Technologies used in Iowa 4-H programs to deliver science, technology, engineering, math and agriculture curricula

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Technologies Used in Iowa 4-H Programs to Deliver Science, Technology, Engineering, Math and Agriculture Curricula

By
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A creative component submitted to the graduate faculty
in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

Agricultural Education with Specialization in Agricultural Extension Education

Program of Study Committee:
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Chapter 1: Introduction

4-H is a global youth organization that developed in the early 1900’s. The National 4-H organization was formed in 1914 when the United States Congress created the Cooperative Extension Service (Seevers, Graham, Gamon, & Conklin, 1997). The Smith-Lever Act of 1914 is a United States federal law that established a system of cooperative extension services, connected to the public land-grant universities, to inform people about current developments in agriculture, home economics, public policy/government, leadership, 4-H, economic development, and other related issues (Gould, Steele, & Woodrum, 2014). The 4-H organization is administered by the National Institute of Food and Agriculture (NIFA) of the United States Department of Agriculture (USDA). The 4-H organization can be found in over 50 countries. As of 2017, there are approximately 6 million members in the U.S. ranging in age from 5 – 21 years old (4-H, 2017). There are an estimated 90,000 clubs worldwide. While all the programs are operated independently, they also work cooperatively with other organizations. There are approximately 100 public universities, 500,000 volunteers, and 3,500 4-H professionals who play a significant role in the oversight and implementation of activities and programs around the United States (4-H, 2017).

The 4-H motto is “To make the best better” and their slogan is “Learn by doing” (Seevers et al., 1997). The purpose and intent of the organization is to engage youth to develop their potential, and to promote youth development globally. 4-H was initially formed with the purpose of teaching youth in rural communities about improved farming and home-making practices. Research experiment stations taught youth agricultural skills and technology, which would then be shared with farmers who were less receptive to learning about new agricultural technology through traditional adult delivery methods. Today, 4-H no longer focuses primarily
on agricultural and home-making activities, but on emphasizing personal growth and preparation for lifelong learning. Programs provide learning opportunities without regard to gender or cultural background. 4-H continues to promote the goal of developing citizenship, leadership, responsibility and life skills through experiential learning and a positive youth development approach (4-H, 2017).

Within the 4-H program oversight structure in Iowa, County Youth Coordinators work closely with volunteers to implement activities and programs that will help 4-H participants develop skills to help prepare them to become contributing members to all levels of society. As in the past, learning new technology is a key component of 4-H activities and programs (Iowa 4-H, 2017). Technology can be defined as “methods, systems, and devices which are the result of scientific knowledge being used for practical purposes” (Collins New English Dictionary, 2018). Technology has moved beyond traditional farm implements and basic computer literacy skills, and now includes advanced skills in the areas of robotics, computer programming, rocketry, biotechnology, alternative energy, agriculture science, and veterinary science. Iowa 4-H strives to create a strong Iowa by preparing their youth membership to be forward-thinking, problem-solvers, leaders, and contributors to all levels of society. With the implementation of their best practices, Iowa 4-H promotes a framework of mentorship and career readiness training that will lead to lifelong learning (Iowa 4-H, 2017). Iowa 4-H science, technology, engineering, and math (STEM) and agriculture programs can continue to develop educated youth by identifying current technology use and recognizing training opportunities to further develop the capacity of youth program educators. A review of literature reveals a need to collect data that will help us understand what technologies are being used in Iowa 4-H programs and activities to deliver STEM and agriculture content, as well as what technology training is needed to make Iowa 4-H
youth-serving staff and volunteers more competent in using technology to deliver program curricula. With this information in hand, an adult education technology training model and an adult education training plan can be developed to effectively train Iowa 4-H educators.

**Purpose and Research Objectives**

The purpose of this study was to identify educational technologies used in delivering 4-H science, technology, engineering and math (STEM) and agriculture program content, and the extent to which 4-H youth-serving staff and volunteers may need additional technology training. There were three related objectives of this study:

1) To identify the technologies used in delivering STEM and agriculture content in Iowa 4-H programs and activities,

2) To identify the extent to which Iowa 4-H Extension, youth-serving staff, and volunteers need additional technology training, and

3) To identify demographic information of Iowa 4-H Extension, youth-serving staff, and volunteers who teach 4-H STEM and agriculture programs.

**Significance of Study**

This study of technology use within the 4-H curriculum and the extent to which Iowa 4-H Extension, youth-serving staff and volunteers feel like additional technology training is needed is valuable from the viewpoint that we need to help prepare youth for the technology-based jobs of the future. To educate Iowa youth about technology, we need confident and qualified staff and volunteer educators to implement 4-H youth STEM and agriculture technology-driven activities and programs. By fully embracing technology through inquiry and experiential learning, Iowa youth will be become college and career ready for the jobs of the 21st century (Iowa 4-H, 2017).
As a result of this study, 4-H educators and leadership will have a clearer picture of what technologies are currently being used to educate Iowa youth members in STEM and agriculture programs and activities. Results from the questionnaire helped identify areas where youth educators may need additional training to more effectively use technology in the learning process. This study will benefit all youth programs by encouraging 4-H administrators to examine existing STEM and agriculture curriculum and determine where learning can be further enhanced through the use of educational technologies. From all the data collection, an effective adult education model and training plan will be developed to meet the technology training needs of 4-H educators.

Definition of Terms

The following terms and acronyms were used in this study:

**Technology**: “Methods, systems, and devices which are the result of scientific knowledge being used for practical purposes” (Collins New English Dictionary, 2018).

**Adult Education**: “A course of study for adults: continuing education” (Merriam Webster Dictionary, 2018).

**Training Model**: A simplified visual depiction of the process of knowledge transfer for a particular task.

**STEM**: An acronym frequently used in education to represent the four disciplines of science, technology, engineering and math (English, 2016).

**Constructivism theory**: A learning theory that primarily explains how a person learns or makes sense of an experience (Loyens & Gijbels, 2008).
Chapter 2: Literature Review

Introduction

This review of the literature begins with constructivism theory, followed by experiential learning which is the guiding framework for 4-H activities and programs (Iowa 4-H, 2017). After a review of learning theory, the remaining topics will cover volunteer training, and how technology is being used around the nation to communicate with program participants and deliver 4-H STEM and agriculture activities and programs.

Constructivism Theory

Constructivism theory is a learning theory that describes how a person learns or makes sense of an experience (Loyens & Gijbels, 2008). One of the early contributors to constructivism theory was Lev Vygotsky. A well-known psychologist from Russia, Vygotsky subscribed to the idea that knowledge was formed from building on previous experiences and within historical contexts, cultural influences, and social interactions (Kolb, 2015). Vygotsky is well-known for his concept of “zone of proximal development”, which means that a learner can progress to higher levels of learning, growth, and development through the guidance and mentorship of an educator or qualified individual, rather than through their own independent learning (Vygotsky, 1978, p.87).

Another early contributor to constructivism theory was Jean Piaget. Piaget described learning in the context of being a social experience, with learners sharing a learning experience and building on each other’s knowledge and personal experiences. Initial learning can occur through manipulating an object and eventually progresses to higher levels of learning and knowledge through reflection and abstract thought (Piaget, 1995).
Constructivism is a theory that is compatible with the needs of educational programs today. Constructivism is based on the concept that learners construct their knowledge from experience (Doolittle & Camp, 1999). As outlined by Doolittle and Camp (1999), there are four fundamentals of constructivism:

1) “Knowledge is not passively accumulated, but rather, is the result of active cognizing by the individual;
2) Cognition is an adaptive process that functions to make an individual’s behavior more viable given a particular environment,
3) Cognition organizes and makes sense of one’s experience, and is not a process to render an accurate representation of reality; and
4) Knowing has its roots in biological/neurological construction, and in social, cultural, and language-based interactions” (para.15).

Constructivism is often described as a continuum, and it is divided into the three categories of Cognitive, Radical and Social Constructivism. Each category covers one or more of the above fundamental components of constructivism (Doolittle & Camp, 1999).

Cognitive constructivism is on one end of the continuum and focuses on the first two fundamentals of constructivism. The learner plays an active role in their process of learning and application of that learning, based on the expected response or answer as directed by the teacher or textbook content (Doolittle & Camp, 1999).

Radical constructivism is on the opposite end of the continuum and focuses on the first three fundamentals of constructivism, while sometimes acknowledging the fourth. It addresses the learning and making meaning of knowledge and seeking an answer to a problem, but not
necessarily an answer suggested or driven by the direction of a teacher or textbook answers. The learner develops a solution based on their understanding of what they have learned (Doolittle & Camp, 1999).

Social constructivism falls between the other two categories of constructivism on the continuum. It addresses all four of the fundamentals of constructivism. Learning takes place through a shared experience and social interaction with others. Knowledge and meaning are constructed through interactions between learners. In a social constructivist learning environment, learners might be involved in group work, with the teacher guiding them and helping in the application process to develop a workable solution for a problem (Doolittle & Camp, 1999).

The essential hallmarks of constructivist pedagogy produce students capable of meeting the needs of employers now and in the future. Constructivism provides for learning in real-life environments, learning through social interaction, provides content and skills that are relevant to the learner, builds upon a learner’s prior knowledge and experiences, and formative assessment is used to more accurately measure a student’s learning. Learners are encouraged to become more active in the learning process. The teacher’s role is essentially to be a guide and facilitator versus being an instructor. As a facilitator, the educator provides responsible guidance in helping learners look at content and real-life situations from multiple perspectives (Doolittle & Camp, 1999). The needs of industry have changed over the last decade due to rapidly changing technology. Employers are now seeking employees that can work using higher order thinking, can efficiently solve problems, and can work in a collaborative work environment (Castronova, 2002). These are all skills that can be developed through a constructivist approach to learning (Doolittle & Camp, 1999).
Experiential Learning

Experiential learning is aligned with constructivist learning theory (Splan, Shea Porr, & Broyles, 2011). Kolb (2015) states that Experiential Learning (EL) is based on the research and understanding that people learn best through experience. Keeton and Tate (1978) define EL as:

Learning in which the learner is directly in touch with the realities being studied. It is contrasted with the learner who only reads about, hears about, talks about, or writes about these realities but never comes into contact with them as part of the learning process. (p. xviii)

The 4-H organization has adopted the EL approach to teaching and learning as evidenced in their Experiential Learning Model (Iowa 4-H, 2017). The EL models reflect an emphasis on the learning process rather than on specific outcomes (Kolb, 2015).

Experiential Learning Theory

Kolb notes that Experiential Learning Theory (ELT) is widely applied and accepted for learner-centered teaching and consequently plays a role in shaping lesson plans, educational design, and educational curriculum. This learning perspective considers a learner’s experiences, perceptions, cognition and behavior (Kolb, 2015).

According to Kolb (2015), learning is cyclical and spiraling in nature, not just a continuous circle. The learning process consists of grasping experiences which begins with and includes “Concrete Experience (CE) or Abstract Conceptualization (AC),” followed by a transformation of the experience through “Reflective Observation (RO) or Active Experimentation (AE)” (Kolb, 2015, p. 42). According to Kolb, “New knowledge, skills, or attitudes are achieved through confrontation among four modes of experiential learning” (Kolb,
Learners themselves choose which abilities they bring to any given learning experience, and therefore to an extent determine the level of their learning. In the cycle of learning, students play active roles as they move in varying degrees among the four modes (Kolb, 2015). Dewey is noted for his thought that reflection is key to making meaning of experiences (Dewey, 1938). Kolb and Dewey had similar desires to create a learning model that would explain how individuals learn, and that would empower learners to use their experience to develop mastery over their learning as they become independent, lifelong learners (Kolb, 2015).

The Iowa and National 4-H models of EL reflect similar concepts to those of Kolb’s.
Figure 1 – 4-H Experiential Learning Model

(Iowa State University Extension and Outreach and Iowa Extension Council Association, 2017)

Experiential Learning Cycle

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Figure 2 – Kolb’s Experiential Learning Model

(Used with written permission from Experience Based Learning Systems, Inc., 2018)

Training and Professional Development of Volunteers

As any employee would in a new position within an organization, 4-H volunteers are provided with initial orientation and training so that they can be prepared for their new roles. For
continued success, the volunteers need to have access to on-going professional development and skills training. Training opportunities are valued in that they increase a volunteer’s ability to successfully do their job and could potentially increase their level of commitment to a program (Fox, Hebert, Martin, & Bairnsfather, 2009).

Training is crucial to creating a qualified volunteer pool in addition to retaining volunteers. Volunteers need to be taught about learning theories in addition to being trained on specialized skills specific to their programs and activities. Volunteers bring a variety of skills and competencies to the learning environment, and County Youth Coordinators attempt to recruit volunteers that are best qualified for each program (Fox et al., 2009). Volunteers have played an invaluable part in the delivery of 4-H programs since its formation (Wessel & Wessel, 1982). Training needs to be an on-going activity to keep volunteers up-to-date and enhance their knowledge, abilities, and personal skill set (Kerka, 2003). Training can be motivational and needs to be focused on what the volunteers feel they need to learn, and then be delivered in a variety of methods based on their preferences (Fox et al., 2009). Interestingly, in the study of volunteers done by Fox et al. in 2009, 12.8% of the study participants felt the need for additional technology training. This study ranked technology training as 17 out of 25 on the level of importance (Fox et al., 2009). According to Schmitt-McQuitty, Carlos, and Smith (2014), “4-H academic and program staff require the knowledge and skills to teach science content, pedagogy, educational standards, positive youth development, and science process skills, fundamental components of 4-H Science Readiness” (para. 6).

Although the focus of this research study was not about professional development in EL, a California based study did reveal the potential need for it. EL is a key component of preparing learners to be science ready, and a survey revealed that there were Youth Development Advisors
and Program Representatives that were clearly unable to identify EL as a component of effective teaching. In interviews, there were only a few that demonstrated an understanding of EL. Most interviewees could not share evidence of or describe what EL looked like in practice. Interviews and survey results demonstrated a need for additional professional development to help program administrators to be more effective (Schmitt-McQuitty et al., 2014).

**Technology in Programs**

Minnesota 4-H designed an Aquatics Robotics program to engage and educate youth, benefit local government agencies, and provide rigorous learning opportunities in STEM. This youth program gave learners experience in using technology to create a Seaperch underwater Remotely Operated Vehicle (ROV) with a team. The program provided learners the opportunity to learn and use new technology, but it also taught them about their local environment, working within a team setting, and how to become more involved within their communities. Newer technologies are used to develop viable solutions to real life problems. Although social media was not a primary focus of this program, it was used later in the program for youth participants to share ideas and best practices, in addition to reaching out to the community. There were many key elements to the success of this program, but one key component was recruitment of specialized volunteers (McNeill, Jirik, & Rugg, 2014).

According to Wallace and Freitas (2016), underwater robotics projects promote critical thinking, problem-solving and team building skills as they explore engineering concepts. Less specialized volunteers can learn alongside their youth participants on entry-level projects. Advanced projects would require working with specialized volunteers in the areas of engineering and science. Underwater robotics is a program that meets the National 4-H STEM goals (Wallace & Freitas, 2016).
In Nebraska, 4-H used robotics to assist in teaching STEM concepts. Programs are being designed to help reverse a downward trend in STEM. It is hoped that these programs will keep students engaged with technology, help promote learning through experimentation, develop problem solving skills, and encourage cooperative learning. 4-H programs are open to all youth, and leaders are trying to draw more women, at-risk youth, and under-served populations such as minority groups. Legos have been a popular toy, so the Nebraska 4-H specifically chose a robotics kit call LEGO Mindstorm for Schools. Students were given the opportunity to learn to program the robots using ROBOLAB. After completion of the lab, students showcased what they learned at the state fair. A website was created to post ideas, images and video clips. Nebraska’s 4-H will be piloting new robotics curriculum because of their successful efforts. Robotics has proven to be a successful resource for integrating science and technology into 4-H educational programs (Barker & Ansorge, 2006).

By joining in on “The Maker Movement”, 4-H is hoping to more quickly achieve their STEM goals and initiatives (Hill, Francis, & Peterson, 2015, para. 4). This movement promotes using new and innovative applications of technologies to create new or repurposed end products. This movement is important because many of these projects include STEM concepts. Some of the projects incorporate electronics, 3-D printing, development of technical skills, in addition to social development using internet technology to share what they have made and gain new ideas or improvements from other projects (Hill et al., 2015). According to Hill, Francis, and Peterson, “Makers are leading the way in the development of industrial robots, 3-D printers, and smart devices that combine hardware, software, and sensors, with the Internet” (Hill et al., 2015, para. 6). 4-H youth are already learning how to make things, so there are just some slight changes needed to make the adjustment. It was suggested that learners use social media
platforms to not only share their completed projects, but to share the whole process and story behind the project. Maker projects may require extra funding, which is a great opportunity to apply for grants and make additional efforts to develop community partnerships. County fairs and competitions are also an excellent place for participants to showcase their projects (Hill et al., 2015).

In the Southwest, video technology was incorporated into a program about capturing rain water to help gardens grow. The program, sponsored by National 4-H Council and Coca-Cola, taught youth technology skills as they created detailed videos of the process of implementing garden infrastructure. Students used cameras to create extensive video to be used in the creation of tutorial videos so that the projects could be duplicated potentially even on a global level. In addition to using cameras and video technology, the learners story-boarded, used the internet for research, and created podcasts. As the learners explored agriculture technologies, they were also able to incorporate other forms of technology to document their work (Tessman & Gressley, 2011).

Social media technology has not necessarily played a prominent role in delivering STEM and agriculture content, but it has proven to be a valuable tool in disseminating information about programs and showcasing what participants have learned from programs. Millennials are active in their use of technology to create extensive social networks. Extension and 4-H programs have more opportunities than ever to reach their youth audience, but there are also concerns about privacy and being represented properly on-line. It was recommended that sites are monitored, and youth informed and provided guidelines on social media use. In a study, it was found that most social media networking sites were used for posting pictures and sharing information about clubs and 4-H projects. For communication purposes, youth are reportedly
using blogging, wall features, and discussion boards. Most of the social media postings had links to 4-H clubs, Extension sites, and other agricultural clubs or organizations (Rhodes, Thomas, & Davis, 2009).

In Minnesota, the 4-H uses Twitter as a means of communication during livestock shows. This social media technology allows livestock show participants to keep updated on operations, including staging and judging as they happen. Tweets also help confirm and supplement other published information without the use of loudspeaker announcements. To help prepare 4-H staff, Twitter was introduced during an annual conference. Participants were asked to follow the program on Twitter, so they could receive announcements. Care was taken in minimizing the number of Tweets to not annoy recipients. The Twitter accounts and other forms of social media were managed by student workers under the supervision of staff. It was determined that the use of Twitter helped the shows to run more smoothly, and favorable survey responses indicated that users were open to using the service again (Nordby, 2014).

Volunteers use technology to help communicate and manage activity and program information. Google Apps is a free, user-friendly tool that helps volunteers. To help them be successful, volunteers may need to be introduced to and trained on how to use the Apps. Volunteers that are successful are essential to building a solid foundation for 4-H youth programs (Terry, Harder, & Zyburt, 2014).

Another technology that has been incorporated into 4-H programs is commonly known among learners as “clickers”. This technology application is commonly used for assessing and communicating program effectiveness. In the state of Nevada, clickers were used in evaluating a brand-new program to make sure desired goals and outcomes were achieved. The study involved 600 youth participants, and program results were generated using the InterWrite
Personal Response System (PRS) and Excel. Youth were engaged, it was easy to use, and interactive learning took place. Active participation and immediate feedback were two benefits for evaluators. For this study in Nevada, the PRS system was used to collect pre- and post-test information. PowerPoint questions were displayed in combination with the student-use of a clicker to record answers. The participants in the study were excited about using the clickers and wanted to see if they could be used in their classrooms at school. For program evaluators, the system provided accurate feedback to make accurate analysis of program effectiveness. As with any new technology, volunteers and program administrators would need to be trained on how to use the system (Barker & Killian, 2011).

Summary

This chapter discussed literature on the topics of constructivism, experiential learning and experiential learning theory, 4-H volunteer training, and how 4-H youth groups around the country have incorporated educational technology to deliver STEM and agriculture content in their activities and programs. The following chapter will be outline and define the methods and procedures for the study.
Chapter 3: Methods and Procedures

Introduction

This chapter outlines the methods and procedures used in completing this study. It covers validity and reliability in addition to identifying the population of the study and details of the researcher-developed questionnaire. Also addressed are the tools used to analyze data and make calculations.

Methods

The purpose of this descriptive study was to identify technologies used in Iowa 4-H programs and activities to deliver STEM and agriculture content. A researcher-developed questionnaire was distributed to the population of the study, Iowa 4-H Extension, youth-serving staff and volunteers, to understand what technologies are being utilized and to identify areas where they may need additional technology training. A census study was conducted due to the relatively small population.

To add credibility and contribute to internal validity of this research study, the Iowa 4-H Director and other youth-serving staff reviewed and provided feedback on the questionnaire. Additionally, a panel of experts reviewed the questionnaire instrument to ensure that it supported and yielded information relevant to the purpose and objectives of the study. The panel of experts included the Iowa 4-H Director, Iowa 4-H program specialists, and faculty from Iowa State University that have expertise in Extension, program evaluation, and educational technology. Weaknesses of this study could include the limited ability to contact non-responders, which may have affected the overall response rate. A strength of this study was the ability to do a census study with an accurate, updated contact list through Iowa 4-H. Any issues with internal validity
could lead to issues with external validity (Ary, Jacobs, & Sorenson, 2010). However, results from this study should yield information that can be utilized in other settings within U.S. 4-H programs.

Data Source or Subjects

The intended target population of this study was all 4-H youth-serving staff and volunteers that are currently teaching or have taught STEM and agriculture content in the last three years. The frame or list of contact information for the targeted population was to be supplied through the support of Iowa 4-H. Due to privacy issues, the Iowa 4-H gatekeeper would not allow the researcher to have direct access to the contacts. Iowa 4-H maintains a frequently updated list of 4-H staff and volunteers. Because it is difficult to distinguish between staff and volunteers that do not teach STEM and agriculture content, the questionnaire ended for those who self-reported that they were not involved with STEM and agriculture programs and activities.

Instrumentation

A questionnaire was researcher-developed because the researcher could not find another questionnaire suitable for the study. A draft of the questionnaire was distributed to the 4-H Director and a youth specialist, in addition to Iowa State University faculty with expertise in the areas of Extension, program evaluation, and educational technologies to improve the quality of the questions. Feedback was implemented to help ensure that the questionnaire clearly and concisely supported the stated objectives. Before distribution to the population of the study, a 4-H youth-serving employee was selected to field test the questionnaire and identify any potential issues. This instrument ultimately yielded the desired outcomes and helped provide information
that can then be compared to other literature about the use of technology in 4-H STEM and agriculture programs and activities. Questionnaires are an appropriate method for discovering and identifying descriptive information about individuals’ needs and experiences (Caffarella & Daffron, 2013).

Variables were measured based on a Likert-type scale. Technologies were categorized by purpose and measured based on usage in 4-H STEM and agriculture programs and activities. Participants rated technology usage as never use, rarely use, occasionally use, frequently use, and consistently use. A 4-point scale was used because it adequately reflected the levels of use of technology without making the questions too confusing or complicated. Additionally, respondents rated their competence in using specified categories of technologies based on a positive statement of competence. For example, the statement might read “I feel competent in teaching 4-H STEM and agriculture content using collaborative technologies.” Likert-type responses were recorded as strongly disagree, disagree, neither agree or disagree, agree, and strongly agree. A 4-point scale was used because it adequately covered the levels of agreement needed for the Likert-type questions. The selected scale is commonly used to report levels of agreement to statements (Ary et al., 2010). “Strongly agree” indicated the highest level of competence. “Strongly disagree” indicated a rating of low competence. The Likert-type questions are ordinal variables which made it appropriate to report frequencies and percentages. Open text response boxes were provided for questions that asked respondents to identify what specific technologies are being used, how they are being used, new technologies that staff would be interested in adding to their programs, and which technologies they would like more training in.
Data Collection

Prior to data collection, the researcher completed Human Subjects Training and submitted an exempt Institutional Review Board (IRB) application for review by the Office of Responsible Research at Iowa State University (ISU). IRB Approval was granted on February 9, 2018. The IRB identification number is 18-048. The researcher received the IRB approval letter via an e-mailed letter.

With support from the Iowa 4-H Director, study participants first received a letter of introduction from the researcher through a link in the 4-H Focus weekly electronic newsletter. This letter of introduction stated the purpose and objectives of the study, requested their participation, and informed them that participation in questionnaire was completely voluntary and all responses would be kept confidential. Additionally, no personal identifiable information would be associated with their responses in any research reports of the study.

Participants were asked to acknowledge their informed consent in the first question of the questionnaire. A link to the questionnaire was provided in the letter of introduction. The first question of the questionnaire asked the participant to check the box indicating that they had been informed of the purpose of the study, that they had a right to opt out of the research study at any time without consequences, and to check the box provided to acknowledge their informed consent. Potential benefits, such as increased technology training, could motivate participants to complete the questionnaire (Dillman, Smyth, & Christian, 2014). The support from the Iowa 4-H gatekeeper was anticipated to add credibility to the research project in addition to potentially increasing response rates.
The letter of introduction and questionnaire link were sent out with Iowa 4-H’s weekly communication to all Iowa 4-H Extension staff and club leaders and volunteers through their List Serve. By sending the letter and questionnaire to all, it provided the opportunity to reach both those that have recently taught STEM and agriculture along with those that are currently involved. Staff participants received weekly reminders with a resend of the survey or link for two weeks through the weekly Iowa 4-H communication. Permission was granted by the Iowa 4-H gatekeeper to contact only county representatives to have them encourage non-responders to participate. The researcher was not granted permission to contact club leaders or volunteers.

After three weeks of the link appearing in the weekly electronic newsletter, there were only ten responses, which yielded an extremely low response rate. Due to the low response to the link in the 4-H Focus newsletter, the researcher individually e-mailed 187 Iowa county staff members requesting them to respond to the questionnaire. The recipients were selected from each County Extension website based on their job title or job description that was associated with 4-H. The response rate was determined by first subtracting out from the total contacts all those who had no recent or current involvement with delivering STEM and agriculture content. The remaining responses were then divided by the total adjusted contacts to give a percentage of response from the target population.

**Treatment**

Variables in this study included categories of technologies used in delivering STEM and agriculture content. Respondent attributes in this study included years of experience in teaching 4-H STEM and agriculture content, age of the educators, the grade levels of the youth that they typically taught, and their current position with 4-H. Because this was not an experimental study, variables were not classified as dependent or independent (Ary et al., 2010).
Data Analysis

Reports were generated by Qualtrics and used to organize and analyze the respondents’ self-reporting of competence in teaching STEM and agriculture content using described technologies, and the extent to which they used technologies in their programs. Descriptive statistics used were frequencies (percentages), and measures of central tendency such as mean, median, and mode (Ary et al., 2010). IBM SPSS 23 was used to calculate descriptive statistics.
Chapter 4: Findings

Introduction

In chapter 4, the researcher will present the results of the study and will display numerical data in tables for ease of analysis. Data from the Likert-type questions will be displayed in tables, while the open text responses will be displayed as written by the respondents.

Response Rate

For the original distribution method of the questionnaire through the 4-H Focus newsletter, the estimated number of 4-H staff to receive the newsletter was 380+ people. It was reported to the researcher in an e-mail that the electronic newsletter was “emailed to over 380 4-H affiliated Extension Staff in Iowa”. The researcher was never provided an exact number of recipients. Due to a breakdown in communication with the Iowa 4-H gatekeeper, no confirmation was received by the researcher on whether or not club leaders and volunteers received the introductory letter and questionnaire link in their weekly electronic communications. Consequently, there was no information provided on how many potential club leaders and volunteers would have received the electronic newsletter containing the introductory letter and questionnaire link. After an initial distribution and potentially two reminders, the researcher only received 10 responses. None of the initial respondents identified as being volunteers.

Due to the ineffectiveness of the original distribution method, the response rate was calculated based on response to an e-mail directly sent to 187 Iowa 4-H Extension and staff members. The total number of respondents was 92. This led to a total response rate of 49.2%. Of the 92 respondents, 9 (9.78%) indicated that they have not been involved with 4-H STEM or
agriculture programs in the last 3 years. This resulted in 83 usable responses with an adjusted response rate of 46.63%. Although the researcher would have preferred a higher response rate, the level of response was acceptable, and the respondents provided some valuable information (Ary et al., 2010).

**Demographics of the Respondents**

Of the 83 responses, there were 48 people who reported being between the ages of 20 and 39, and 33 that reported being age 40 and above. Two respondents did not write in their age.

Out of the 83 responses, most of the respondents (52.44%) reported teaching grade level K-3, and 43.9% of the participants reported teaching grade levels 4-8. Only 3.66% of the study participants typically teach 9-12 grade level students. Out of 83 responses, 50 people or 60.24% have been teaching 4-H STEM or agriculture programs for 0-5 years. Thirty-three respondents or 39.76% have been teaching 4-H STEM or agriculture content for 6 or more years. One respondent did not record which grade level they typically teach.

Respondents to this study hold a variety of job titles, but the most common of the 92 responses was County Youth Coordinator (56.52%). The many different job positions recorded indicate that many different people play important roles in developing and delivering meaningful educational experiences for Iowa 4-H programs and activities.

The following information represents the current title or position that respondents most closely associated with their work.
Table 1

*Current Title or Position with 4-H*

<table>
<thead>
<tr>
<th>Current Title or Position with 4-H</th>
<th>Responses (n = 92)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4-H Volunteer</td>
<td>1</td>
</tr>
<tr>
<td>County Youth Coordinator (CYC)</td>
<td>52</td>
</tr>
<tr>
<td>4-H Extension Agent</td>
<td>11</td>
</tr>
<tr>
<td>Other</td>
<td>17</td>
</tr>
<tr>
<td>Youth-serving Staff</td>
<td>11</td>
</tr>
</tbody>
</table>

Those that selected “other” wrote in their position as County Program Coordinator, Program Assistant Part-time, 4-H Youth Program Specialist, County Director, Administrative Assistant, Clover Kids Educator, 4-H Support, County Program/Youth Coordinator, Program Coordinator, County Program Assistant, Regional Youth Programming, Youth Program Assistant, Livestock Coordinator, Afterschool Program Coordinator, Youth Program Specialist, and K-12 Outreach Program Coordinator.

The following table shows the number of years that respondents self-reported that they have taught 4-H programs related to STEM or agriculture.
Table 2

*Number of Years Teaching Iowa 4-H STEM or Agriculture Programs*

<table>
<thead>
<tr>
<th>Number of Years Teaching STEM or Agriculture</th>
<th>Responses (n=83)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>f</td>
</tr>
<tr>
<td>0-2</td>
<td>23</td>
</tr>
<tr>
<td>3-5</td>
<td>27</td>
</tr>
<tr>
<td>6-8</td>
<td>10</td>
</tr>
<tr>
<td>9-10</td>
<td>6</td>
</tr>
<tr>
<td>11 or more</td>
<td>17</td>
</tr>
</tbody>
</table>

The following table depicts the grade level range of the students that the 4-H educators teach.

Table 3

*Grade Level of Students Taught*

<table>
<thead>
<tr>
<th>Grade Level of Students</th>
<th>Responses (n=82)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>f</td>
</tr>
<tr>
<td>K-3</td>
<td>43</td>
</tr>
<tr>
<td>4-8</td>
<td>36</td>
</tr>
<tr>
<td>9-12</td>
<td>3</td>
</tr>
</tbody>
</table>

The following table presents data on the age ranges of the study respondents.
Table 4

*Current Age of 4-H Extension, Staff and Volunteers*

<table>
<thead>
<tr>
<th>Age Range of Respondent</th>
<th>Responses (n=81)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>f</td>
</tr>
<tr>
<td>20-29</td>
<td>24</td>
</tr>
<tr>
<td>30-39</td>
<td>24</td>
</tr>
<tr>
<td>40-49</td>
<td>16</td>
</tr>
<tr>
<td>50-59</td>
<td>14</td>
</tr>
<tr>
<td>60-69</td>
<td>3</td>
</tr>
</tbody>
</table>
**Extent of Use of Technology**

The following table summarizes data related to respondents’ use of specified categories of technology. Participants responded to researcher-developed questions that asked them to rate their level of use of specified technology categories to deliver 4-H STEM and agriculture content. Respondents used a 4-point Likert-type scale to record their level of use from never use (0) to always use (4).

Table 5

*Extent to which specified categories of technologies are used*

<table>
<thead>
<tr>
<th>Category of Technology</th>
<th>Never Use</th>
<th>Rarely Use</th>
<th>Occasionally Use</th>
<th>Frequently Use</th>
<th>Always Use</th>
<th>Mdn</th>
<th>Mode</th>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collaborative</td>
<td>83</td>
<td>16</td>
<td>19.28</td>
<td>29</td>
<td>34.94</td>
<td>7</td>
<td>8.43</td>
<td>2</td>
<td>2.41</td>
</tr>
<tr>
<td>Networking</td>
<td>83</td>
<td>7</td>
<td>8.43</td>
<td>17</td>
<td>20.48</td>
<td>19</td>
<td>22.89</td>
<td>29</td>
<td>13.25</td>
</tr>
<tr>
<td>Video-</td>
<td>83</td>
<td>16</td>
<td>19.28</td>
<td>24</td>
<td>28.92</td>
<td>31</td>
<td>37.35</td>
<td>11</td>
<td>13.25</td>
</tr>
<tr>
<td>Sharing &amp;</td>
<td>83</td>
<td>41</td>
<td>49.40</td>
<td>29</td>
<td>34.94</td>
<td>11</td>
<td>13.25</td>
<td>1</td>
<td>1.25</td>
</tr>
<tr>
<td>Blogging &amp;</td>
<td>83</td>
<td>56</td>
<td>67.47</td>
<td>16</td>
<td>19.28</td>
<td>10</td>
<td>12.05</td>
<td>1</td>
<td>0.00</td>
</tr>
<tr>
<td>Micro-</td>
<td>83</td>
<td>17</td>
<td>20.48</td>
<td>14</td>
<td>16.87</td>
<td>38</td>
<td>45.78</td>
<td>10</td>
<td>4.82</td>
</tr>
<tr>
<td>Blogging</td>
<td>83</td>
<td>24</td>
<td>28.92</td>
<td>13</td>
<td>15.66</td>
<td>20</td>
<td>24.10</td>
<td>24</td>
<td>2.41</td>
</tr>
<tr>
<td>Programming</td>
<td>83</td>
<td>28.92</td>
<td>13</td>
<td>15.66</td>
<td>20</td>
<td>24</td>
<td>24.10</td>
<td>24</td>
<td>2.41</td>
</tr>
<tr>
<td>Robotics,</td>
<td>83</td>
<td>24</td>
<td>28.92</td>
<td>13</td>
<td>15.66</td>
<td>20</td>
<td>24.10</td>
<td>24</td>
<td>2.41</td>
</tr>
<tr>
<td>Electronics,</td>
<td>83</td>
<td>24</td>
<td>28.92</td>
<td>13</td>
<td>15.66</td>
<td>20</td>
<td>24.10</td>
<td>24</td>
<td>2.41</td>
</tr>
<tr>
<td>Programming</td>
<td>83</td>
<td>17</td>
<td>20.48</td>
<td>14</td>
<td>16.87</td>
<td>38</td>
<td>45.78</td>
<td>10</td>
<td>4.82</td>
</tr>
</tbody>
</table>

*Note: n, f, %, and Mdn, Mode, M, SD represent the number of participants, frequency, percentage, median, mode, mean, and standard deviation respectively.*
<table>
<thead>
<tr>
<th>Category of Technology</th>
<th>n</th>
<th>f</th>
<th>%</th>
<th>f</th>
<th>%</th>
<th>f</th>
<th>%</th>
<th>f</th>
<th>%</th>
<th>Mdn</th>
<th>Mode</th>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>VR &amp; AR</td>
<td>82</td>
<td>37</td>
<td>45.12</td>
<td>26</td>
<td>31.71</td>
<td>14</td>
<td>17.07</td>
<td>5</td>
<td>6.10</td>
<td>0</td>
<td>0</td>
<td>1.0</td>
<td>0</td>
</tr>
<tr>
<td>Mapping &amp; Positioning</td>
<td>83</td>
<td>21</td>
<td>25.30</td>
<td>35</td>
<td>42.17</td>
<td>22</td>
<td>26.51</td>
<td>5</td>
<td>6.02</td>
<td>0</td>
<td>0</td>
<td>1.0</td>
<td>1</td>
</tr>
<tr>
<td>Assessment</td>
<td>82</td>
<td>32</td>
<td>39.02</td>
<td>24</td>
<td>29.27</td>
<td>21</td>
<td>25.61</td>
<td>4</td>
<td>4.88</td>
<td>1</td>
<td>1.22</td>
<td>1.0</td>
<td>0</td>
</tr>
<tr>
<td>Record-keeping</td>
<td>82</td>
<td>26</td>
<td>31.71</td>
<td>23</td>
<td>28.05</td>
<td>16</td>
<td>19.51</td>
<td>16</td>
<td>19.51</td>
<td>1</td>
<td>1.22</td>
<td>1.0</td>
<td>0</td>
</tr>
<tr>
<td>Web-based games &amp; simulations</td>
<td>81</td>
<td>23</td>
<td>28.40</td>
<td>19</td>
<td>23.46</td>
<td>30</td>
<td>37.04</td>
<td>9</td>
<td>11.11</td>
<td>0</td>
<td>0</td>
<td>1.0</td>
<td>2</td>
</tr>
</tbody>
</table>

*Note.* 0=Never Use, 1=Rarely Use, 2= Occasionally Use, 3=Frequently Use, 4=Always Use
**Competence in Using Technology**

The following table summarizes respondents’ self-rating of competence in response to positive statements about their ability to use specified categories of technology to deliver 4-H STEM and agriculture program content. An example statement from the researcher-developed questionnaire was, “I feel competent using collaborative technologies to deliver 4-H STEM and agriculture program content.” Respondents’ rated their level of competence with using collaborative technologies utilizing a 4-point Likert-type scale with responses ranging from strongly disagree (0) to strongly agree (4).

### Table 6

*Self-Rating of Competence using Likert-type Scale*

<table>
<thead>
<tr>
<th>Category of Technology</th>
<th>n</th>
<th>f</th>
<th>%</th>
<th>f</th>
<th>%</th>
<th>f</th>
<th>%</th>
<th>f</th>
<th>%</th>
<th>Mdn</th>
<th>Mode</th>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collaborative</td>
<td>83</td>
<td>3</td>
<td>3.61</td>
<td>13</td>
<td>15.66</td>
<td>23</td>
<td>27.71</td>
<td>37</td>
<td>44.58</td>
<td>7</td>
<td>8.43</td>
<td>3.0</td>
<td>3</td>
</tr>
<tr>
<td>Networking</td>
<td>83</td>
<td>3</td>
<td>3.61</td>
<td>7</td>
<td>8.43</td>
<td>13</td>
<td>15.66</td>
<td>33</td>
<td>39.76</td>
<td>27</td>
<td>32.53</td>
<td>3.0</td>
<td>3</td>
</tr>
<tr>
<td>Video-sharing</td>
<td>83</td>
<td>3</td>
<td>3.61</td>
<td>11</td>
<td>13.25</td>
<td>26</td>
<td>31.33</td>
<td>35</td>
<td>42.17</td>
<td>8</td>
<td>9.64</td>
<td>3.0</td>
<td>3</td>
</tr>
<tr>
<td>Blogging &amp; Microblogging</td>
<td>83</td>
<td>14</td>
<td>16.87</td>
<td>23</td>
<td>27.71</td>
<td>23</td>
<td>27.71</td>
<td>20</td>
<td>24.10</td>
<td>3</td>
<td>3.61</td>
<td>2.0</td>
<td>1</td>
</tr>
</tbody>
</table>

[3.0, 1.07081, 1.96318, 1.12331]
| Category of Technology                  | n  | f   | %  | f   | %  | f   | %  | f   | %  | f   | %  | f   | %  | Mdn | Mode | M   | SD  |
|----------------------------------------|----|-----|----|-----|----|-----|----|-----|----|-----|----|-----|----|-----|------|------|------|------|
| Website Creation                       | 83 | 22  | 26.51 | 22 | 26.51 | 27 | 32.53 | 11 | 13.25 | 1 | 1.2 | 1.0 | 2 | 1.3614 | 1.05436 |
| Image-sharing & Movie-making           | 83 | 6   | 7.23 | 12 | 14.46 | 30 | 36.14 | 30 | 36.14 | 5 | 6.02 | 2.0 | 2 | 2.1928 | 1.00557 |
| Robotics, Electronics, Programming     | 83 | 10  | 12.05 | 20 | 24.10 | 19 | 22.89 | 29 | 34.94 | 5 | 6.02 | 2.0 | 2 | 1.9880 | 1.15288 |
| VR and AR                              | 82 | 20  | 24.39 | 20 | 24.39 | 29 | 35.37 | 12 | 14.63 | 1 | 1.22 | 2.0 | 2 | 1.4390 | 1.05523 |
| Mapping & Positioning                  | 83 | 12  | 14.46 | 16 | 19.28 | 31 | 37.35 | 23 | 27.71 | 1 | 1.20 | 2.0 | 2 | 1.8193 | 1.03764 |
| Assessment                             | 82 | 10  | 12.20 | 18 | 21.95 | 30 | 36.59 | 22 | 26.83 | 2 | 2.44 | 2.0 | 2 | 1.8537 | 1.03186 |
| Record-keeping                         | 82 | 10  | 12.20 | 14 | 17.07 | 27 | 32.93 | 27 | 32.93 | 4 | 4.88 | 2.0 | 2 | 2.0122 | 1.09425 |
| Web-based games & simulations          | 82 | 10  | 12.20 | 12 | 14.63 | 38 | 46.34 | 20 | 24.39 | 2 | 2.44 | 2.0 | 2 | 1.9024 | .98895 |

*Note.* 0= Strongly Disagree, 1=Disagree, 2= Neither Agree or Disagree, 3=Agree, 4=Strongly Agree
Specific Technologies Being Used

Specific technologies reported being utilized in K-3 grade levels were Bee Bots, FLL robots and technology, Cubelets, Science Kit, Lego NXT EV3, Dash Dot, wondercode.org, Hour of Code, and Bristle Bots. For grade levels 3-5, a respondent reported using the “maker movement” teaching method. The respondent described this method as “give a task, then step back and let them go and create”. The most detailed feedback was provided for grade levels 4-8. Listed technologies included FaceTime, Breakout EDU, C6, Bio Farm, a county app, iPad, laptops, tablets, Dash and Dot coding robots, and Bee Bots coding robots. Also listed were 4-H innovators curriculum (web-based with videos), Making Stem Connections kit, Cubelets, Makey Makey, First LEGO League, First LEGO League Jr., and Scratch Coding.

When asked to share about the specific technologies that they are using, other comments were as follows:

You are assuming in your questions that we have curriculum and requests for such tools. That is not the case most ask for “hands on learning” and want us to step away from technology at times so they do not use technology as a crutch. Also, not certain all the “social media” is appropriate for teaching since in fact the name implied social media. Computers, smart phones, and other technologies play an important part in teaching and educating youth but if they don’t know how to find something on line they need to realize there are other sources such as books, tools etc. This seemed rather bias in making assumptions that if you do not use all the media and technology you are failing youth – try to teach a youth about livestock just using a computer – it doesn’t work.

“Believe in doing hands-on activities; use the “maker movement” teaching method (give a task, then step back and let them go and create).”

“I help with regional STEM Programming in k-12 grade. We do have a county app for 4-H. As a member of the STEM Board we strongly include STEM in all of our programming. We are also open to new forms of technology that we can share.”
The following additional comments highlighted use of specific technology as well as emphasized a strong use of robotics, programming, coding and innovation technology within STEM experiential learning programs:

“iPads, laptops, other tablets Dash & Dot coding robots Bee Bots coding robots, Alabama 4-H Innovators curriculum (web-based with videos).”

“We received a Making STEM Connections kit from the Science Center of Iowa through the STEM Scale-Up program and have been utilizing Cubelets and Make Makey this year. We love this new technology and the students enjoy the activities we provide.”

“We have also utilized the Bee-Bots and Dash & Dot from Wonder Workshop that is provided by Iowa 4-H Clover Kids. We also offer FIRST LEGO League and FIRST LEGO League Jr. programming our county, with several groups and volunteers for each program.”

**Current Use of Technology**

The following comments are what respondents shared about their use of technology in delivering 4-H STEM and agriculture content:

“want to use it more.”

“I feel I don’t have enough knowledge in a lot of these areas. I could also expand to different age groups if I had more knowledge/training in these other technology areas.”

“minimal”

The following comments also identified barriers to increased use of technology:

“We would use more technology in programming if we could afford to purchase the tech needed and if the technology could be used anywhere regardless of internet access.

Some locations make it hard to have technology as they are not equipped to handle it. I work with groups that meet outside or non-power/internet areas. So, things are just easier to use that require no hook-ups.”

One respondent recognized the use of technology in staying connected to their students. The person stated, “I think we need to explore developing apps for free/inexpensive download.
Kids are on their devices all the time, and it would be great way to push education/information out to them where they are.”

Other respondents highlighted the importance of using technology to enhance the learning process as evidenced in the following statements:

“I would enjoy using more forms of technology, however I always consider if the technology is enhancing and deepening the learning, or if it is just a toy.”

“I like to keep in mind the SAMR (Substitution, Augmentation, Modification, Redefinition) model as I include technology. I really like to work in the Modification (significant task redesign) or Redefinition (new, previously inconceivable, tasks) portions of the SAMR Model when I incorporate technology.”

**Need for Technology Training**

Questionnaire participants expressed interest in receiving training in collaborative technologies, Virtual Reality (VR), video-sharing technologies, movie-making technologies, blogging, website creation, drones, Farm at Hand, robotics, GPS, online systems, and training on how to record, edit, caption and post videos.

Others expressed interest in training, but they were less specific about the types. Some examples of the individual responses included:

“Any training on things in technology would be helpful. I don’t depend on technology because sometimes I’m in places with limited access.”

“Anything new for teaching K-6.”

“Open to learning about anything.”

“Open to any and all trainings.”

“Any would be great.”

“Anything to help benefit the kids.”

One study participant stated that they would like to know more about technology and how to incorporate it into the curriculum. The recorded response was:
“I would like to know more about the types of technology that can be used to help with teaching STEM curriculum. A lot of the curriculum we use is not always bringing in technology. It is teaching the material by using different activities. Such as doing experiments on their own and seeing the results.”

**New Technology Interests**

When asked about which technologies they are not currently using but would view as valuable tools in delivering 4-H STEM and agriculture content, the respondents commented as follows:

“After doing this survey, it looks like I need lots of help with lots of technology! Please and thank you!”

“Video Sharing Virtual Reality Farm at hand Movie making 3D printing Drones”

“I would like to know more about most of the listed technologies in the previous questions.”

“All that were discussed in the questions. Drones. Showing how GPS works with tractors, the dairy industry milking technology. Soil sample technology.”

“I have a GoPro that I know nothing about. I’d like to do more with video recording and editing to use for educational and marketing purposes for our 4-H programs.”

“Depending on the age, technologies such as Edmodo, YouTube, and others that allow youth to learn on demand and remotely could be very helpful in educating and reaching more youth.”

**Discussion of Findings**

Using the initial method of distribution for the questionnaire did not yield an acceptable response rate. To obtain a higher response rate, proven research methods should be used. An initial introductory letter written by a gatekeeper within Iowa 4-H would have shown stronger support for the study. Follow-up measures with individually addressed e-mails reminding recipients to complete the questionnaire helped to promote a stronger response rate (Ary et al., 2010).
It was interesting to note that a little more than half of the respondents (60.24%) had 0-5 years of experience in teaching 4-H STEM and agriculture programs, and the other half had 6 or more years of experience. An analysis of the age of respondents revealed a strong majority (59.26%) are between the ages of 20-39. This represents a strong base of experienced educators with strong group of newer, possibly younger people, joining the Iowa 4-H team of educators. Although this study did not ask the respondent to identify their gender, a quick review of the Iowa County Extension websites revealed a strong percentage of female staff. A majority of the respondents identified their job titles as being CYCs.

The technologies most overall used by the respondents also appeared to be the technologies that they felt most competent in using to delivering 4-H STEM and agriculture program content. Although some of the more frequently used technologies such as Facebook may not be used to deliver program content, they are used to document learning and promote programs.

Technologies such as robotics, programming, and coding seemed to mirror the use of technology in other 4-H programs around the United States. This is not surprising due to the strong 4-H STEM initiative. However, these technologies are not the most frequently used because they aren’t necessarily a good fit or appropriate for all programs and activities.

Although respondents may feel somewhat competent in being able to use technologies, they may not be using them to deliver STEM and agriculture content in Iowa 4-H programs and activities. Reasons for not using available technology include:

- They may not know how to incorporate them into curriculum
- The technology may not be a good fit for the curriculum
- The technology may be too expensive
- Limited or no internet access
- Funding issues

The majority of respondents expressed a definite interest and need for additional technology training. Interestingly, some of the requested training is for the technologies least used by 4-H STEM and agriculture educators. Although most respondents had a positive
response toward the study in general and for additional technology training, there were some concerns raised. For instance, one respondent didn’t see the use for technology when working with cattle and felt like there are times when technology just isn’t appropriate. I would tend to agree, but there are still times when an experiential learning project can be enhanced with the use of technology. For example, when working with cattle, an app could be used to help record tag numbers, calf birth weights, and location of cattle on properties. Other issues were expressed in ensuring that technology is being used properly to enhance learning and not used just as a “crutch” or a “toy”.

One of the most interesting revelations to me from this study were the barriers to the use of technology, especially since that was not a focus of the study. Many of the barriers can be overcome, but it will take some creativity and greater thought to overcome the barrier of limited or no internet access.
Chapter 5: Conclusions and Recommendations

Introduction

In this chapter, the researcher analyzes and interprets the findings from Chapter 4. Data will be used to help respond to the research objectives. The researcher draws conclusions and formulate technology training recommendations for Iowa 4-H leadership. The data, conclusions, and recommendations can be used to formulate appropriate educational plans.

Analysis and Conclusions

The top four technology groupings currently being most used by respondents of this study were networking, collaborative, video-sharing, and image-sharing and movie-making. Networking technologies were rated as the most frequently used technology, as indicated by the lowest “Never Use” percentage and the highest $M$ on both extent of use and respondent’s competence in using the technology. For extent of use, Networking technologies also had a median score of 2 and the highest mode score of 3. The categories of collaborative, video-sharing, and image-sharing and movie-making also scored higher than other categories of technology on the self-rating of competence in using the technologies as evidenced by higher $M$, median and/or mode scores.

The four middle or moderately used technology categories were robotics, electronics and programming, mapping and positioning, record-keeping, and web-based games and simulations. This is not surprising from the standpoint that they are used typically in more specialized or technology specific programs. For the robotics, electronics and programming category, respondents had a mode score of 3, indicating that they agreed they were competent in using the technology. For mapping and positioning technology, and web-based games and simulations,
respondents were more likely to rate their competence level as “Neither Agree or Disagree”. Record-keeping competence scored as a $M$ of 2.0122, making it one of the higher mid-range scores.

The four least used technology categories according to respondents were blogging and micro-blogging, website creation, Virtual Reality (VR) and Augmented Reality (AR), and assessment. Interestingly, the least used technologies of blogging, website creation and VR/AR also appeared to have the highest responses for “Highly Disagree” and “Disagree” when respondents were asked to rate positive statements of competence in using the technologies to deliver 4-H STEM and agriculture content. These technologies were also among the list of technologies that respondents indicated they were interested in learning more about. Assessment technologies were also a top “Never Use” rated technology, but respondents seemed more confident in their ability to use them. These technologies may not be readily accessible based on availability of internet access, cost, or respondents may have not yet discovered low-cost options that could be easily incorporated.

Although respondents may feel somewhat competent in being able to use technologies, they may not necessarily be using them to deliver content in Iowa 4-H programs and activities. This may be a result of not knowing how to incorporate the technology into curriculum, the technology may not be a good fit for the curriculum, the technology may be too expensive, or the respondents may be in an area with limited or no internet access.

To help identify the extent of the need for additional technology training, respondents were asked to rate their level of competence in using different categories of technology to deliver STEM and agriculture content. Open response questions were also asked to get input on what specific technologies they wanted to learn more about, how they are using existing technology,
what new technologies they would like to incorporate and any other information about technology use that they wanted to share.

Findings of this study indicated a definite need and interest in technology training for staff and volunteers. Other than networking technologies, few of the respondents felt like they could “strongly agree” with their rating of competence in using the technologies to deliver STEM and agriculture content. Iowa 4-H Extension and staff expressed a need and willingness to incorporate more and newer technologies into programs and activities, but they also were cognizant of funding issues for technology in addition to limitations based on location and internet accessibility. Some respondents expressed a concern that technology needs to not be used as a “crutch” in learning, that the technology incorporated enhance learning rather than being a “toy”, and that technology may not be appropriate at all in some learning situations. For example, it might be difficult to see just how technology such as Facebook or Twitter or Instagram or blogging may be used to teach STEM or agriculture. If not used for teaching content, technology could play a role in showcasing the steps taken to complete a project for others to replicate and learn from, it may be used to keep the public informed of upcoming programs or events, or to share success with others. At minimum, the technologies can play a role in sharing what has been learned.

Technology plays a role in experiential learning whether it is part of the learning process or the documenting of learning as it transpires and sharing with others to replicate. Through the eyes of a social constructivist educator, technology helps aid in the learning process as well as brings learners together through social and cultural interactions. Networking and collaborative technologies can also help connect learners with 4-H participants outside of their local community.
Respondents identified barriers to increased use of technology as: funding, staff knowledge and comfort level with technology, and availability of internet access. Some of these barriers can be more easily overcome, while internet access may be more of a challenge.

Based on feedback from the open-response questions of the questionnaire, Iowa 4-H STEM and agriculture technology use appears to be strongly focused on robotics, programming, and the “Maker Movement”. This seems to be in keeping with much of what is being reported in previous research from programs around the country. A respondent mentioned that they would like more training in other technologies so that they could teach additional age groups.

Demographic related questions revealed that there are many different positions within the Iowa 4-H system that play a role in creating and delivering STEM and agriculture programs and activities. The majority of the respondents indicated that they were County Youth Coordinators. Respondents varied greatly in age and experience within the 4-H programs. More information could have been gathered, such as educational background and gender, to help form a more complete picture of 4-H educators. Interestingly, a quick review of County Extension websites revealed a significant number of these educators are women.

**Recommendations**

Based on the findings and conclusions of this study, it is recommended that Iowa 4-H create partnerships with local industry to help fund and implement new technology. This would aid in overcoming funding issues and help Iowa 4-H programs to grow and keep pace with changing technology. As cited in the literature review, some programs have used grants and sponsorships with companies such as Coca-Cola to help fund programs (Tessman & Gressley, 2011).
For emerging, and potentially more expensive technologies to purchase, a recommendation would be for Iowa 4-H to make a single or smaller purchase of the technology and have a travelling program around the state or regions, with a lead person heading the program who can train the trainers around the state on how to use and implement the technology into programs or activities. Virtual Reality (VR) and Augmented Reality (AR) appear to be the emerging technologies that will benefit 4-H learners. 4-H staff tasked with developing programs could work with industry partners to help develop relevant curriculum for these and other technologies to help prepare Iowa youth for future careers in STEM and agriculture.

I would recommend beginning by determining areas where new technologies can be integrated into current Iowa 4-H programs and activities. This process may be as simple as brainstorming with current staff, volunteers, and educational partners. Additionally, it would be helpful to analyze 4-H programs around the country to see how they have incorporated technology into their programs. This review could also provide insight into how to fund desired technologies and overcome issues with internet accessibility.

The following educational plan(s) are recommended:

1. Partner with Iowa State faculty and industry to help identify areas where technology could be incorporated into existing programs and brainstorm to develop new programs utilizing emerging technologies. Technology use should be relevant and add meaning to the experiential learning process. If not used specifically to deliver STEM and agriculture content, technology may be integrated into the learning process by documenting the learning experience and providing a means to share the experience so that others can replicate it.
2. Use local talent from Iowa State University to help with the educational process. An educational technology expert would be an excellent resource person to consult with about current and emerging educational technologies. They would be a credible person to have as a guest speaker at a regional workshop or conference to discuss technology and how to incorporate it into curriculum. Additionally, potential ideas for technology use could come from previous master’s graduate research. For example, an Iowa State University graduate student developed curriculum for using drones in high school agricultural education programs. By learning how to operate drones, students could learn how farmers use technology to scout crops for pests.

3. Using Iowa State University graduate students and Iowa 4-H specialists as authors, include a monthly spotlight on “Technology Tips” in the 4-H Focus newsletter. This section could highlight new technologies, share technology teaching tips, showcase successful technology use in programs, and provide suggested resources for staff and volunteers. Additionally, the newsletter could provide information about low or no cost technologies to implement in the educational process.

4. Use survey results that suggest areas of desired training to create an educational plan to use at regional training workshops or conferences. For example, at a conference training, the top four technology categories could be highlighted with breakout sessions for each, and participants can choose to attend the session(s) that best fit their training needs. Sessions should be taught with a constructivist and experiential learning approach and resemble closely how the technology would be implemented in a STEM or agriculture program or activity. There would be a focus on teamwork with learners communicating and interacting to work toward the finished project. For example, a group of learners may be working together on a science experiment, with each group member performing a certain role in the concrete experience. One of the group members uses
iMovie technology to document the experiment through pictures and then the participants work together to edit it, add music, change theme, etc. to complete a presentation of their experiment. This teaching method allows 4-H educators to understand how to use the technology in addition to how to apply it in a STEM or agriculture program or activity. The 4-H youth learner will ultimately gain a skill that can be potentially used in higher education course work or careers.

5. After training sessions, participants should be surveyed so that trainers can make sure that objectives are being met and provide opportunity to identify future training needs. Based on staff and volunteers’ previous knowledge, future training programs could potentially be created for all levels of learners; beginning, intermediate, and advanced, depending on the complexity of the technology.

The following Adult Education Technology Training Model and Adult Education Training Plan are suggested for planning and implementing regional technology training for 4-H educators.
Adult Education Technology Training Model

(Adapted from Kolb’s Experiential Learning Model, 2018)
Adult Education Training Plan

For Regional Technology Trainings

**Introduction:** (Guest Speaker) will discuss the value and importance of using technology in the education process, present information on new and emerging technologies, and share partnership opportunities.

Rotating small group breakout sessions for technologies that 4-H educators have a need and desire for additional training.

<table>
<thead>
<tr>
<th>Goals</th>
<th>Objectives</th>
<th>Method</th>
<th>Experiential Learning Activity</th>
<th>Assessment or Evaluation</th>
<th>Feedback from Group Discussion</th>
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</thead>
<tbody>
<tr>
<td>Educator will be able to identify <strong>Website-creation Technologies</strong> and how to use and incorporate them into 4-H STEM and agriculture programs and activities.</td>
<td>Educator will be able to proficiently use website-creation technologies to document learning and showcase projects in a 4-H STEM or agriculture program or activity.</td>
<td>Short PP presentation on website-creation technologies and how to use them in teaching. Trainer will demonstrate how to create a basic website through a short demonstration.</td>
<td>Small groups will work together to create a basic website to present content related to STEM or agriculture, in the same way that they would expect their learners to use the technology.</td>
<td>Create a plan on how you could incorporate website-creation technologies into one of your programs or activities. Is the technology appropriate to the program or activity?</td>
<td>Does this technology enhance learning? Will this technology produce a skill that can be used in other areas of their life?</td>
</tr>
<tr>
<td>Educator will be able to identify <strong>Blogging and Microblogging Technologies</strong> and how to use and incorporate them into 4-H STEM and agriculture</td>
<td>Educator will be able to create a Twitter account and proficiently use Twitter in a 4-H STEM or agriculture program or activity.</td>
<td>Short presentation on using Twitter in an educational setting. Educator will set up a Twitter account and use it to tweet information about 4-H.</td>
<td>Use Twitter to share information about an upcoming 4-H event or to share your learner’s success within a program.</td>
<td>Identify ways in which Twitter can add value and engagement to your 4-H programs and activities.</td>
<td>How can Twitter add value to your 4-H STEM or agriculture program? Would another blogging program be more appropriate</td>
</tr>
<tr>
<td>Educator will be able to identify <strong>VR and AR Technologies</strong> and how to use and incorporate them into 4-H STEM and agriculture programs and activities.</td>
<td>Educator will be able to proficiently identify these emerging technologies and how to use them. These technologies will require additional training. This session would just be an overview.</td>
<td>AR and VR are emerging technologies that are not always readily accessible. View components of Vive and understand how to set it up.</td>
<td>Using VR/AR Vive technology, play a game or explore a sunken ship.</td>
<td>Identify multiple ways that you can use AR/VR in your 4-H setting. Identify local industries using the technologies. Arrange field trip for your program or activity.</td>
<td>Is this technology feasible? How do you overcome funding issues and internet accessibility?</td>
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<tr>
<td>Educator will be able to identify <strong>Assessment Technologies</strong> and how to use and incorporate them into 4-H STEM and agriculture programs and activities.</td>
<td>Educator will be able to set up a Kahoot! Account and use it proficiently to set up a quiz for a program or activity.</td>
<td>Trainer will demonstrate how to set up a Kahoot! account and how to set up a student quiz for assessment purposes.</td>
<td>Using Kahoot!, set up your own personal account and create a quiz appropriate for a 4-H STEM or agriculture lesson.</td>
<td>Using Kahoot! have a teammate take your quiz. Identify any issues that may arise.</td>
<td>What are some of the low or no cost options available? Would you have students use their real names or use a made-up name for anonymity.</td>
</tr>
</tbody>
</table>

(Adapted from Berger, Caffarella, & O’Donnell, 2004)

**Summary**

Conclusions were drawn after careful analysis of ordinal data and written responses from questionnaire participants. Constructivism and experiential learning theory were used to formulate recommendations for 4-H leadership. With input from extension, staff and volunteers, training programs can be developed to help increase relevant technology use and create training workshops that will be beneficial for 4-H educators. An adult education training model for
technology and an adult educational training plan were researcher-developed to aid in planning regional technology trainings.

**Implications of the Study**

This study confirmed that following recommended research methods will help produce the best results. Research is messy and doesn’t always go as planned. When working with organizations, it helps to understand the behaviors of organizations. Before beginning research and attempting to collect data, it’s important to understand the constraints of an organization when it comes to collecting data using methods such as electronic surveys and questionnaires. Privacy issues can become a barrier to data collection. Good communication is key to working with organizations and achieving research goals. If a researcher is not satisfied with the constraints of an organization, they need to have an alternative plan of action or work with a different organization if possible.

The adult education training model and adult education training program are important tools in the development of educational training plans. This training model can be used to help establish a general outline for programs. The researcher-developed training plan is more detailed than a model and aids trainers with providing consistent trainings and a more detailed framework that can be further adjusted based on feedback or regional needs and constraints. In this study, the researcher-created training plan purposefully included constructivism and experiential learning theory in the technology training for Iowa 4-H STEM and agriculture educators. 4-H leadership can develop future technology trainings based on the adult education training plan.

This study can also benefit others by providing a questionnaire that could be adjusted to fit research in other similar educational settings, such as 4-H programs in other states, or
potentially in other educational settings such as school-based agriculture education. As in the research study with Iowa 4-H, the ease of data collection could be very dependent on the constraints of the gatekeeper of the contact information for potential respondents.
References

4-H History. (2017, June 30). Retrieved from http://4-h.org/about/history/


Iowa 4-H. Iowa State Extension. Retrieved from https://www.extension.iastate.edu/4h/


Kerka, S. (2003). *Volunteer development: Practice application brief*. Ohio State University: ERIC Clearinghouse on Adult, Career, and Vocational Education


What is 4-H? (2017, June 30). Retrieved from http://4-h.org/about/what-is-4-h/
Appendix I

The project referenced above has been declared exempt from the requirements of the human subject protections regulations as described in 45 CFR 46.101(b) because it meets the following federal requirements for exemption:

- (2) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey or interview procedures with adults or observation of public behavior where
  - Information obtained is recorded in such a manner that human subjects cannot be identified directly or through identifiers linked to the subjects; or
  - Any disclosure of the human subjects’ responses outside the research could not reasonably place the subject at risk of criminal or civil liability or be damaging to their financial standing, employability, or reputation.

The determination of exemption means that:

- You do not need to submit an application for annual continuing review.
- You must carry out the research as described in the IRB application. Review by IRB staff is required prior to implementing modifications that may change the exempt status of the research. In general, review is required for any modifications to the research procedures (e.g., method of data collection, nature or scope of information to be collected, changes in confidentiality measures, etc.), modifications that result in the inclusion of participants from vulnerable populations, and/or any change that may increase the risk or discomfort to participants. Changes to key personnel must also be approved. The purpose of review is to determine if the project still meets the federal criteria for exemption.

Non-exempt research is subject to many regulatory requirements that must be addressed prior to implementation of the study. Conducting non-exempt research without IRB review and approval may constitute non-compliance with federal regulations and/or academic misconduct according to ISU policy.

Detailed information about requirements for submission of modifications can be found on the Exempt Study Modification Form. A Personnel Change Form may be submitted when the only modification involves changes in study staff. If it is determined that exemption is no longer warranted, then an Application for Approval of Research Involving Humans Form will need to be submitted and approved before proceeding with data collection.

Please note that you must submit all research involving human participants for review. Only the IRB or designees may make the determination of exemption, even if you conduct a study in the future that is exactly like this study.

Please be aware that approval from other entities may also be needed. For example, access to data from private records (e.g., student, medical, or employment records, etc.) that are protected by FERPA, HIPAA, or other confidentiality policies requires permission from the holders of those records. Similarly, for research conducted in institutions other than ISU (e.g., schools, other colleges or universities, medical facilities, companies, etc.), investigators must obtain permission from the institution(s) as required by their policies. An IRB determination of exemption in no way implies or guarantees that permission from these other entities will be granted.

Please don’t hesitate to contact us if you have questions or concerns at 515-294-4566 or IRB@iastate.edu.
Technologies used in delivering STEM and agriculture content in 4-H programs and activities

Survey Flow

<table>
<thead>
<tr>
<th>Block: Default Question Block (46 Questions)</th>
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<tbody>
<tr>
<td>Page Break</td>
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</table>
Q1 Thank you for taking time to participate in this study. By checking the box below, you are confirming that you understand the purpose of this study, that you have the right to opt out of the study, and you understand that all information will be treated as highly confidential. No personal identifying information will be shared at any point in the study or within the research project.

☐ I confirm. (1)

Page Break

Q2 What is your current position within Iowa 4-H? Please choose the option that best fits your current job description. If you chose “other”, please type your position in the box provided.

☐ 4-H Volunteer (1)

☐ County Youth Coordinator (CYC) (2)

☐ 4-H Extension or youth-serving staff (3)

☐ Other (4) __________________________________________________________________________

Page Break

Q3 Are you currently or have you within the past three years been involved with teaching any 4-H programs or activities in science, technology, engineering and math (STEM) or agriculture? Please select yes or no.

☐ Yes (1)

☐ No (2)

Skip To: End of Survey if Are you currently or have you within the past three years been involved with teaching any 4-H pro... = No
Q8 How many years have you been teaching 4-H programs related to STEM or agriculture? Please use the drop down-box to select your number of years of service.

▼ 0-2 (1) ... 11 or more years (5)

Q9 Which grade level range most accurately represents the students that you teach in STEM or agriculture programs and activities? Please use the drop-down box to select the appropriate grade level range.

▼ K-3 (1) ... 9-12 (3)

Page Break

Q7 What is your age? Please type your answer in the box provided below.

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Q11 The following questions are related to technologies that may be used in the teaching and learning of science, technology, engineering and math (STEM) and agricultural content. Questions will be grouped based on categories of technology. Please rate your level of use of the technologies in your programs and then your feeling of competence in regard to using each category of technology to teach STEM and agriculture content.

Page Break

Q10 Collaborative technologies include but are not limited to tools such as Edmodo, Google docs, Wikipedia, Prezi, Survey Monkey, Slideshare, Zoho docs, and Trello.
Q13 Please rate your extent of use of collaborative technologies in your STEM and agriculture programs and activities.

- Never Use (1)
- Rarely Use (2)
- Occasionally Use (3)
- Frequently Use (4)
- Consistently Use (5)

Q12 Please rate your feeling of competence in using collaborative technologies to teach STEM and agriculture content. Please rate your level of agreement based on the statement.

I feel competent in using collaborative technologies to teach STEM and agriculture content.

- Strongly Disagree (1)
- Disagree (2)
- Neither Agree or Disagree (3)
- Agree (4)
- Strongly Agree (5)

Q14 Networking technologies may include but are not limited to Facebook, Google+, Instant Messaging, Texting, and Forums.
Q15 Please rate your extent of use of networking technologies in your STEM and agriculture programs and activities.

- Never Use... (1)
- Rarely Use... (2)
- Occasionally Use... (3)
- Frequently Use... (4)
- Consistently Use... (5)

Q16
Please rate your feeling of competence in using networking technologies to teach STEM and agriculture content. Please rate your level of agreement based on the statement:

I feel competent in using networking technologies to teach STEM and agriculture content.

- Strongly Disagree... (1)
- Disagree... (2)
- Neither Agree or Disagree... (3)
- Agree... (4)
- Strongly Agree... (5)
Q17 Video-sharing technologies may include but are not limited to YouTube, Vimeo and Blip.

Q18 Please rate your extent of use of video-sharing technologies to teach STEM and agriculture content.

- Never Use (1)
- Rarely Use (2)
- Occasionally Use (3)
- Frequently Use (4)
- Consistently Use (5)

Q19 Please rate your feeling of competence in using video-sharing technologies to teach STEM and agriculture content. Please rate your level of agreement based on the statement:

I feel competent in using video-sharing technologies to teach STEM and agriculture content.

- Strongly Disagree (1)
- Disagree (2)
- Neither Agree nor Disagree (3)
- Agree (4)
- Strongly Agree (5)
Q20 **Microblogging and blogging technologies** include but are not limited to Twitter, Blogger, WordPress, and Tumblr.

---

Q21 Please rate your extent of use of microblogging and blogging technologies in teaching STEM and agriculture content.

- Never **Use** (1)
- Rarely **Use** (2)
- Occasionally **Use** (3)
- Frequently **Use** (4)
- Consistently **Use** (5)

---

Q22 Please rate your feeling of competence in using microblogging and blogging technologies in teaching STEM and agriculture content. Please rate your level of agreement based on the statement:

I feel competent in using microblogging and blogging technologies to teach STEM and agriculture content.

- Strongly **Disagree** (1)
- **Disagree** (2)
- Neither Agree or **Disagree** (3)
- **Agree** (4)
- Strongly **Agree** (5)
Q23 Website creation technologies include but are not limited to Weebly, Wix, Site123, and SiteBuilder.com.

Q24 Please rate your extent of use of website creation technologies in teaching STEM and agriculture content.

- Never Use (1)
- Rarely Use (2)
- Occasionally Use (3)
- Frequently Use (4)
- Consistently Use (5)

Q25 Please rate your feeling of competence in using website creation technologies in teaching STEM and agriculture content. Please rate your level of agreement based on the statement:

I feel competent in using website creation technologies to teach STEM and agriculture content.

- Strongly Disagree (1)
- Disagree (2)
- Neither Agree or Disagree (3)
- Agree (4)
- Strongly Agree (5)
Q26 Image-sharing and movie-making technologies include but are not limited to Instagram, Pinterest, Flickr, Picassa, movie, cell phone cameras, and their link.

Q27 Please rate your extent of use of image-sharing and movie-making technologies in teaching STEM and agriculture content.

- Never Use (1)
- Rarely Use (2)
- Occasionally Use (3)
- Frequently Use (4)
- Consistently Use (5)

Q28 Please rate your feeling of competence in using image-sharing and movie-making technologies to teach STEM and agriculture content. Please rate your level of agreement based on the statement:

I feel competent in using image-sharing and movie-making technologies to teach STEM and agriculture content.

- Strongly Disagree (1)
- Disagree (2)
- Neither Agree or Disagree (3)
- Agree (4)
- Strongly Agree (5)
Q29 Robotics, electronics, and programming technologies include but are not limited to Ozobots, Lego Mindstorm, ROBOLAB, remotely operated vehicles (ROV), Arduino, digitalWrite, drones, and 3-D printing.

Q30 Please rate your extent of use of robotics, electronics, and programming technologies in teaching STEM and agriculture content.

- Never Use ... (1)
- Rarely Use ... (2)
- Occasionally Use ... (3)
- Frequently Use ... (4)
- Consistently Use ... (5)

Q31 Please rate your feeling of competence in using robotics, electronics, and programming technologies in teaching STEM and agriculture content. Please rate your level of agreement based on the statement:

I feel competent in using robotics, electronics and programming technologies to teach STEM and agriculture content.

- Strongly Disagree ... (1)
- Disagree ... (2)
- Neither Agree or Disagree ... (3)
- Agree ... (4)
- Strongly Agree ... (5)
Q32 Virtual Reality (VR) and Augmented Reality (AR) technologies include but are not limited to HTC Vive, Discovery VR, Cardboard Viewer, Google Sky Maps, Layar, AUGMENT, Sun Seeker, AR GPS Drive/Walk Navigation, and Quiver.

Q34 Please rate your extent of use of Virtual Reality (VR) and Augmented Reality (AR) technologies in teaching STEM and agriculture content.

- Never Use (1)
- Rarely Use (2)
- Occasionally Use (3)
- Frequently Use (4)
- Consistently Use (5)

Q33 Please rate your feeling of competence in using Virtual Reality (VR) and Augmented Reality (AR) technologies in teaching STEM and agriculture content. Please rate your level of agreement based on the statement:

I feel competent in using Virtual Reality (VR) and Augmented Reality (AR) technologies to teach STEM and agriculture content.

- Strongly Disagree (1)
- Disagree (2)
- Neither Agree or Disagree (3)
- Agree (4)
- Strongly Agree (5)
C35 Mapping and positioning technologies include but are not limited to Global Positioning Systems (GPS), Geographic Information Systems (GIS), Google Earth, Google Maps, and Trimble.

C36 Please rate your extent of use of mapping and positioning technologies in teaching STEM and agriculture content.

☐ Never Use. (1)
☐ Rarely Use. (2)
☐ Occasionally Use. (3)
☐ Frequently Use. (4)
☐ Consistently Use. (5)

C37 Please rate your feeling of competence in using mapping and positioning technologies in teaching STEM and agriculture content. Please rate your level of agreement based on the following statement:

I feel competent in using mapping and positioning technologies to teach STEM and agriculture content.

☐ Strongly Disagree. (1)
☐ Disagree. (2)
☐ Neither Agree or Disagree. (3)
☐ Agree. (4)
☐ Strongly Agree. (5)
Q38 Assessment technologies include but are not limited to Personal Response System (PRS) “clickers”, Kahooti, and Nearpod.

Q39 Please rate your extent of use of assessment technologies in teaching STEM and agriculture content.

- Never Use - (1)
- Rarely Use - (2)
- Occasionally Use - (3)
- Frequently Use - (4)
- Consistently Use - (5)

Q40 Please rate your feeling of competence in using assessment technologies in teaching STEM and agriculture content. Please rate your level of agreement based on the following statement:

I feel competent in using assessment technologies to teach STEM and agriculture content.

- Strongly Disagree - (1)
- Disagree - (2)
- Neither Agree or Disagree - (3)
- Agree - (4)
- Strongly Agree - (5)
Q41 Record-keeping technologies include but are not limited to Agriculture Experience Tracker (AET), Microsoft Excel, QuickBooks, and Farm at Hand.

Q42 Please rate our extent of use of record-keeping technologies in teaching STEM and agriculture content.

- Never Use (1)
- Rarely Use (2)
- Occasionally Use (3)
- Frequently Use (4)
- Consistently Use (5)

Q43 Please rate your feeling of competence in using record-keeping technologies to teach STEM and agriculture content. Please rate your level of agreement based on the following statement:

I feel competent in using record-keeping technologies to teach STEM and agriculture content.

- Strongly Disagree (1)
- Disagree (2)
- Neither Agree or Disagree (3)
- Agree (4)
- Strongly Agree (5)
Q44 Other web-based learning technologies include but are not limited to computer simulations and game-based learning.

Q45 Please rate your extent of use of web-based learning technologies such as computer simulations and game-based learning in teaching STEM and agriculture content.

- Never Use (1)
- Rarely Use (2)
- Occasionally Use (3)
- Frequently Use (4)
- Consistently Use (5)

Q46 Please rate your feeling of competence in using web-based learning technologies such as computer simulations and game-based learning to teach STEM and agriculture content. Please rate your level of agreement with the following statement:

I feel competent in using web-based learning technologies such as computer simulations and game-based learning to teach STEM and agriculture content.

- Strongly Disagree (1)
- Disagree (2)
- Neither Agree or Disagree (3)
- Agree (4)
- Strongly Agree (5)
Q9
In the space provided, please feel free to list any specific technologies that you use in teaching 4-H STEM and agriculture programs and activities. Technologies would include any specialized equipment, internet APPS, web-based technologies, or any new or improved teaching methods.

__________________________________________________________________________________
__________________________________________________________________________________
__________________________________________________________________________________
__________________________________________________________________________________

Page Break

Q12
In the space provided, please feel free to list any technologies that you are not currently using that you think would be valuable tools in delivering 4-H STEM and agriculture content in the future.

__________________________________________________________________________________
__________________________________________________________________________________
__________________________________________________________________________________
__________________________________________________________________________________

Page Break
Q11
In the space provided, please feel free to share any other information about your use of technology in delivering 4-H STEM and agriculture content.
April 9, 2018

Dear Iowa 4-H Staff:

My name is Pamela Rank and I am a graduate student at Iowa State University. I am writing to request your participation in filling out a questionnaire that will help to identify educational technologies used in Iowa 4-H programs to deliver science, technology, engineering and math (STEM), and agriculture curriculum. Your responses to this questionnaire are very valuable and will help in potentially identifying opportunities to enhance youth learning through technology, in addition to recognizing areas where staff might benefit from additional technology training.

This is a questionnaire that should take you no more than 10-15 minutes to complete. Please click on the link below or copy and paste it into your browser to go to the Qualtrics survey website.

https://iastate.qualtrics.com/jfe/form/SV_1X3hDKxMtyCgA4Z

Your participation in this survey is completely voluntary and all responses will be kept confidential. No personal identifiable information will be associated with your responses in any research reports of this study. Should you have any further questions or concerns, please feel free to contact me directly at pjrank@iastate.edu or 406-697-9030. I appreciate your time and effort in completing this questionnaire as truthfully and completely as possible.

It is only through the help of staff like yourself that allows me to obtain information to help advance technology-based educational youth programs and activities.

Thank you again for participating in this study.

Sincerely,

Pamela Rank
ISU Graduate Student
Agricultural Education and Studies
Appendix IV

April 9, 2018

Dear Iowa 4-H Club Leaders and Volunteers:

My name is Pamela Rank and I am a graduate student at Iowa State University. I am writing to request your participation in filling out a questionnaire that will help to identify educational technologies used in Iowa 4-H programs to deliver science, technology, engineering and math (STEM), and agriculture curriculum. Your responses to this questionnaire are very valuable and will help in potentially identifying opportunities to enhance youth learning through technology, in addition to recognizing areas where staff might benefit from additional technology training.

This is a questionnaire that should take you no more than 10-15 minutes to complete. Please click on the link below or copy and paste it into your browser to go to the Qualtrics survey website.

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Your participation in this survey is completely voluntary and all responses will be kept confidential. No personal identifiable information will be associated with your responses in any research reports of this study. Should you have any further questions or concerns, please feel free to contact me directly at pjrank@iastate.edu or 406-697-9030. I appreciate your time and effort in completing this questionnaire as truthfully and completely as possible.

It is only through the help of leaders like yourself that allows me to obtain information to help advance technology-based educational youth programs and activities.

Thank you again for participating in this study.

Sincerely,

Pamela Rank
ISU Graduate Student
Agricultural Education and Studies
Appendix V

Dear First Last,

You have received in recent 4-H Focus newsletters a questionnaire link for county staff and volunteers. Please take this opportunity to respond to this important questionnaire. Knowledge gained from this study will help us better understand the current technologies being used in Iowa 4-H and identify possible training needs for volunteers.

Below is a link for the questionnaire. I encourage you to share this link with the volunteers in your county.

**Questionnaire Link:**

[Link](https://iastate.qualtrics.com/jfe/form/SV_1X3hDKxMtyCgA4Z)

The questionnaire will be closing very soon, so please respond as quickly as possible. Participation is voluntary, and all response information will remain confidential.

Thank you for your time,

Pamela Rank  
Graduate Student  
Agricultural Education and Studies  
[pjrank@iastate.edu](mailto:pjrank@iastate.edu)  
cell 406-697-9030

Dr. Robert Martin  
Professor  
Agricultural Education and Studies  
[drmartin@iastate.edu](mailto:drmartin@iastate.edu)
Appendix VI