contact Dr. Rebecca Lawver at Rebecca.lawver@usu.edu or (435) 797-1254.

If you would like to complete the survey now, click here:

Thank you for your time,

Aleigh Aurin
Graduate Student
Utah State University

Dr. Rebecca Lawver
Associate Professor, Agriculture Education
Utah State University

Appendix B

Survey Email

SUBJECT: Agriscience Research Survey

To Whom It May Concern,

My name is Aleigh Aurin, I am a Masters graduate student at Utah State University working with Dr. Rebecca Lawver on my thesis project titled UTAH 4-H EXTENSION PERSONNELS' BARRIERS, ROLES, AND INFORMATION SOURCE PREFERENCES FOR UTILIZING AGRICULTURAL SCIENCE PROJECTS.

The purpose of this study is to identity the barriers 4-H Extension personnel face implementing Agriscience projects in their youth programs.

I would greatly appreciate your time and assistance in helping me with my research.

If you would like to begin the survey today, click HERE.

If you have any questions or concerns, please feel free to contact Dr. Lawver at Rebecca.lawver@usu.edu or 435-797-1254.

Sincerely,

Aleigh Aurin
Graduate Student
Utah State University

Dr. Rebecca Lawver
Associate Professor, Agriculture Education
Utah State University

Appendix C

Reminder Email

SUBJECT: Agriscience Research Survey

SUBJECT: UTAH 4-H EXTENSION PERSONNELS' SURVEY ON AGRICULTURE SCIENCE PROJECTS

To Whom It May Concern,

We are writing to follow up on the previous email we sent asking for your participation in a survey on Agriscience Projects. This survey will allow us to discover more about how you use or what barriers you may have with incorporating Agriscience projects into your programs. Because we know you are very busy this time of year and we realize your time is valuable we have limited the survey to only 5-10 minutes. Your participation and answers in this survey will provide valuable insight that will aid in the advancement of agriculture education. Please click on the link below to go to the survey website (or copy and paste the survey link into your internet browser).

If you would like to begin the survey today, click HERE.

Should you have any further questions or comments, please contact Dr. Rebecca Lawver at Rebecca.lawver@usu.edu or (435) 797-1254

Again, thank you for taking time out of your busy schedule to complete this survey.
Thanks again,

Aleigh Aurin
Graduate Student
Utah State University

Dr. Rebecca Lawver
Associate Professor, Agricultural Education
Utah State University

Appendix D

Thank You Email

SUBJECT: Agriscience Research Study

To Whom It May Concern,

Thank you for completing the survey on the barriers 4-H Extension personnel face implementing Agriscience projects in their youth programs. I greatly appreciate your time and assistance in helping me with my research.

If you have any remaining questions or concerns, please contact Dr. Rebecca Lawver at rebecca.lawver@usu.edu or 435-797-1254.

Sincerely,

Aleigh Aurin
Graduate Student
Utah State University

Dr. Rebecca Lawver
Associate Professor, Agriculture Education
Utah State University

Appendix E

Letter of Information

Please fully review the following document before deciding whether to proceed with this survey.

Office of Research and Graduate Studies
UtahStateUniversity
Institutional Review Board

Page 1 of 2
Protocol #9783
IRB Approval Date: 11/19/2018
Consent Document Expires: 11/18/2021
IRB Password Protected per IRB Coordinator

v.8.3 May2017

Letter of Information

UTAH EXTENSION PERSONNELS' BARRIERS, ROLES, AND INFORMATION SOURCE PREFERENCES FOR UTILIZING AGRICULTURAL SCIENCE PROJECTS

Introduction
You are invited to participate in a research study conducted by Rebecca G. Lawver, an associate professor in the School of Applied Sciences Technology and Education and Ms. Aleigh Aurin a Graduate Student at Utah State University. The purpose of this study is to identity the barriers Extension personnel face implementing agriscience projects in their youth programs.

This form includes detailed information on the research to help you decide whether to participate in this study. Please read it carefully and ask any questions you have before you agree to participate.

Procedures
The questionnaire consists of 4 sections and will take approximately 20 minutes or less. Questions are designed to identify the barriers, roles and the way Extension personnel prefer to get information about using agriscience projects in their youth programs. This questionnaire will be conducted with an online Qualtrics-created survey. There will be 166 Extension Personnel invited to participate in this survey.

Risks
This is a minimal risk research study. That means that the risks of participating are no more likely or serious than those you encounter in everyday activities. In order to minimize those risks and discomforts, the researchers will assign a respondent number and use password protecting files and computers. If you have a bad research-related experience or are injured in any way during your participation, please contact the principal investigator of this study right away at (435) 797-1254.

Benefits
There is no direct benefit to you for participating in this research study. More broadly, this study will help the researchers learn more about collaboration between agricultural teachers and extension agents/educators and may help develop professional development pertaining to the topic and identify areas where both organizations could work more closely.

Confidentiality
All data obtained from participants will be kept confidential and will only be reported in an aggregate format (by reporting only combined results and never reporting individual ones). All questionnaires will be concealed, and no one other than the primary investigator and assistant researchers will have access to them. The data collected will be stored in the HIPPA-compliant, Qualtrics-secure database until it has been deleted by the primary investigator.

It is unlikely, but possible, that others (Utah State University or state or federal officials) may require us to share the information you give us from the study to ensure that the research was conducted safely and appropriately. We will only share your information if law or policy requires us to do so.

The research team works to ensure confidentiality to the degree permitted by technology. It is possible, although unlikely, that unauthorized individuals could gain access to your responses because you are responding online. However, your participation in this online survey involves risks similar to a person's everyday use of the internet.

Office of RESEARCH and GRADUATE STUDIES
UtahStateUniversity
INSTITUTIONAL REVIEW BOARD

Page 2 of 2
Protocol #9783
IRB Approval Date: 11/19/2018
Consent Document Expires: 11/18/2021
IRB Password Protected per IRB Coordinator

v.2 3 May2017

Voluntary Participation, Withdrawal & cost
Participation in this research study is completely voluntary. You have the right to withdraw at any time or refuse to participate entirely without affecting your relationship with the researchers, Utah State University and without consequence or loss of benefits. To withdraw, you may leave the survey without completing the survey. Because the surveys are anonymous your responses cannot be withdrawn once you've submitted as there is no identifiable information included.

IRB Review
The Institutional Review Board (IRB) for the protection of human research participants at Utah State University has reviewed and approved this study. If you have questions about the research study itself, please contact the Principal Investigator at 435-797-1254 or Rebecca.lawver@usu.edu. If you have questions about your rights or would simply like to speak with someone other than the research team about questions or concerns, please contact the IRB Director at (435) 797-0567 or irb@usu.edu.

Informed Consent
By clicking the radio button "yes, I agree to participate", you agree to participate in this study. You indicate that you understand the risks and benefits of participation, and that you know what you will be asked to do. You also agree that you have asked any questions you might have, and are clear on how to stop your participation in the study if you choose to do so. Please be sure to retain a copy of this form for your records.

Rebecca G. Lawver	Aleigh Aurin
Principal Investigator	Student Investigator
(435) 797-1254; Rebecca.lawver@usu.edu	jumperaleigh@gmail.com

School of Applied Sciences Technology and Education | 435-797-1254 | 2300 Old Main Hill | Logan, UT 84322

○ Yes, I agree to participate

○ No, not at this time

What types of 4-H Ag Science do you do with your youth?

- ☐ Biotechnology
- ☐ Agriculture Literacy
- ☐ Global Food Security
- ☐ Sustainablity
- ☐ Business or Economics in Agriculture
- ☐ STEM
- ☐ Food Science and Technology
- ☐ Agriculture Engineering
- ☐ Water Quality
- ☐ Robotics
- ☐ GIS and GPS
- ☐ Healthy Living
- ☐ Gardening
- ☐ I do not do Ag Science Projects

Please identify the level of importance for each project area and your knowledge to be able to lead youth in these areas.

	Level of Importance					Perceived Ability				
	Not Important	Of Little Importance	Neutral	Important	Very Important	No Knowledge	Little Knowledge	Neutral	Some Knowledge	Knowledgeable
Biotechnology	○	○	○	○	○	○	○	○	○	○
Agriscience	○	○	○	○	○	○	○	○	○	○
STEM	○	○	○	○	○	○	○	○	○	○
Robotics	○	○	○	○	○	○	○	○	○	○
GIS and GPS	○	○	○	○	○	○	○	○	○	○
Healthy Living	○	○	○	○	○	○	○	○	○	○
Creative Arts	○	○	○	○	○	○	○	○	○	○
Expressive Arts	○	○	○	○	○	○	○	○	○	○
Citizenship	○	○	○	○	○	○	○	○	○	○
Leadership	○	○	○	○	○	○	○	○	○	○
Horse	○	○	○	○	○	○	○	○	○	○
Livestock	○	○	○	○	○	○	○	○	○	○
Poultry	○	○	○	○	○	○	○	○	○	○
Dog	○	○	○	○	○	○	○	○	○	○
Junior Master Gardener and Youth Gardening	○	○	○	○	○	○	○	○	○	○
Special Garden Project	○	○	○	○	○	○	○	○	○	○
Water Quality	○	○	○	○	○	○	○	○	○	○

What are the barriers to incorporating biotechnology and Agriscience into your 4-H youth program?

	Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree
Lack of Equipment	○	○	○	○	○
Time	○	○	○	○	○
Accessibility of Instructional Materials	○	○	○	○	○
Accessibility to Workbook	○	○	○	○	○
Lack of Knowledge	○	○	○	○	○
Ability of Youth	○	○	○	○	○
Acceptance by Youth	○	○	○	○	○
Community Support	○	○	○	○	○
Available Volunteers	○	○	○	○	○
Interest of Youth	○	○	○	○	○
Available Facilities	○	○	○	○	○
Other	○	○	○	○	○

End of Block: Block 5

Start of Block: Block 3

I believe it is my responsibility to:

	Strongly agree	Somewhat agree	Neither agree nor disagree	Somewhat disagree	Strongly disagree
Teach 4-H youth about Agriscience					
Involve youth in Agriscience activities					
Educate farmers and agriculturist about Agriscience					
Encourage youth to participate in 4-H programs					
Help youth find program that interests them					
Listen to youth					
Demonstrate understanding of 4-H programs and topics					

End of Block: Block 3

Start of Block: Block 4

The following question uses drag and drop to rank the answers. I prefer to receive information from:

______ Workbooks
______ Agricultural Magazines
______ Scientific Journals
______ Newspapers
______ YouTube
______ Podcasts
______ Internet
______ Workshops
______ Agricultural Science Teachers
______ University Professors
______ University Courses
______ Other Cooperative 4-H Extension Services

End of Block: Block 4

Start of Block: Default Question Block

What is your age?

○ 18-20

○ 21-30

○ 31-40

○ 41-50

○ 51-60

○ 61 or older

What is your gender?

○ Male

○ Female

○ Other

○ Prefer not to answer

What is the highest level of school you have completed or the highest degree you have received?

- ○ Bachelor Degree
- ○ Bachelor Degree with some graduate level classes
- ○ Graduate Degree
- ○ Graduate Degree with other graduate classes
- ○ Doctorate Degree

How long have you worked in 4-H Extension?

- ○ Less than 1 year
- ○ 1-5 years
- ○ 6-10 years
- ○ 11-15 years
- ○ 16 years or more

End of Block: Default Question Block