STEM CURRICULUM CHALLENGES WITHIN

OKLAHOMA 4-H: A DELPHI STUDY

By

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Scientific literacy is essential for the success of youth in the 21st century (National Science Board, 2018). Employers are searching for scientifically literate individuals to fill the STEM employment pipeline, which is growing at a faster rate than any other (U.S. Department of Commerce, 2017). A renewed focus on STEM (Science, Technology, Engineering, and Math) occurred in formal education in the mid-1990s (National Academy of Science, 1996). Non-formal educational organizations are providing an avenue to expand this knowledge and peak science interest (Kahler & Valentine, 2011; Kisiel, 2006). A non-formal organization, the 4-H program, recognized the importance of educating youth to be science-minded (National 4-H Council, 2018b; Noyce Foundation, 2013) As STEM programs are becoming more prevalent within 4-H, it was essential to address challenges Extension educators and 4-H volunteers face when teaching STEM curriculum. The Delphi technique was utilized to collect the opinions of a geographically dispersed group of 4-H Extension educators and volunteers. Each group served on a separate panel and were asked the question, “What challenges do you face when teaching STEM curriculum?” After three rounds of study, both the educator and volunteer panels identified two challenges faced when teaching STEM curriculum. Through identification of these challenges, Oklahoma state 4-H staff can better address the professional development needs of educators and volunteers within the organization, and support the desired scientific literacy outcomes of 4-H youth.

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CHAPTER I

INTRODUCTION

Scientific literacy is on the forefront of minds in America (National Research Council [NRC], 1996; National Science Board [NSB], 2018; The White House, 2017). Science holds an essential role in the well-being and sustainability of our country (Rice, Rugg, & Davis, 2016). Science, Technology, Engineering, and Mathematics (STEM) jobs are going un-filled, though the demand for skilled STEM workers is continually increasing (U.S. Department of Commerce [DOC], 2017). The Nation's youth are the workforce of tomorrow, and to succeed in the 21st century they need to be scientifically literate (NSB, 2018; The White House, 2017). Youths' views towards science at a young age greatly shape the development of their scientific literacy as adults (NRC, 1996).

The 4-H program began in rural communities of the United States as a means of transferring new agricultural technologies from the universities who developed them to reluctant farmers. Researchers had youth experiment with the new technologies and pass their experience and knowledge along to the adults (4-H History Preservation, 2018; National 4-H Council, 2018a). In 1914, with the passage of the Smith-Lever Act, the Cooperative Extension System was formed and 4-H was nationalized (National 4-H Council, 2018a). With an agricultural foundation, the 4-H program has its roots in science (Worker, 2016). 4-H now encompasses science, healthy living, and citizenship, and is the nation's largest youth development program

(National 4-H Council, 2018b; 4-H National Headquarters, 2011). Over six million youth participate in 4-H and, as of 2015, five million science projects were being completed (Tufts, 2013). 4-H participants are two times more likely to participate in science programs out-of-school, and 4-H girls are three times more likely to participate in science during 12th grade, compared to girls in any other out-of-school activity (Tufts, 2013).

Within Oklahoma, there were more than 166,000 youth impacted by the 4-H program in 2017. Over 133,000 of those youth were participating in STEM activities (Oklahoma 4-H, 2018a). Along with 4-H clubs and in-school programs, youth can expand their learning experience by selecting a hands-on project area (National 4-H Council, 2018c). In Oklahoma, there are 33 different project areas falling within the STEM umbrella.

Oklahoma 4-H relies on Oklahoma Cooperative Extension [OCES] educators and adult volunteers to oversee all 4-H activities (Oklahoma 4-H, 2018b). With 4-H present in all 77 counties of Oklahoma, educators, and over 3,500 volunteers, rely on the support of Oklahoma 4-H state staff for professional development (Oklahoma 4-H, 2018a). According to Robinson (2013) youth educators, including OCES educators and volunteers, should be able to communicate science-based knowledge. Little research exists on preparation of educators and volunteers to teach science curriculum, but it is imperative to identify these challenges to ultimately improve scientific literacy of youth (Smith & Schmitt-McQuitty, 2013).

Statement of the Problem

To address scientific literacy within the Oklahoma 4-H program, Oklahoma State 4-H staff must first become aware of the challenges faced by educators and volunteers when teaching STEM curriculum. By addressing the needs of those presenting the curriculum to youth, more efficient methods of promoting scientific literacy can be implemented.

Purpose

The purpose of this study was to determine the perceived challenges faced by tenured 4-H volunteers and Cooperative Extension educators when teaching STEM curriculum to 4-H youth in Oklahoma.

Objectives

1. To identify demographic characteristics of selected tenured Oklahoma 4-H volunteers and Oklahoma Cooperative Extension educators.
2. To discover challenges faced when teaching STEM curriculum by selected tenured Oklahoma 4-H volunteers and Oklahoma Cooperative Extension educators.

Significance of the Study

Scientific literacy is important in preparation of students for the workforce and in competence of current employees (Miller, 1998). The significance of scientific literacy has been recognized by the National 4-H Council, and 4-H now offers vast curricula in STEM topics for use in 4-H clubs nation-wide (Turnbull, Mielke, & Butler, 2013). 4-H volunteers and educators can use STEM curriculum to address scientific literacy with youth and help attain 4-H’s goal of life skill development (National 4-H Council, 2018a; Rice et al., 2016). Oklahoma offers many of these curricula for use by educators and volunteers (Oklahoma 4-H, 2018b). However, many youth are still not being exposed to STEM concepts in a manner that will bridge the scientific literacy gap (Heck, Carlos, Barnett, & Smith, 2012). By identifying challenges faced by Oklahoma 4-H volunteers and educators when teaching STEM curriculum, Oklahoma State 4-H staff can better address the training needs of these individuals so 4-H youth can become scientifically literate.

Scope

This study included two panels of experts. One panel consisted of tenured Oklahoma 4-H volunteers that have served a minimum of five years in their role (Culp & Schwartz, 1999b). The volunteers are also current, or past members, of the Oklahoma 4-H Volunteer Board. The second panel consisted of Oklahoma Cooperative Extension educators that were nominated and deemed as an "expert" by their respective district program specialists. These educators also have a minimum half-time appointment in the area of 4-H.

Assumptions

1. All panelists will have some familiarity with the definition of STEM curriculum.
2. All panelists will be knowledgeable of their role within Oklahoma 4-H.
3. All panelists will honestly and accurately respond to items in the questionnaires.

Limitations

1. This study was limited to selected Oklahoma Cooperative Extension educators and Oklahoma 4-H volunteers and may not represent the collective ideas of all educators and volunteers within Oklahoma 4-H.
2. Panelists were proportionally stratified based on the geographic variable of Extension district, not based on district population.

Definitions

Scientific Literacy- "…the knowledge and understanding of scientific concepts and processes required for personal decision making, participation in civic and cultural affairs, and economic productivity." (National Academy of Sciences, 1996, p. 33)

4-H- "… a community of seven million young people around the world learning leadership, citizenship, and life skills." (Tufts University, 2013, p. 54)

Tenured 4-H Volunteer- A volunteer that has served five or more years in their role with 4-H (Culp & Schwartz, 1999b)

Oklahoma Cooperative Extension Educator- "Cooperative Extension Educators are professional employees of Oklahoma State University. They provide educational programs in agriculture, family and consumer sciences, 4-H youth development, and community and rural development." (Oklahoma Cooperative Extension Service [OCES], 2017, para. 1)

Delphi Technique- a method of gaining group opinion convergence from experts within a field to address real-world issues. (Hsu & Sandford, 2007)

21st Century Skills- "…the knowledge, skills, and expertise students should master to succeed in work and life in the 21st century." (Partnership for 21st Century Learning [P21], 2015, p. 2)

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CHAPTER II

REVIEW OF LITERATURE

Scientific Literacy

“The most important thing we can do is inspire young minds and advance the kind of science, math, and technology education that will help youngsters take us to the next phase of space travel” (National Aeronautics and Space Administration, 2016). This quote, stated by the first American to orbit the Earth, John Glenn, is a cry to Americans that science education is vital for the success of our county. While current focus has not solely rested on space travel, there has been a push for Science, Technology, Engineering, and Mathematics (STEM) education at the federal, state, and local levels (Cafarella, McCulloch, & Bell, 2017; Department of Labor [DOL], 2007; Shafer, 2015; The White House, 2017).

In 1996, the National Research Council released science education standards with the goal of making scientific literacy a reality for all (NRC, 1996). Scientific literacy is defined as, “the knowledge and understanding of scientific concepts and processes required for personal decision making, participation in civic and cultural affairs, and economic productivity” (NRC, 1996). Miller (1998) further breaks scientific literacy down in to two subcategories: practical science literacy and civic science literacy. Practical science literacy focuses on the knowledge and awareness of scientific concepts, whereas civic scientific literacy is the ability to apply scientific knowledge to solve problems and inform public policy (Miller, 1998). Both definitions stress the idea that true scientific literacy is more than the ability to memorize theories, it includes the aptitude to apply knowledge. STEM education, with scientific literacy in mind, will focus on knowledge, understanding, and application of scientific concepts as well as understanding and application of the inquiry process to produce scientifically and technologically informed citizens (NRC, 1996).

To succeed in the 21st century, it is essential for the United States to focus on preparing individuals to fill careers within the STEM pipeline through STEM education and training (NSB, 2018). It is also imperative that youth and society become scientifically literate, as science holds a vital role in the health and sustainability of our country (Rice et al., 2016). Government, industry, and many other organizations have recognized STEM jobs are vital to uphold and boost our economic standing and competitiveness (DOL, 2007; NSB, 2018; Stohlmann, Moore, McClelland, & Roehrig, 2011). According to the National Science Board (2018), the number of jobs requiring extensive STEM abilities has increased by 34% in the last ten years. Employment in STEM fields has grown faster than employment in any other field. For the last five years STEM employment has increased 1.7% per year compared to 0.6% per year growth in non-STEM occupations (DOC, 2017). Individuals holding STEM occupations, regardless of education level, on average receive over $10 per hour more than those with non-STEM occupations (DOC, 2017).

STEM Education

Due to the importance of STEM careers in the United States economy, attention has been given to STEM education by numerous government agencies, including the past three Presidents of the United States (Department of Education [ED], 2015; DOL, 2007; The White House, 2017). In 2006, former President George W. Bush established the American Competitiveness Initiative, which calls for investment in education, workforce training, and expanded research and innovation in the fields of science and technology (The White House, 2006). Under the guidance of former President Barack Obama, a committee on STEM education was formed in response to a priority set to improve STEM education in the United States (ED, 2015 & Department of Energy [DOE], 2013). The committee consisted of 13 agencies that worked together with the goal to, "improve science, technology, engineering, and mathematics (STEM) education by implementing the Federal STEM Education 5-Year Strategic Plan" (DOE, 2013). The strategic plan specifically outlines federal investment occurring in the areas of P-12, undergraduate, and graduate education (DOE, 2013). In 2017, President Donald Trump signed a Presidential Memorandum stating 200 million dollars per year will be invested into grant funds to be used in secondary and post-secondary education (The White House, 2017).

National Science Test Results

Currently STEM education in the United States is not keeping up with that of many other developed countries (Wang, Moore, Roehrig, & Park, 2011). According to the National Center for Education Statistics (2011), the science achievement of United States 4th graders was in the top 10 of 57 education systems in 2011. However, by the 8th grade the science achievement of U.S. students dropped to be within the top 23 of 56 education systems. This information was gathered through the Trends in International Mathematics and Science Study (TIMSS) conducted by the National Center for Education Statistics every four years (Institute of Education Sciences, 2017). In 2015, United States 4th graders ranked 8th out of 46 education systems participating in the international benchmark. United States 8th graders ranked 8th out of 34 participating education systems. There were no measurable differences noted between the science scores for both grades between 2011 and 2015 (National Center for Education Statistics [NCES], 2015).

The National Assessment of Educational Progress (NAEP), also referred to as The Nation's Report Card, is designed to inform the public regarding academic achievement of United States education systems (NCES, 2012). Like the TIMSS study, the NAEP looks at performance of both 4^{th} and 8^{th} grade students, and is conducted every four years (Institute of Education Sciences, 2017). In addition, the NAEP included an assessment of 12^{th} grade students (NCES, 2012).

The NAEP has three achievement levels (a) basic, in which participants have partial mastery of a subject; (b) proficient, in which participants have competency in a subject area; and (c) advanced, in which participants have superior performance in a subject area (NCES, 2012). Nationally, in 2015, 38% of United States 4^{th} graders scored at or above the proficient level in science, 34% of 8^{th} graders scored at or above proficient, and 22% of 12^{th} graders scored at or above proficient. Since 2009, the percentage of U.S. students in 4^{th} and 8^{th} grades scoring at or above proficient increased by 4%, with no measurable difference noted in 12^{th} grade scores (NCES, 2017). However, the percentage of 12^{th} graders enrolled in a science course increased by 4% between 2009 and 2015 resulting in an enrollment rate of 57% (The Nation's Report Card, 2015a).

Nationally, science achievement has been increasing. However, the NAEP also compares the performance of each state to an average national public score. Oklahoma, the state of interest in this project, does not show measurable differences from the national public average. Oklahoma 4^{th} graders had an average score of 153, which is also the national public score. Oklahoma 8^{th} graders had an average score of 151, which is below the national public score of 153 (The Nation's Report Card, 2015b).

The movement for STEM education has included motives of economic strength and United States sustainability (DOL, 2007; NSB, 2018; Rice et al., 2016; Stohlmann et al., 2011). Governments, industry, and other organizations involved in this movement recognize STEM education needs to begin at a young age (ED, 2015; DOL, 2007; NSB, 2018). According to the University of Washington Institute for Science+Math Education, starting science instruction when students are young enables them to develop a positive attitude towards science education (Cafarella et al., 2017). The National Research Council, in their National Science Education Standards release (1996) stated, “The attitudes and values established toward science in the early years will shape a person’s development of scientific literacy as an adult” (p. 22). Though challenges arise, formal educational settings are vital to preparing students in STEM subject areas and integration (Tsupros & Kohler, 2008).

Informal and Non-Formal Educational Settings

Formal education settings are not the only means of enriching youths’ lives with Science, Engineering, Technology, and Mathematics engagement, both in-formal and non-formal avenues can also be used (Falk & Dierking, 2010; Kisiel, 2006; Smith & Schmitt-McQuitty, 2013). According to Kahler and Valentine (2011), educational programs occurring outside of formal school hours can aid in quality science understanding and reinforce concepts youth are learning in the classroom. Miller (1998) suggests that what is learned in formal educational settings can be enriched through informal methods. Falk and Dierking (2010) state less than five percent of an average American’s life is spent within a classroom and contend the majority of science education occurs outside of formal schooling.

It is noted that non-traditional means of educating youth in science may help peak their interest and success in the classroom as well (Kisiel, 2006). Fortus (2014) recognized the school and classroom environment has a large impact on a youth’s attitude towards science. By providing an engaging atmosphere and fostering the desire to learn, an educator can circumvent the decline in motivation to learn science (Fortus, 2014). A program conducted by the Natural History Museum in Los Angeles, California for urban teenagers found that avoiding a classroom atmosphere and allowing varied learning environments with hands-on experiences was effective in increasing student engagement and interest in science and STEM careers (Kisiel, 2006).

Recognition of pedagogical methods of engagement and instruction can be beneficial in all settings (Kisiel, 2006; Turnbull et al., 2013). Kisiel (2006) suggests providing hands-on experiences, utilizing different learning environments, recognizing student choice and input, and incorporating projects with real outcomes. An evaluation of 4-H science programming also found active and hands-on activities, connecting an activity to the real world, and discussing STEM careers and pathways were methods to increase youth engagement (Turnbull et al., 2013). The 4-H study further discusses inquiry-based learning as a method of increasing STEM interest (Turnbull et al., 2013) Inquiry-based learning is, “students learning or applying material in order to meet a challenge, such as to answer a question, conduct an experiment, or interpret data (Nilson, 2010 p. 106). No matter the methodology, a collaborative effort between organizations is best when the goal is scientific literacy (Falk & Dierking, 2010).

The 4-H Program

Science Programming

One non-formal educational organization being used to promote scientific literacy is the 4-H program (Turnbull et al., 2013). According to the National 4-H Council (2018c), 4-H is “America’s largest youth development organization” that “empowers young people with skills to lead for a lifetime.” With nearly 6 million participants in the program, science education can reach a large audience when integrated in to 4-H programming and can improve scientific literacy of youth (National 4-H Council, 2018c; Smith & Schmitt-McQuitty, 2013). In 2006, an initiative was set with the intent of increasing 4-H STEM program numbers and quality. The hope was to raise science interest, promote science literacy, and increase the number of youth entering STEM related degree fields and STEM careers (Turnbull, et al., 2013). By 2012, 1.33 million new youth had been reached with science programming due to the direct impact of the 4-H Science Initiative (Noyce Foundation, 2013).

Youth generally decide whether they enjoy STEM subjects by the 4th grade, and whether they want to pursue a STEM career by 8th grade (Leas, Nelson, Grandgenett, Tapprich & Cutucache, 2017). With interest in filling the STEM-career pipeline from government and private entities, it is imperative to begin science education at a young age (Cafarella et al., 2017; NSB, 2018). 4-H offers a Cloverbud program that begins at five years old, during which youth can be introduced to STEM (National 4-H Council, 2018b). A study by Heck, Carlos, Barnett, and Smith (2012) examined interest and attitudes of science within elementary and high school aged students. They were curious whether participation in 4-H increased science interest of youth and enrollment in higher level science coursework. It was found that while interest in science did not differ while in elementary school, students who participated in 4-H were taking higher-level, and a larger number of, science courses in high school (Heck et al., 2012).

4-H operates under three mission mandates, or primary content areas, to achieve its goal of youth and adult collaboration for community change: (a) citizenship; (b) healthy living; (c) science (4-H National Headquarters, 2011). These mission mandates serve as the educational foundation for all 4-H programming. 4-H National Headquarters (2011) believes science education is essential for youth and success in the 21st century. The National Institute of Food and Agriculture (2017) agrees a scientifically literate society is vital and 4-H is addressing this need through intentional outreach.

4-H History

In the early 1900s, farmers did not willingly accept new agricultural innovations from the universities developing them. However, it was discovered youth would willingly experiment with new technology and, in turn, would pass this knowledge and experience along to adults (National 4-H Council, 2018a). In 1902, A.B. Graham established a youth program in Ohio and T.A. Erickson started after-school clubs in Minnesota (National 4-H Council, 2018a). In the same year, O.J. Kern started a club in Illinois and O.H. Benson formed a club in Iowa (4-H History Preservation, 2018). By 1909, a boys' corn club was established in Johnston County, Oklahoma, with 50 enrolled members (Oklahoma Historical Society, 2009). In 1914, the Smith-Lever Act created the Cooperative Extension System, a partnership of the National Institute of Food and Agriculture and land-grant universities (National 4-H Council, 2018a). Funding for Extension, and for the youth clubs, was provided through this act and Oklahoma boasted almost 12,000 members in "4-H" clubs by 1915 (Oklahoma Historical Society, 2009). In 2017, Oklahoma 4-H impacted 166,587 youth through positive youth development programs (Oklahoma 4-H, 2018a). Though 4-H still offers agricultural programming, it has evolved to include science, health, and citizenship programs as well (Borden, Perkins, & Hawkey, 2014; National 4-H Council, 2018c).

4-H Structure

Staff.

While states vary in the structure of their Extension systems, many still have three basic levels of staffing: (a) state, (b) district/area, and (c) county (Astroth, 2007). In Oklahoma, these levels of staffing are accurate with state staff, district staff, and county staff dedicated to 4-H. According to the Oklahoma Cooperative Extension Service (OCES, 2017), "Extension educators provide research-based information to clientele in the areas of agriculture, family and consumer sciences, 4-H youth development, and community and rural development." The county Extension educators work directly with the community to address needs and provide relevant programming (OCES, 2017). Extension educators are also responsible for developing and maintaining a volunteer base, which is especially pertinent for 4-H programs (DASNR, 2018).

Volunteers.

Adult volunteers and Extension educators oversee all 4-H activities in Oklahoma (Oklahoma 4-H, 2018b). According to Pleskac (2009), 4-H youth development programs rely on volunteers to, “make it possible for land grant universities to deliver on the youth development mandate.” In fact, almost all nonprofit and public organizations are volunteer driven and could not accomplish their goals without them (Terry, Harder, & Pracht, 2011). Millions of youth are able to participate in 4-H due to volunteers, and these volunteers need to be valued and supported (Nippolt, Pleskac, Schwartz, & Swanson, 2012). In Oklahoma, 3,736 adult volunteers and 989 youth volunteers were on roster in 2017 (Oklahoma 4-H, 2018a).

Youth.

Beginning at age five, youth can enroll in a non-competitive program, called Cloverbuds (National 4-H Council, 2018b; Oklahoma 4-H, 2018a). At eight, youth are eligible to join a traditional 4-H program and participate until age 19 (Oklahoma 4-H, 2018a). Nationwide, 4-H programming is available within every county and parish (National 4-H Council, 2018b). In Oklahoma, 4-H is rooted in all 77 counties with the common mission of: (a) providing community-based experiential learning, (b) helping youth develop skills that will benefit them throughout life, (c) fostering leadership and volunteerism, and (d) strengthening families and communities (Oklahoma 4-H, 2018a). A study done by Tufts University (2013) indicated that 4-H members excel compared to their peers. They are four times more likely to contribute to the well-being of their community, two times more likely to be civically active, two times more likely to make healthy lifestyle choices, and two times more likely to participate in out of school science programs (Tufts University, 2013).

Extension Educators

Extension educators in Oklahoma are expected to prepare and deliver programs using a variety of educational methods, along with evaluation, recruitment, training, and coordination of other activities within their respective counties (OCES, 2017). 4-H educators serve on the frontline of youth development and are able to document their educational impact at a greater level than other staff (Astroth, 2007). County educators are of the utmost importance to 4-H, as Extension programming is disseminated at the county level in 95% of U.S. states (Astroth, 2007).

Educator Motivation and Retention

Retention of educators is an on-going issue, well-documented by Cooperative Extension systems (Harder, Gouldthorpe & Goodwin, 2014; Safrit & Owen, 2010; Vines et al., 2018). Family obligations, salary level, and feeling under-valued and over-worked can contribute to low retention rates of educators. Many ideas exist, thought to decrease the turnover rate within Extension systems, including mentoring of new hires, offering flexible schedules, and providing a nurturing community (Harder, Gouldthorpe & Goodwin, 2014; Safrit & Owen, 2010; Vines et al., 2018). When looking at retention, motivators to continue on a chosen career path should be evaluated as well (Harder, Gouldthorpe & Goodwin, 2014). Extension educators are primarily driven by their desire to make a difference. Their motivators tend to be altruistic, though job maintenance factors such as job security, income, and benefits are important as well (Harder, Gouldthorpe & Goodwin, 2014). When an educator leaves Extension, there is a negative economic impact and disruption of county programming that occurs (Safrit & Owen, 2010; Vines et al., 2018). In a study conducted by Safrit and Owen (2010), it was discovered that training of educators is an important aspect of job satisfaction and retention. Within their study training is referred to as, “providing moral support and material resources for continuous professional education.” Astroth (2007) believes that if Extension is imparting research based knowledge to youth then an “investment in knowledge department” needs to occur with Extension staff as well.

Educators and STEM Programming

Part of the knowledge imparted to youth pertains to scientific literacy. According to Robinson (2013), educators within the Extension system should be able to communicate science-based knowledge in an effective way to constituents. However, to do so, educators must be trained in science programming as well. Smith (2008) believed to have an impact on scientific literacy of youth, 4-H must provide adequate training to the staff members leading 4-H activities. In a study conducted by Brown, Kiernan, Smith, and Hughes (2003), "a need for training to increase agents' science background and their confidence using it" was established. If the goal is increasing scientific literacy, Smith and Schmitt-McQuitty (2013) contend that professional development of educators is essential.

Volunteers

The 4-H organization relies on volunteers to ensure the success and impact of 4-H programs in promotion of positive youth development (Alexander & Freel, 2018; Pleskac, 2009; Sinasky & Bruce, 2007). According to Missouri 4-H (2008), "volunteers create, support, and are part of the 4-H community." It is therefore important to address volunteer motivation and retention as it relates to the 4-H program (Culp & Schwartz, 1999a; Terry, Pracht, Fogarty, Pehlke, & Barnett, 2013).

Volunteer Motivation and Retention

Volunteers are motivated to serve for a variety of reasons (Alexander & Freel, 2018; Cleveland & Thompson, 2007; Culp & Schwartz, 1999a; Worker, 2016) Culp and Schwartz (1999a) categorized motivators in to three general categories: achievement, affiliation, and power. Affiliation motives including belief in 4-H's mission, family members' involvement, and desire to share skills and talents, served as the primary motivators for volunteers in a study conducted by Culp and Schwartz (1999a). Findings by Alexander and Freel (2018) support the idea that affiliation motives remain the most powerful in volunteer recruitment and retention. A study including interviews, round table discussion, and an open-ended survey of Arkansas 4-H volunteers concluded that four commonalities existed in the motivation to become a volunteer: (a) volunteers generally had children in the program, (b) volunteers want to give back to their communities, (c) volunteers understand and respect the reputation of 4-H, and (d) volunteers are alumni (Alexander & Freel, 2018). "4-H alumni whose children are 4-H members will be the most likely candidates to accept a volunteer position with the 4-H program" said Culp and Schwartz (1999a). Other motives found include the desire to learn, personal development, and the need to make a difference in the lives of youth (Cleveland & Thompson, 2007; Worker, 2016)

Acknowledging the individual motivations of volunteers can aid not only in volunteer recruitment, but also in the retention of volunteers (Terry et al., 2013). Recruitment, training, and retention comprise an important challenge the 4-H program needs to address (Borden et al., 2014). The annual volunteer retention rate in Oklahoma was 60%, as of 2015, with the national average hovering around 62% (Corporation for National and Community Service, 2017). With possible investment in a volunteer being valued at $13,000, it is important to manage the resource of volunteers with respect and efficiency (Terry et al., 2013). 4-H volunteers in Oklahoma donate an average of 220 hours of time per year to the program; the donation of time, and other resources that volunteers provide, are worth over $1.9 billion, according to Oklahoma 4-H (2017a).

Volunteerism is shown to increase personal well-being, lower stress levels, increase self-esteem, and lower risk of disease (Terry et al., 2013). While these benefits can aid in the satisfaction of volunteers, it is also important to address their altruistic motivations at the program level (Culp & Schwartz, 1999a). Providing quality training, ensuring acceptance, and having an open line of communication are ways to increase volunteer satisfaction, which in turn increases volunteer retention (Alexander & Freel, 2018, Terry et al., 2013). Volunteers believe they make a difference in the lives of the youth they serve, and this intrinsic motivation needs to be fostered by those supporting the volunteers (Pleskac, 2009). Effective training programs can also encourage volunteer participation and retention by addressing other motivators such as specialized skill set development and social affiliation (VanWinkle, Busler, Bowman, & Manoogian, 2002).

Volunteers and STEM Programming

While county Extension educators do a large amount of in-school enrichment programs, 4-H out-of-school clubs are primarily run by adult volunteers (DASNR, 2018; Oklahoma 4-H, 2018b). Little research exists on the aptitude of 4-H volunteers to present STEM curriculum to youth (Worker, 2016). Volunteers have diverse backgrounds, some are familiar with STEM concepts and others lack competence and confidence in the same (Haugen, Stevenson, & Meyer, 2016; Worker, 2016). However, "effective science programming needs effective science educators" said Schmitt-McQuitty, Carlos, and Smith (2014). This not only applies to the volunteers, but also to Extension educators. Further study is needed to determine effective methods in preparing volunteers and educators to teach STEM curriculum to youth in non-formal settings (Haugen et al., 2016).

Conceptual Framework

The framework of 21st Century Skills, as presented by the Partnership for 21st Century Learning (P21), guided this study (P21, 2016). Created through input from educators, education experts, and business leaders, this framework defines "…the skills, knowledge, expertise, and support systems that students need to succeed in work, life, and citizenship" (P21, 2016). Traditionally, for use in public education, the P21 structure addresses a more holistic method of approaching instruction, including focus on hard and soft skills, as well as integration of technology so today's youth can, "work smarter and learn more effectively" (P21, 2007). The conceptual model of 21st Century Learning is presented in Figure 1.

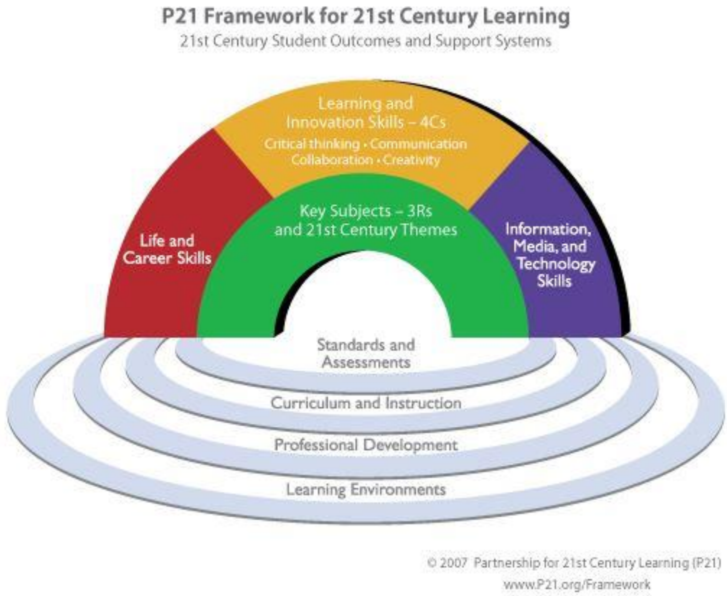

Figure 1. P21 Framework for 21st Century Learning

The items on the half circle: (a) Key Subjects and 21st Century Themes, (b) Life and Career Skills, (c) Learning and Innovation Skills, and (d) Information, Media, and Technology Skills, are outcomes desired, and areas of mastery students need to attain to succeed in the 21st century. The items listed below the half circle are support systems crucial to student and organization success (P21, 2015). These items cannot be separated from each other, as all are interconnected in the process of instruction and education. According to Moersch (2011), most classrooms have an oversimplified idea of 21st century learning and push technology adaptation at the expense of soft skills, such as those found in the learning/innovation and life/career skills centers. However, the Partnership for 21st Century Learning (2015) recognizes the importance of these soft skills and acknowledges educational experiences can occur beyond school walls to ensure youth success in work and life.

The 4-H program shares a common goal with the partnership: empowering youth with “skills to lead for a lifetime” (National 4-H Council, 2018c). The 4-H mission mandates, citizenship, healthy living, and science directly align with P21’s key subjects and 21st century interdisciplinary themes (4-H National Headquarters, 2011; P21, 2015). The 4-H mission mandate of citizenship aligns with P21's key subject of government and civics and the interdisciplinary theme of civic literacy. The 4-H mission mandate of healthy living aligns with P21's interdisciplinary theme of health literacy, and the 4-H mission mandate of science aligns with P21's key subject of science and the interdisciplinary theme of environmental literacy.

4-H also utilizes a targeting life skills model developed by Pat Hendricks (1998) that serves as a guide to aim 4-H youth towards life skill development (Figure 2). There are many overlaps of 4-H life skills and those outlined by the Partnership for 21st Century Learning (P21, 2015). Learning and innovation skills that P21 focuses on include, critical thinking, problem solving, communication, and collaboration (P21, 2016). On the 4-H targeting life skills model, critical thinking, problem solving, communication, teamwork, and contributions to group all align with these life skill goals. Under P21's life and career skills category, initiative and self-direction, and leadership and responsibility are deemed important. 4-H's targeted life skills of self-motivation, self-responsibility, leadership, and responsible citizenship align with those categories.

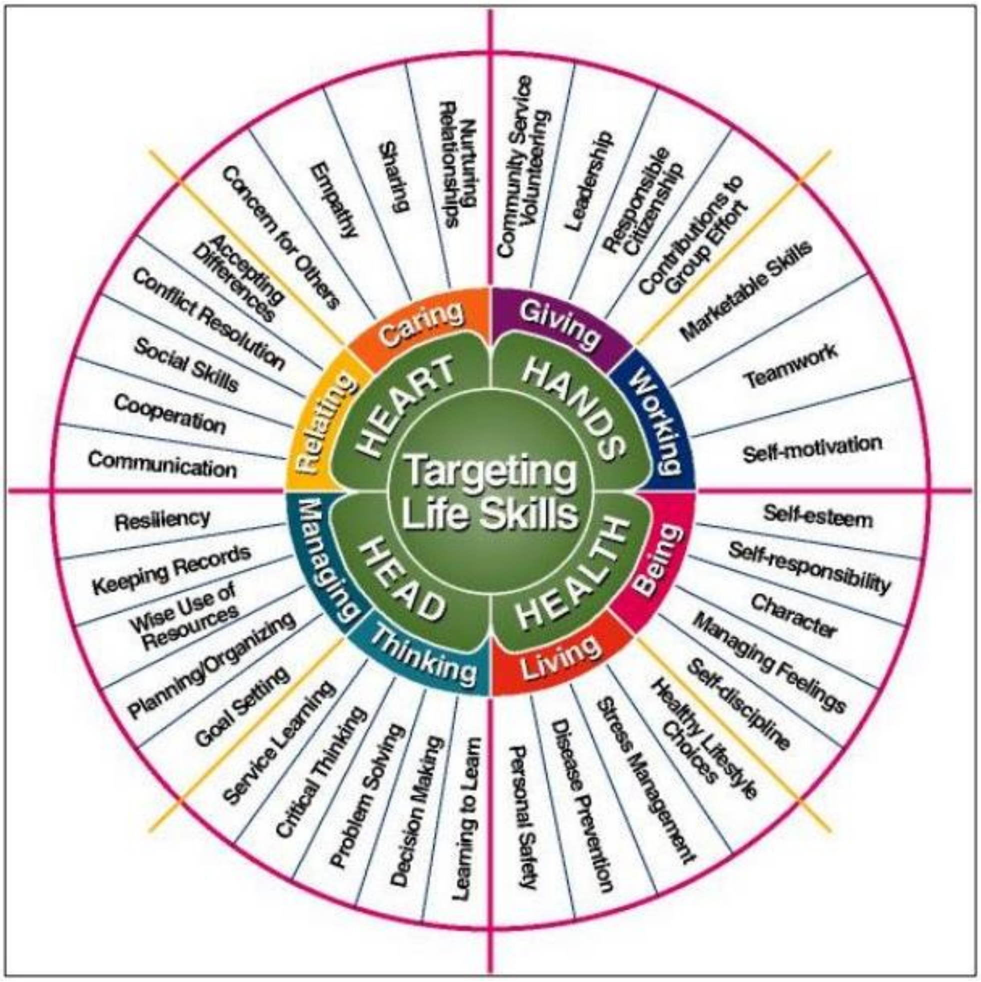

Figure 2. 4-H Targeting Life Skills Model

Recognizing the similarities of the Partnership for 21st Century Learning's goals and those of 4-H it can be stated, positive youth development and effective education are the foundation of what both entities desire. Through a collaboration of businesses and individuals, P21 established a description of skills youth need to possess to be successful in the 21st century (P21, 2015). These skills are currently being addressed though 4-H programming (Oklahoma 4-H Volunteer Development, 2012). The National 4-H Council (2018a) in a description of the 4-H program stated one of the goals of 4-H is, "to improve the nation's ability to compete in key scientific fields and take on the leading challenges of the 21st century." The P21 framework provides elements that are critical to this 21st century success (P21, 2016).

The Delphi Method

Within the realm of education, the Delphi technique has been utilized for varying purposes including, curriculum development, evaluation, and identification of program barriers (Martin & Frick, 1998). Delphi studies allow for the collection of opinions from numerous experts within a field, despite geographic separation (Hsu & Sandford, 2007; Mayfield, Wingenbach & Chalmers, 2005; Stitlington & Coetzer, 2014). Structured, anonymous commentary is provided by the experts to gather consensus of opinion regarding a topic or issue (Brady, 2015a). Three rounds of questionnaires are sent to a panel of experts, with information and results being presented to panel members between each round (Hanfin, 2004). Through this iteration process panelists can examine and clarify their ideas (Dalkey, 1972; Hsu & Sandford, 2007). Delphi methodology combines both quantitative and qualitative data to inform practice within an organization (Ludwig, 1997).

Summary

Regardless of whether students will go on to work in a STEM-related profession or just live in a STEM-influenced world, we should strive for all to have positive attitudes to science and its role in society, motivation to understand the science of issues directly related to their lives and their general well-being, and a belief in their ability to make sense of issues. (Fortus, 2014)

The need for STEM education has been addressed by government agencies, private entities, school systems, and non-formal educational settings, such as 4-H in recent years (Cafarella et al., 2017; DOL, 2017; Shafer, 2015; The White House, 2017; Turnbull et al., 2013). All recognize its importance and want to create a scientifically literate society, and provide youth with the knowledge and skills needed to succeed in 21st century life (4-H National Headquarters, 2011; P21, 2015; Rice, Rugg, & Davis, 2016). In 2006, an initiative was introduced by National 4-H Headquarters and the National 4-H Council to increase and improve STEM programming within 4-H (Turnbull et al., 2013). Through this initiative, pedagogical methods of science instruction were examined to determine their effectiveness in increasing youth engagement and knowledge (Turnbull et al., 2013). With an established need for both Extension educator and volunteer training in STEM topics, the awareness of instructional methods can help guide professional development and increase student learning (Astroth, 2007; Haugen et al., 2016; Safrit & Owen, 2010). Examination of the Partnership for 21st Century Learning's framework of 21st century outcomes and 4-H's targeting life skills model also provide a guide for youth success in the 21st century (Oklahoma 4-H Volunteer Development, 2012; P21, 2015). To further address the specific needs of Oklahoma 4-H in regards to STEM programming, the Delphi technique was utilized to gain consensus of opinion on challenges related to STEM instruction and educator and volunteer roles within the organization.

CHAPTER III

METHODOLOGY

Purpose

The purpose of this study was to determine the challenges faced by tenured 4-H volunteers and Cooperative Extension educators when teaching STEM curriculum to 4-H youth in Oklahoma.

Research Objectives

1. To identify demographic characteristics of selected tenured Oklahoma 4-H volunteers and Oklahoma Cooperative Extension educators.
2. To discover challenges faced when teaching STEM curriculum by selected tenured Oklahoma 4-H volunteers and Oklahoma Cooperative Extension educators.

Institutional Review Board

For all human subjects' research, the Office of University Research Compliance at Oklahoma State University requires Institutional Review Board (IRB) approval. The purpose of this review is to ensure the rights and welfare of all research subjects are respected throughout the duration of the study. The IRB granted approval for this study in August of 2017 (Appendix A). Due to the nature of a Delphi study, modifications were submitted to add questionnaires for rounds two and three of the project (Appendices B and C).

An additional modification was requested to send a third email reminder to panelists in round two (Appendix D).

Research Design

Delphi methodology is regarded as a process of gathering individual ideas to form group opinion in response to a complex problem (Hsu & Sandford, 2007; Linestone & Turoff, 1975). In the early 1950s, RAND Corporation scientists, Olaf Helmer and Norman Dalkey, developed and utilized the methodology to address military threats against the United States (Brooks, 1979; Custer, Scarcella, & Stewart, 1999; Linestone & Turoff, 1975). By seeking the views of military experts and developing a consensus of opinion, these scientists and other government personnel were able to make an informed decision regarding national security measures (Custer et al., 1999). The Delphi technique is now used for more than technological forecasting, it is used to inform program planning, needs assessment, policy, and utilization of resources within a variety of fields such as business, science, education, and medicine (Hsu & Sandford, 2007; Martin & Frick, 1998).

According to Dalkey (1969), the Delphi methodology has three primary features: (a) anonymous response, (b) iteration and controlled feedback, and (c) statistical group response. Anonymity is achieved by reporting only group data, no individual identifiers are included (Brooks, 1979). Ensuring anonymity can reduce the negative effect of dominant individuals in a group and allow all to share their opinions freely (Fletcher & Marchildon, 2014; Hsu & Sandford, 2007). Through iteration and controlled feedback, participants can examine and clarify ideas based on shared group responses (Hsu & Sandford, 2007). The ability to generate additional ideas aids in the reduction of noise or biased communication not focused on problem solving (Dalkey, 1972). Finally, statistical response ensures every panel member’s opinion is represented in the final results (Dalkey, 1972).

Panel Selection

Participant selection is of the utmost importance in a Delphi study (Brady, 2015b; Hsu & Sandford, 2007; Ludwig, 1997). Panelists should be knowledgeable, or regarded as "experts" in the topic of study, and be willing to share their honest perceptions of an issue (Brooks, 1979; Ludwig, 1997). While selection of potential panelists is primarily done by the researcher, it is also common to solicit nominations from those familiar with the target group (Hsu & Sandford, 2007). Random selection of panelists is not appropriate for a Delphi study (Ludwig, 1997). Therefore, purposive sampling was utilized. Purposive sampling is when "the researcher specifies the characteristics of the population of interest and locates individuals with those characteristics" (Johnson & Christensen, 2015, p.264). Two populations were focused on in this study: Oklahoma Cooperative Extension educators and Oklahoma 4-H volunteers. Purposive samples of each population were proportionally stratified based on geographic location, ensuring equal representation of the four Oklahoma Cooperative Extension districts: the Northeast, Southeast, Northwest, and Southwest (Johnson & Christensen, 2015; Saucier, McKim, & Tummons, 2012).

Volunteer Panel

Oklahoma 4-H, along with all 4-H programs, relies on volunteers to be successful and effectively reach local youth (Terry, Pracht, Fogarty, Pehlke, & Barnett, 2013). When selecting a sample, Brady (2015a) states, "Participant expertise must be defined with predetermined criteria in order for a sample to be properly identified and recruited." Therefore, to be deemed an expert, potential volunteer panelists had to meet two characteristics. Firstly, panelists should currently be serving, or have served within the past five years, on the Oklahoma 4-H Volunteer Board. The Oklahoma 4-H Volunteer Board is a group of certified, elected 4-H volunteers that assist and support the Oklahoma 4-H program through education of other volunteers, encouraging growth of youth and adults in project areas, and providing support to other leadership teams and staff

(Oklahoma 4-H, 2017b). Secondly, potential panelists must be tenured volunteers, with a tenured volunteer being defined by service of five or more years in their role with 4-H (Culp & Schwartz, 1999b). Contact information was received from the Oklahoma 4-H Volunteer specialist. An email was sent requesting participation in the study to 28 volunteers, seven from each of the four Extension districts). Email scripts for round one are included in Appendix E. The initial email included a copy of the IRB required participant information sheet (Appendix F), and a link to the first round questionnaire (Appendix G). A response rate of 50% was achieved, with 14 of the 28 potential panelists participating in round one.

Educator Panel

Oklahoma Cooperative Extension educators were nominated by their respective 4-H district program specialists (DPSs) to serve on the second Delphi panel. The nomination procedure followed the recommendation of Hsu and Sandford (2007) to receive nominations from well-known and respected leaders. The district program specialists work directly with educators in support of their 4-H endeavors and therefore are knowledgeable regarding the educators' 4-H experience and abilities. The DPSs were asked to recommend educators they deemed "expert" in the area of 4-H youth development and had a minimum of a 50% 4-H appointment within the Oklahoma Cooperative Extension system. The 28 nominated educators, seven from each Extension district, were sent an email invitation to participate in the study (Appendix E). The email invitation included the IRB required participant information sheet and a link to the first round questionnaire (Appendices F and G). A response rate of 79 percent was achieved, with 22 of the 28 invited panelists participating in round one.

Instrument

While the Delphi technique is founded on the idea of gathering input from experts to solve complex problems, many modifications to the original technique exist (Hanafin, 2004;

Linestone & Turoff, 1975; University of Illinois, n.d.). Traditionally, Delphi methodology used mailed pen and paper questionnaires and solicited response to four rounds of questions to develop consensus (Ramsey, 2009). Currently, a modified three-round design is more common (Martin & Frick, 1998). Brooks (1979) and Custer et al. (1999) determined three rounds of questionnaires sufficient in gleaning consensus through the Delphi technique. The first-round questionnaire typically includes an open-ended question related to the topic of interest (Hsu & Sandford, 2007; Ludwig, 1997). Fletcher and Marchildon (2014) refer to this round as the exploration phase, during which information on a specified topic is explored. The second-round questionnaire is developed by the researcher and includes items that have been surmised from first round responses. This is referred to as the evaluation phase (Fletcher & Marchildon, 2014). Panelists are asked to rate the items presented and offered the opportunity to rationalize their rating (Hsu & Sandford, 2007; Ludwig, 1997). The third-round questionnaire allows participants to analyze previous responses and revise their rating (Fletcher & Marchildon, 2014).

Due to technological advances, the majority of questionnaires are now sent through computer applications. The use of computers reduces cost, takes less of the researcher's and respondents' time, and increases response rate over the traditional use of mailed pen and paper questionnaires (Mayfield, Wingenbach, & Calmers, 2005). The term given to this variation of the Delphi method is the conference approach (Linestone & Turoff, 1975). This study utilized a three round Delphi conference approach and included two panels of experts. Hanafin (2004) mentions two panels can be used in a Delphi study and Gross (1980) mentions the positive aspect of separately considering each groups' concerns. In studies conducted by Knight (2017) and Ramsey (2009), two expert panels were used so items meeting consensus after three rounds could be compared. Data gathered from each panel was kept separate throughout the duration of the study.

Potential panelists were invited to participate in the study via personalized email following the recommendation of Dillman, Smyth, and Christian (2014). Dillman et al. (2014)

mentions personalization helps respondents know an email is legitimate and can establish a connection between them and the surveyor (p. 329). Response rate increases of 4.5% to 8% have been noted due to email personalization (Dillman et al., 2014). A direct link to the first-round questionnaires were included in emails to the respective panelists. These questionnaires were originally developed in Microsoft Word 2016® but were migrated in to the online surveying software, *Qualtrics*, for distribution. Upon receiving first round responses, challenge statements were developed and sent out to panelists in a round-two questionnaire. Panelists were asked to rank their agreement with each challenge statement. For statements that did not meet a pre-determined level consensus in the second round, a third questionnaire was sent. Panelists were asked to rank their agreement to the challenge statements for a final time.

Validity

When an instrument measures what it is intended to measure, it is referred to as valid (Drost, 2011). Delphi studies focus on construct validity, or whether the researcher correctly transformed the ideas from round one in to accurate statements that reflect reality (Drost, 2011). Face and content validity, two types of construct validity, were examined for this study. Face validity is a subjective evaluation of the accuracy of constructs, while content validity ensures these constructs support an overall concept (Drost, 2011). All questionnaires were examined for face and content validity by an expert panel, consisting of Oklahoma State University Department of Agricultural Education, Communications, and Leadership faculty and Oklahoma 4-H state staff, before being sent to the study participants. Any suggested modifications were made to ensure that each questionnaire was clearly worded and represented the intended measures.

Reliability

According to Drost (2011), “reliability is consistency of measurement over time or stability of measurement over a variety of conditions” (p. 108). Unlike some research methods, it is recommended the Delphi technique use a small-medium sample size (Brady, 2015a). Ten to 20 participants is common practice, as long as a representative pooling of judgement regarding the topic is at hand (Brady, 2015a; Hsu & Sandford, 2007; Ludwig, 1997; Ramsey & Edwards, 2012) To achieve a reliability correlation coefficient of 0.9, a minimum of 13 panelists is necessary at the completion of all three rounds of study (Dalkey et al., 1972). At the conclusion of this study 13 participants remained on the educator panel, therefore a reliability of 0.9 was achieved. However, only seven participants remained on the volunteer panel, equating to a correlation coefficient of 0.6 (Dalkey et al., 1972).

Data Collection

To assess the challenges faced by 4-H educators and volunteers when teaching STEM curriculum, three questionnaires were distributed to each panel, providing two-weeks for participant response, following the recommendations of Hsu and Sandford (2007) and Sitlington and Coetzer (2014). Dillman et al (2014) suggests sending emails first thing in the morning and, after an invitation email, sending reminder emails at spaced out at intervals during the survey period. Emails were sent at the recommended time for each round. A reminder was sent to panelists three days after the initial invitation with another reminder was sent seven days after the first. An exception was made in the round-two when a third reminder email was sent due to low participation.

Round One

The first questionnaires were composed of demographic questions and the open-ended question, “What challenges do you face when teaching STEM curriculum?” Demographic questions included district association, years served in respective roles, gender, race/ethnicity, education attained, and whether or not formal or in-formal training had been received in science.

Fourteen volunteers (50%) and 22 educators (79%) completed their respective first round questionnaires.

Round Two

Completion of the first-round questionnaire prompted an invitation to participate in the second-round questionnaire. Email scripts for round two are included in Appendix H. Round two questionnaires (Appendix I) consisted of challenge statements developed from the answers to the open-ended question in round one. The panelists were asked to rank their agreement with each item on a six-point Likert-type scale: 1 = Strongly Disagree, 2 = Disagree, 3 = Slightly Disagree, 4 = Slightly Agree, 5 = Agree, and 6 = Strongly Agree. This response scale follows that of other agricultural education professionals who have used Delphi methodology for social sciences research (Ramsey, 2009; Shinn et al., 2009; Siegfried, 2011). Ludwig (1997) suggests having a predetermined level of consensus for Delphi studies. For this study, an a-priori decision was made, if 75% of each panel ranked an item a “5” or “6” then the statement would meet consensus and be removed from further study. Items that received less than 75% agreement but more than 51% agreement, it would be sent in a round-three questionnaire. Items that received less than 51% agreement did not meet consensus and were removed from further examination. Panelists were provided with anonymous feedback from round one to aid them in understanding the rationale of the challenge statements (Fletcher & Marchildon, 2014; Hsu & Sandford, 2007; Ludwig, 1997; Sitlington & Coetzer, 2014). A comment box was also provided with each challenge statement, allowing participants to clarify ideas or offer justification for responses (Hsu & Sandford, 2007; Ludwig, 1997). Eight volunteers (29%) and 13 educators (46%) completed round two.

Round Three

Completion of the second-round questionnaire prompted an invitation (Appendix J) to participate in the third-round questionnaires (Appendix K).Challenge statements that did not reach consensus in round two but reached agreement of 51%-74% were included. Panelists were asked to rank their agreement with these challenge statements for a final time. Anonymous feedback (Appendix Q) from round-two was included for participants to examine (Fletcher & Marchildon, 2014; Ludwig, 1997). A comment box was also provided with each challenge statement, allowing participants to clarify ideas or offer justification for responses (Hsu & Sandford, 2007; Ludwig, 1997). Seven volunteers (25%) and 13 educators (46%) completed round-three.

Data Analysis

To generate the challenge statements presented to panelists in round two, a thematic analysis was completed on responses to the open-ended question for both panels. Thematic analysis is a common technique utilized to identify themes within qualitative research findings (Johnson and Christensen, 2015). Participant responses were examined for duplicate wording and ideas, along with compound statements that would need to be separated (Ramsey, 2009; Shinn et al., 2009). Inductive codes, or codes developed by the researcher after examining data, were utilized (Johnson & Christensen, 2015). Statements were segmented or divided in to meaningful analytical units (Johnson & Christensen; Prochaska, 2013) and hand coded to identify concepts within the qualitative data set. To ensure intercoder reliability, or the consistency of different coders achieving similar results (Johnson & Christensen, 2015), an additional researcher coded the data independently. Results were shared and common themes developed in to the challenge statements presented to each panel. To ensure the researchers correctly captured the participant's perspectives, the thematic analysis was sent to them along with the second-round questionnaire.

They were provided with the opportunity to clarify statements if desired, though none chose to do so.

In rounds two and three, panelists were asked to rank their level of agreement to challenge statements developed from the thematic analysis. Consensus of opinion would be met if 75% or more of respondents selected a “5” or “6” on a six-point likert type scale. To determine the percentage of agreement, the frequency distribution value percentage was attained and reported (Buriak & Shinn, 1989). To analyze the demographic questions from each panel, frequencies and percentages were used.

CHAPTER IV

FINDINGS

Purpose

The purpose of this study was to determine the challenges faced by tenured 4-H volunteers and Cooperative Extension educators when teaching STEM curriculum to 4-H youth in Oklahoma.

Research Objectives

3. To identify demographic characteristics of selected tenured Oklahoma 4-H volunteers and Oklahoma Cooperative Extension educators.

4. To discover challenges faced when teaching STEM curriculum by selected tenured Oklahoma 4-H volunteers and Oklahoma Cooperative Extension educators.

Source of Data: Delphi Panelists

Findings presented in this chapter are comprised of data collected from tenured Oklahoma 4-H volunteers and Oklahoma Cooperative Extension educators who served on two Delphi panels. Panel one consisted of tenured Oklahoma 4-H volunteers. Panel two consisted of Oklahoma Cooperative Extension educators.

Demographics of Panelists: Volunteer Panel

Tenured 4-H volunteers, those having served at least five years in their role (Culp & Schwartz, 1999b), who are current or previous members of the Oklahoma 4-H Volunteer Board, were asked to respond to seven demographics questions in support of research objective one. Invitations were sent to 28 individuals who fell within the selection criteria. Of the 28 individuals invited, 14 responses were received in round one for a response rate of 50%. At the time of the questionnaire, Oklahoma 4-H was geographically divided in to four districts. When asked which district panelists associated themselves with, 35.71% of panelists stated the Northeast district, 21.43% stated the Northwest district, 28.57% stated the Southeast district, and 14.29% stated they were associated with the Southwest district (see Table 1).

Table 1

Demographic Characteristics: Volunteer Panel (N=14)

Demographics	*f*	%
District		
Northeast	5	35.71
Northwest	3	21.43
Southeast	4	28.57
Southwest	2	14.29
Years served as 4-H volunteer		
0-5	3	21.43
6-10	1	7.14
11-15	9	64.29
16-20	1	7.14
Gender		
Female	11	78.57
Male	3	21.43
Age		
20-29	0	0.00
30-39	2	14.29
40-49	6	42.86
50-59	5	35.71
60-69	1	7.14

Demographics	*f*	%
Race/Ethnicity		
African American	0	0.00
Asian	0	0.00
Caucasian	11	78.57
Hispanic/Latino/Chicano	0	0.00
Native American	1	7.14
Other	2	14.29
Highest educational degree earned		
GED	0	0.00
High-school diploma	3	21.43
Associate's degree	1	7.14
Bachelor's degree	5	35.71
Master's degree	4	28.57
Doctoral degree	1	7.14
Other	0	0.00
Survey Taker: Have you received any formal or informal training in science? [a]		
Received a science-related degree or certification	4	23.53
Attended science workshops or training	7	41.18
I have no training	2	11.76
Other	4	23.53

[a] Participants were able to select all applicable answers

Three panelists (21.43%) have served as a 4-H volunteer for 0-5 years. One panelist (7.14%) selected the 6-10 year category, while the majority of panelists selected that they have served as a 4-H volunteer for 11-15 years. A remaining panelist (7.14%) identified 16-20 years of service have been given to the 4-H program in a volunteer capacity.

The majority of the volunteer panel (78.57%) identified as being female, with the remainder of the panel (21.43%) identifying as male. Panelists were also asked their age. Two panelists (14.29%) fell within the 30-39 age range, six (42.86%) fell within the 40-49 age range, five (35.71%) within the 50-59 age range, and one panelist (7.14%) fell within the 60-69 age range. When asked about their race/ethnicity, the majority of respondents (78.57%) stated they are Caucasian, one respondent (7.14%) identified as Native American, and two respondents (14.29%) selected the "other" category. Upon selection of "other", panelists were able to type their race/ethnicity category, if desired. One panelist stated they were both Caucasian and Native American (Choctaw).

Participants serving on the volunteer panel were questioned to determine the highest educational degree that they have earned. Three panelists (21.43%) had earned only a high-school diploma. One panelist (7.14%) earned an associate's degree, five panelists (35.71%) earned a bachelor's degree, four panelists (28.57%) earned a master's degree, and one panelist (7.14%) earned a doctoral degree.

Participating volunteers were asked if they had received any formal or informal training in science. Panelists were able to select all applicable answers and offer descriptions of each answer. Four panelists selected, "I have received a degree or certification in a science-related field." It was discovered that these volunteers had degrees/certifications in the following areas: "civil engineering," "nursing/audiology teaching certification for science," "agronomy crops and soils," and a "Master's in plant and soil science." Seven panelists selected, "I have attended science workshops/science training." Once this response was selected, an additional question appeared to gauge how many workshops had been attended in the last five years. The answers were as follows: 2, 3, 3, 5, 8, 10, with one panelist stating they are "CCA certified, archery certified in 2013, [and] lots of work related training." Two panelists selected, "I have no training." Four panelists selected, "Other" and provided the following comments, "I have attending 4-H STEM training," "Bachelor's degree in elementary education so I have had basic science up to 8th grade," and "district and state volunteer workshops that pertain to the science project areas."

Demographics of Panelists: Educator Panel

Oklahoma Cooperative Extension educators, with a minimum of 50% 4-H appointment, were nominated to serve on the educator panel by Oklahoma 4-H district program specialists. Prospective panelists were sent a questionnaire that included demographics questions to address research objective one. Invitations were sent to 28 potential participants, 22 responses were received in round one resulting in a response rate of 79%. At the time of the questionnaire, Oklahoma 4-H was geographically divided in to four districts. When asked which district panelists associated themselves with, 18.18% of panelists stated the Northeast district, 27.27% stated the Northwest district, 27.27% stated the Southeast district, and 27.27% stated that they were associated with the Southwest district (see Table 2).

Table 2

Demographic Characteristics: Educator Panel (N=22)

Demographics	*f*	%
District		
Northeast	4	18.18
Northwest	6	27.27
Southeast	6	27.27
Southwest	6	27.27
Years served as Extension Educator		
0-5	13	59.09
6-10	4	18.18
11-15	1	4.55
16-20	2	9.09
21-25	1	4.55
26-30	1	4.55
Gender		
Female	14	63.64
Male	8	36.36
Age		
20-29	8	36.36
30-39	5	22.73

Demographics	*f*	%
40-49	2	9.09
50-59	6	27.27
60-69	1	4.55
Race/Ethnicity		
African American	0	0.00
Asian	0	0.00
Caucasian	17	77.27
Hispanic/Latino/Chicano	2	9.09
Native American	2	9.09
Other	1	4.55
Highest educational degree earned		
GED	0	0.00
High-school diploma	0	0.00
Associate's degree	0	0.00
Bachelor's degree	15	68.18
Master's degree	7	31.82
Doctoral degree	0	0.00
Other	0	0.00
Survey Taker: Have you received any formal or informal training in science? [a]		
Received a science-related degree or certification	10	30.30
Attended science workshops or training	18	54.55
I have no training	4	12.12
Other	1	3.03

[a] Participants were able to select all applicable answers

Thirteen panelists (59.09%) indicated that they have served 0-5 years in their role as Extension educator. Four educators (18.18%) have spent 6-10 years in service, one educator (4.55%) 11-15 years, two educators (9.09%) 16-20 years, one educator (4.55%) 21-25 years, and the final educator (4.55%) has served 26-30 years. The majority of participants were female (63.64%) with the remaining participants identifying as male (36.36%).

Panelists were asked to provide their age, eight (36.36%) fell within the 20-29 age range. Five panelists (22.73%) fell within the 30-39 age range, two panelists (9.09%) within the 40-49 range, six panelists (27.27%) within the 50-59 range, and the final panelist (4.55%) fell within the 60-69 age range. When asked about their race/ethnicity, the majority of respondents (77.27%) indicated Caucasian descent. Two respondents (9.09%) indicated Hispanic/Latino/Chicano descent, two respondents (9.09%) indicated Native American descent, and one panelist (4.55%) selected, “Other.” Upon selection of, “other” panelists were able to type their race/ethnicity category, if desired. One panelist stated that they identify as, “Irish and Native American.” Educators were also asked to select the highest educational degree that they have achieved. Fifteen educators (68.18%) indicated the completion of a bachelor’s degree, while the remaining seven educators (31.82%) indicated completion of a Master’s degree.

Participating educators were also asked if they had received any formal or informal training in science. Participants were able to select all applicable answers and provide open-response feedback. Ten panelists indicated they received a degree or certification in a science-related field. Six panelists stated they have degrees in animal science, with one having a biology double major. “Biotechnology,” “STEM,” and, “family and consumer science” were also mentioned. Eighteen respondents indicated participation in science workshops/science training. When this response was selected, an additional question appeared asking participants to list the estimated number of science workshops and training attended within the last five years. Responses of 3, 4, 5, 6, 10, 12, 15, and 30 were received. One panelist specified, “STEM” and another identified, “drone discovery” science training. Four panelists indicated they have not received any formal or informal science training, and one panelist selected, “Other” but provided no open response feedback.

Round One Findings: Volunteer Panel

Round one of this study sought to discover the perceived challenges faced by Oklahoma 4-H volunteers when teaching STEM curriculum. To address objective two, panelists were asked to respond to an open-ended question, “What challenges do you face when teaching STEM curriculum?”

Fourteen panelists completed the first round questionnaire. Participant responses were analyzed and adjustments made for similar phrases and compound statements (Ramsey, 2009; Shinn et al., 2009). A total of 28 concepts guided the researcher in development of 14 perceived challenges faced by volunteers when teaching STEM curriculum to Oklahoma 4-H youth. These challenges were presented to panelists in the round two questionnaire (See Table 3).

Table 3

Perceived Challenges Faced When Teaching STEM Curriculum: Volunteer Panel

Challenges Faced When Teaching STEM Curriculum
Funding for supplies/equipment
Accessing resources/supplies/equipment
Lacking time in schedule for STEM education
Lacking confidence in STEM subject matter
Lacking knowledge of available curriculum
Lacking parental support
Making STEM curriculum appropriate for wide age ranges
Establishing an interested youth audience
Competing with other activities for youths’ time
Associating the name STEM with subject difficulty
Curriculum design is too structured
Receiving help from parents/community members
Rural location limiting access to training
Youth prefer quick experiments

Panelists identified numerous obstacles faced while preparing and teaching STEM curriculum. Time, funding, confidence, and dissatisfaction with current curriculum design were common challenges. One panelist mentioned that, “sometimes [there is] not enough time to do the subject justice, or enough materials for the class.” Another stated, “money tends to be an issue.” Yet another mentioned, “getting help from others, supplies or curriculum to teach, and parents support” as challenges faced while teaching STEM curriculum.

Round Two Findings: Volunteer Panel

The second-round questionnaire sought to assess the level of agreement each panelist had with the challenge statements developed in the first round (See Table 4). The questionnaire was sent to the 14 panelists who completed the first round. Eight responses were received, resulting in a response rate of 57.14%.

Table 4

Frequencies and Percentages Presented in Round Two: Volunteer Panel (N=8)

Statement	Strongly Disagree		Disagree		Slightly Disagree		Slightly Agree		Agree		Strongly Agree	
	%	*f*	%	*f*	%	*f*	%	*f*	%	*f*	%	*f*
Funding for supplies/ equipment	0.00	0	12.50	1	12.50	1	0.00	0	25.00	2	50.00	4
Accessing resources/ supplies/equipment	0.00	0	0.00	0	25.00	2	12.50	1	37.50	3	25.00	2
Lacking time in schedule for STEM education	0.00	0	25.00	2	12.50	1	12.50	1	50.00	4	0.00	0
Lacking confidence in STEM subject matter	0.00	0	12.50	1	12.50	1	50.00	4	25.00	2	0.00	0
Lacking knowledge of available curriculum	0.00	0	12.50	1	37.50	3	0.00	0	50.00	4	0.00	0
Lacking parental support	0.00	0	12.50	1	0.00	0	25.00	2	37.50	3	25.00	2

Statement	Strongly Disagree %	*f*	Disagree %	*f*	Slightly Disagree %	*f*	Slightly Agree %	*f*	Agree %	*f*	Strongly Agree %	*f*
Making STEM curriculum appropriate for wide age ranges	12.50	1	0.00	0	12.50	1	37.50	3	12.50	1	25.00	2
Establishing an interested youth audience	0.00	0	12.50	1	25.00	2	12.50	1	37.50	3	12.50	1
Competing with other activities for youths' time	0.00	0	0.00	0	12.50	1	0.00	0	37.50	3	50.00	4
Associating the name STEM with subject difficulty	12.50	1	12.50	1	25.00	2	12.50	1	37.50	3	0.00	0
Curriculum design is too structured	0.00	0	37.50	3	25.00	2	25.00	2	0.00	0	12.50	1
Receiving help from parents/community members	12.50	1	0.00	0	12.50	1	50.00	4	12.50	1	12.50	1
Rural location limiting access to training	0.00	0	37.50	3	25.00	2	25.00	2	12.50	1	0.00	0
Youth prefer quick experiments	0.00	0	0.00	0	0.00	0	37.50	3	37.50	3	25.00	2

A six-point Likert-type scale was provided for panelists to rank their level of agreement with each challenge statement (Ramsey, 2009; Shinn et al., 2009; Siegfried, 2011): 1 = Strongly Disagree, 2 = Disagree, 3 = Slightly Disagree, 4 = Slightly Agree, 5 = Agree, 6 = Strongly Agree. Additionally, panelists were provided the opportunity to offer descriptions and clarifications of their rankings. Two challenge statements met consensus in this round (See Table 5). When 75% or more of the panel ranked the challenge a "5" or "6" on the scale it was determined that consensus was achieved (Knight, 2017; Ramsey, 2009).

Table 5

Challenges that Reached 75% or more Agreement in Round Two: Volunteer Panel (N=8)

Challenges Faced when Teaching STEM Curriculum	% Agreement
Funding for supplies/equipment	75.00
Competing with other activities for youths' time	87.50

Funding for supplies and equipment (75.00%).

Panelists agreed that a challenge faced when teaching STEM curriculum within Oklahoma 4-H is finding the funding for supplies and equipment. One volunteer stated, "It seems the deeper we get into the STEM projects, the more funding is needed." Others declared that, "the supplies do not work and were donated. I looked to outside sources" and "I feel that we should be allowed funding to help offset the cost of the supplies."

Competing with other activities for youths' time (87.50%).

Volunteers acknowledge, and believe, that a challenge is competing with other activities for youths' time. "Once members reach a certain age, it doesn't matter if they like STEM or not, they get into sports and FFA which takes over their time schedule and they must choose more often than not to participate with 4-H or their other obligations" said one panelist. Another declared, "Hard to get them involved in 4-H when they admit they have sports, band, church, and everything else you can imagine." Some simply mention that competition with sports and other activities is a struggle when getting youth to participate in 4-H and especially in 4-H STEM subject matter.

Challenges that fell within the 51% to 74% agreement range were to be presented to panelists in the third and final round of the study. Three challenge statements had rankings that landed within this range (See Table 6).

Table 6

Challenges that Received more than 51% but Lower than 75% Agreement in Round Two: Volunteer Panel (N=8)

Challenges Faced when Teaching STEM Curriculum	% Agreement
Accessing resources/supplies/equipment	62.50
Lacking parental support	62.50
Youth prefer quick experiments	62.50

Accessing resources/supplies/equipment (62.50%).

While it did not meet consensus in round two, panelists felt that accessing resources/supplies/equipment was a slight challenge that Oklahoma 4-H faces when teaching STEM curriculum. One volunteer mentioned that even if a county has supplies they have issues accessing them due to waiting lists. They end up resorting to “sub-par” activities. Another mentioned, “it was hard to get equipment and the county did not seem interested in helping.”

Lacking parental support (62.50%).

Panelists also felt that lack of parental support is a slight challenge. One panelist simply commented, “no parental support.” Others believed that parents may not understand science curriculum and that causes a lack of participation. Another panelist believed this was an issue, not only for STEM activities, but all 4-H activities stating, “If former 4-H members can’t even support their own kids in the program, then we really struggle with those who don’t have a 4-H background.”

Youth prefer quick experiments (62.50%).

Volunteers somewhat agreed that youth preferring quick experiments was a challenge faced when teaching STEM curriculum. One volunteer mentioned, “some youth have short attention spans” and another mentioned, “we live in a world that is in small time clips.” While volunteers felt that youth preferred quick experiments they also recognized that there were ways to overcome this obstacle in some circumstances. A volunteer mentioned that making the experiments fun, and not trying to parallel a school experience or lesson, aided in keeping the youths attention. “They didn’t realize what they were doing was part of the STEM curriculum” said the volunteer.

Any challenges that received less than 51% agreement in the second round were removed from further study. Nine challenges were excluded from additional investigation (See Table 7).

Table 7

Challenges that Received Less than 51% Agreement in Round Two: Volunteer Panel (N=8)

Challenges Faced when Teaching STEM Curriculum	% Agreement
Lacking time in schedule for STEM education	50.00
Lacking confidence in STEM subject matter	25.00
Lacking knowledge of available curriculum	50.00
Making STEM curriculum appropriate for wide age ranges	37.50
Establishing an interested youth audience	50.00
Associating the name STEM with subject difficulty	37.50
Curriculum design is too structured	12.50
Receiving help from parents/community members	25.00
Rural location limiting access to training	12.50

Lacking time in schedule for STEM education (50.00%).

Panelists did not reach consensus on the challenge of lacking time in schedules for STEM education. While some volunteers did feel this was an issue stating, “We only have so much time during a meeting and most STEM projects are quite lengthy” others felt that this was not a difficulty they faced. One panelist stated, “I have time for this.” Another mentioned that they have time but no supplies, and yet another stated, “Need to place it into the schedule due to the importance of STEM and the critical thinking process.”

Lacking confidence in STEM subject matter (25.00%).

The majority of volunteers did not feel that lacking confidence in STEM subject matter was a barrier when teaching STEM curriculum. One mentioned, “I think some in the state believe this is an issue because they want specific criteria from the state level to be followed.” Others mentioned that STEM training for the leaders and not just the county educators would be helpful and believed that having additional help, and back up activities, for some curriculum would be useful.

Lacking knowledge of available curriculum (50.00%).

While lacking knowledge of available curriculum did not meet consensus or fall within the agreement range to be examined in the third round, 50% of volunteers believed this was a challenge. “Unless leaders search and shop in the 4-H Mall on a regular basis, we are not told by our county educators what curriculum is available on a county level” said one panelist. Another simply stated, “Do not know what all curriculum is available.” An additional panelist has a science background, but not one in electronics, and felt the only science curriculum the state was pushing fell within that area.

Making STEM curriculum appropriate for wide age ranges (37.50%).

Panelists indicated that this was not a monumental challenge facing volunteers when teaching STEM curriculum. While some acknowledged the difficulty in providing curriculum appropriate for all age ranges, “this needs to cover ages 9-19,” others provided suggestions to overcome this barrier. One panelist stated, “Lots of stuff out there but may not have 4-H stamp of approval. Look toward other groups and share resources and there are lots of curriculum out there for different ages.” Another mentioned that is hard to make curriculum appropriate for wide age ranges regardless of the subject. This volunteer made the suggestion to “give the younger ones the job of taking pictures and documenting the activities” they would then incorporate this information in a scrapbook which makes them “feel successful and part of the team.”

Establishing an interested youth audience (50.00%).

Half of the volunteer panel felt that establishing an interested youth audience was a challenge faced when teaching STEM curriculum. One panelist stated, “there are kids that do not know about this area” while another said, “they are interested.” A third panelist mentioned that establishing an interested audience “falls on me” also indicating, “I can sell anything” but lacking the materials for follow-through in the STEM subject area.

Associating the name STEM with subject difficulty (37.50%).

Panelists felt associating the name STEM with subject difficulty was only a slight challenge. Of the four comments received from panelists regarding this area they were split on agreement in this area. Two panelists indicated, “All kids think this is a hard area” and “the words for the acronym stand for fairly scary subject areas to youth. When they think of science, the think of a classroom setting in which most kids don’t enjoy.” However, two other panelists mentioned, “I don’t believe STEM associates with difficulty unless they have previously had negative experiences with it” and “most kids like the name. It makes them feel smarter.”

Curriculum design is too structured (12.50%).

Only one panelist (12.5%) ranked this challenge at a "5" or "6" on the likert-type scale. However, the majority of comments indicated that curriculum itself is an issue. "I have not seen a curriculum" said one volunteer. Another indicated that they don't even try to utilize curriculum stating, "Sorry, I did my own thing." One mentioned, "Yes, it is designed for older, more knowledgeable leaders, educators, and members. Those members who are new to STEM feel lost because it has so many steps that are targeted for the older members." "I think there is a lot of thought that the state office wants things done a specific way and then a leader can't find the curriculum or get information from the state office, so they don't try it" stated an additional volunteer. Only one comment from a volunteer viewed curriculum in a positive light saying, "It has to be structured to get the necessary results and for safety."

Receiving help from parents/community members (25.00%).

Panelists indicated that receiving help from parents/community members was only a slight challenge facing volunteers when teaching STEM curriculum. One panelist stated, "parents have pitched in in our club" and another said, "I had to push the idea but it did work…sometimes." One indicated that if you know the right people to ask you can receive help, however if resources aren't readily available, or they do not have knowledge enough to make the project successful it can discourage the youth. In regards to community members support a volunteer stated, "Those community members that know the 4-H program will support it, however we have to face it that small town businesses are dying and thus the local support is drying up." A final panelist stated, "no one wants to help anymore."

Rural location limiting access to training (12.50%).

The majority of volunteers did not feel that accessing training was a challenge faced. One panelist stated, "this only applies if you let it it's not that far to Stillwater." Another panelist indicated that there is a plethora of training opportunities that can be made “readily available” to volunteers using the online platform. “If they have access to a computer, they should have access to some type of online training” said the panelist.

Round Three Findings: Volunteer Panel

The round three questionnaire sought to assess the agreement of panelists with challenge statements that did not meet consensus in round two but fell within the 51%-74% agreement range (See Table 8). The third round served as a final opportunity for volunteers to address the challenges and provide feedback. The questionnaire was sent to the eight panelists who completed round two. Seven of the eight responded to the third round resulting in a response rate of 87.5%.

Table 8

Frequencies and Percentages Presented in Round Three: Volunteer Panel (N=7)

Statement	Strongly Disagree		Disagree		Slightly Disagree		Slightly Agree		Agree		Strongly Agree	
	%	*f*	%	*f*	%	*f*	%	*f*	%	*f*	%	*f*
Accessing resources/supplies/ equipment	0.00	0	14.29	1	0.00	0	42.86	3	28.57	2	14.29	1
Lacking parental support	0.00	0	0.00	0	42.86	3	14.29	1	14.29	1	28.57	2
Youth prefer quick experiments	0.00	0	0.00	0	0.00	0	28.57	2	42.86	3	28.57	2

A six-point Likert-type scale was provided for panelists to rank their level of agreement with each challenge statement (Ramsey, 2009; Shinn et al., 2009; Siegfried, 2011): 1 = Strongly Disagree, 2 = Disagree, 3 = Slightly Disagree, 4 = Slightly Agree, 5 = Agree, 6 = Strongly Agree. Additionally, panelists were provided the opportunity to offer descriptions and clarifications of their rankings. If 75% or more of the panel ranked the challenge a “5” or “6” on the scale it was determined that consensus was achieved (Knight, 2017). No challenge statements met consensus in this round (See Table 9).

Table 9

Challenges that did not Receive 75% or more Agreement in Round Three: Volunteer Panel (N=7)

Challenges Faced when Teaching STEM Curriculum	% Agreement
Accessing resources/supplies/equipment	42.86
Lacking parental support	42.86
Youth prefer quick experiments	71.43

Accessing resources/supplies/equipment (42.86%).

One panelist simply agreed accessing resources/supplies/equipment is a challenge for them stating, “Agree accessing STEM resources have been a challenge.” Another panelist mentioned, “It is difficult to have access to resources and supplies if our county doesn’t let the club leaders know that we have equipment.” The same panelist indicated waiting lists for equipment at the county level causing enthusiasm of youth for certain project areas to decline. One volunteer mentioned even when they had supplies they, “were either missing parts of did not work.”

Lacking parental support (42.86%).

Three volunteers (42.86%) agreed lack of parental support was a challenge. One panelist commented, “Too many parents want to drop them [youth] off and you do the work.” Another mentioned, “parents need to be more involved.” However, two volunteers gave suggestions to combat this problem that they are using within their clubs. “Parents are required to stay for meetings” said one panelist. A second volunteer stated, If we have more workshops geared at the parents so they may see and experience STEM, the might enjoy it and want their child to become more involved. We are never going to be able to get more kids interested until we have the parents interested.

Youth prefer quick experiments (71.43%).

While the majority of panelists believed that youth preferring quick experiments is an issue facing Oklahoma 4-H STEM programs, it did not reach the a-priori consensus percentage of 75%. Only one panelist provided a comment in this round stating that youth lose interest if an experiment is too long, especially younger youth. It was mentioned that, “Anything over 15 minutes needs to be aimed at older members who are definitely interested in the learning part of the experiment.”

Final thoughts, comments, and suggestions of volunteers in relation to this study were supplied at the end of the questionnaire. One statement supports the challenge of youth preferring quick experiment, “We need quick guided STEM activities to access, that lists the activity and supplies needed to complete it.” Another volunteer states that curriculum needs to be age appropriate and geared towards project areas. Parents also need to be more interested the panelist said. “I think that if they [curriculum] are geared for certain ages and certain project areas, we can keep the members hooked and want to learn more!” After three rounds of questionnaires concluded, two challenges met consensus and were determined to be challenges faced by volunteers when teaching STEM curriculum to Oklahoma 4-H youth (See Table 10).

Table 10

STEM Curriculum Challenges within Oklahoma 4-H Identified by Oklahoma 4-H Volunteers

Challenges Faced when Teaching STEM Curriculum
Funding for supplies/equipment
Competing with other activities for youths’ time

Round One Findings: Educator Panel

Round one of this study sought to discover the perceived challenges faced by Oklahoma 4-H educators when teaching STEM curriculum. To address objective two, panelists were asked to respond to an open-ended question, "What challenges do you face when teaching STEM curriculum?"

Twenty-two panelists completed the first-round questionnaire. Participant responses were analyzed and adjustments made for similar phrases and compound statements (Ramsey, 2009; Shinn et al., 2009). A total of 33 concepts guided the researcher in development of 14 perceived challenges faced by educators when teaching STEM curriculum to Oklahoma 4-H youth. These challenges were presented to panelists in the round two questionnaire (See Table 11).

Table 11

Perceived Challenges Faced When Teaching STEM Curriculum: Educator Panel

Challenges Faced When Teaching STEM Curriculum
Funding for supplies/equipment
Accessing resources/supplies
Feeling adequately trained
Lacking time in schedule for STEM education
Lacking confidence in subject matter
Lacking knowledge of subject matter
Making STEM curriculum applicable to youth
Making STEM curriculum engaging to youth
Making STEM curriculum appropriate for wide age ranges
Establishing an interested youth audience
Youth associating the name STEM with subject difficulty

Challenges Faced When Teaching STEM Curriculum
Competing with other activities for youths’ time
Communicating with school teachers
Enabling volunteers to use STEM curriculum at a club level

Participating educators identified numerous obstacles they are experiencing while teaching STEM curriculum to Oklahoma 4-H youth. Obstacles included training, funding, time management, and many others. Regarding training one panelist stated, “I am often uncomfortable teaching STEM curriculum because I feel like I don’t fully understand it” while another mentioned, “I feel like I need a little background information given to me so I actually sound like I know what I’m talking about.” An educator also stated, “The biggest challenge that I face when teaching STEM is being adequately trained on the kits that are made available to me.” “The challenge I face is funding” said one panelist. “One challenge is cost. To bring some of the things to a classroom, supplies or enough equipment for an entire class gets expensive sometimes” stated a panelist. Another mentioned, “Finding time to prepare and present educational workshops is my biggest challenge.”

Round Two Findings: Educator Panel

The second-round questionnaire sought to assess the level of agreement each panelist had with the challenge statements developed in the first round (See Table 12). The questionnaire was sent to the 22 panelists who completed the first round. Responses were received from 13 panelists, resulting in a response rate of 59.00%.

Table 12

Frequencies and Percentages Presented in Round Two: Educator Panel (N=13)

Statement	Strongly Disagree %	*f*	Disagree %	*f*	Slightly Disagree %	*f*	Slightly Agree %	*f*	Agree %	*f*	Strongly Agree %	*f*
Funding for supplies/ equipment	0.00	0	7.69	1	15.38	2	23.08	3	46.15	6	7.69	1
Accessing resources/ supplies	0.00	0	7.69	1	7.69	1	23.08	3	53.85	7	7.69	1
Feeling adequately trained	0.00	0	0.00	0	8.33	1	16.67	2	58.33	7	16.67	2
Lacking time in schedule for STEM education	0.00	0	7.69	1	15.38	2	30.77	4	30.77	4	15.38	2
Lacking confidence in subject matter	0.00	0	16.67	2	0.00	0	33.33	4	33.33	4	16.67	2
Lacking knowledge of subject matter	0.00	0	15.38	2	7.69	1	30.77	4	30.77	4	15.38	2
Making STEM curriculum applicable to youth	0.00	0	15.38	2	30.77	4	15.38	2	38.46	5	0.00	0
Making STEM curriculum engaging to youth	0.00	0	23.08	3	15.38	2	23.08	3	38.46	5	0.00	0
Making STEM curriculum appropriate for wide age ranges	0.00	0	0.00	0	15.38	2	23.08	3	61.54	8	0.00	0
Establishing an interested youth audience	0.00	0	15.38	2	30.77	4	15.38	2	38.46	5	0.00	0
Youth associating the name STEM with subject difficulty	0.00	0	15.38	2	7.69	1	23.08	3	46.15	6	7.69	1
Competing with other activities for youths' time	0.00	0	0.00	0	0.00	0	25.00	3	41.67	5	33.33	4
Communicating with school teachers	0.00	0	7.69	1	15.38	2	23.08	3	46.15	6	7.69	1
Enabling volunteers to use STEM curriculum at a club level	7.69	1	15.38	2	7.69	1	15.38	2	46.15	6	7.69	1

A six-point Likert-type scale was provided for panelists to rank their level of agreement with each challenge statement (Ramsey, 2009; Shinn et al., 2009; Siegfried, 2011): 1 = Strongly Disagree, 2 = Disagree, 3 = Slightly Disagree, 4 = Slightly Agree, 5 = Agree, 6 = Strongly Agree. Additionally, panelists were provided the opportunity to offer descriptions and clarifications of their rankings. Two challenge statements met consensus in this round (See Table 13). When 75% or more of the panel ranked the challenge a "5" or "6" on the scale it was determined that consensus was achieved (Knight, 2017).

Table 13

Challenges that Reached 75% or more Agreement in Round Two: Educator Panel (N=13)

Challenges Faced when Teaching STEM Curriculum	% Agreement
Feeling adequately trained	75.00
Competing with other activities for youths' time	75.00

Feeling adequately trained (75.00%).

Educators agreed that feeling adequately trained was a challenge that they face when teaching STEM curriculum to Oklahoma 4-H youth. "I have several kits I have no idea what to do with because they were there before me" said one educator. Another stated, "Although trainings are held, going beyond those activities is difficult because I am often challenged by how to start." One panelist referenced this is an issue when recruiting volunteers, "A frequent comment made by those asked to volunteer" the panelist said.

Competing with other activities for youths' time (75.00%).

Panelists believe that another challenge faced when teaching STEM curriculum is the competition with other activities for youths' time. While nine panelists ranked this statement as a

“5” agree or “6” strongly agree, only one comment was provided in reference to this issue. “Kids are busy and they have to pick and choose their activities and STEM sometimes does not make the cut but for those who choose STEM, it is very rewarding” said the panelist.

Challenges that fell within the 51% to 74% agreement range were to be presented to panelists in the third and final round of the study. Six challenge statements had rankings that landed within this range (See Table 14).

Table 14

Challenges that Received more than 51% but Lower than 75% Agreement in Round Two: Educator Panel (N=13)

Challenges Faced when Teaching STEM Curriculum	% Agreement
Funding for supplies/equipment	53.84
Accessing resources/supplies	61.54
Making STEM curriculum appropriate for wide age ranges	61.54
Youth associating the name STEM with subject difficulty	53.84
Communicating with school teachers	53.84
Enabling volunteers to use STEM curriculum at a club level	53.84

Funding for supplies/equipment (53.84%).

While this challenge statement did not reach consensus in round-two, panelists did feel that it was a slight issue faced when teaching STEM curriculum. “Budgets are short, other areas for funding are priority” stated one panelist. Another mentioned, without grants, funding is an issue, “Items are costly and if we can receive grants, it is fine. Having to wait on grants at times is difficult.” One panelist plans STEM activities in advance and asks for donations to shop for needed supplies. Another educator stated they can usually find funding, but recognizes that is a challenge for other counties to do so.

Accessing resources/supplies (61.54%).

Eight panelists agreed that accessing resources/supplies is a challenge. One educator stated, “Goes along with funding issues.” Another mentioned, “Sometimes in a rural area it is more difficult to get what is needed for projects.” “It is hard to purchase some supplies locally and without a P-Card in my county it is almost impossible to order from the internet” said another.

Making STEM curriculum appropriate for wide age ranges (61.54%).

Panelists felt making STEM curriculum appropriate for wide age ranges is a slight issue faced. “Just depends on topic/item” said one educator. Another felt that teaching a wide range of ages is difficult with any curriculum, not STEM only. “The projects that we have available to teach seem to keep the students engaged. Sometimes there needs to be skill levels available for younger youth, or possibly more challenging levels for the older ones” said another panelist.

Youth associating the name STEM with subject difficulty (53.84%).

Over half of the participating panelists felt that youth associating the name STEM with subject difficulty was a barrier to teaching STEM curriculum. “Some students’ automatically associate science and math with challenging and hard” said an educator. However, another educator said, “Never really found this as a problem.”

Communicating with school teachers (53.84%).

Educators agreed that communicating with school teachers was a slight challenge faced when teaching STEM curriculum. One panelist mentioned, “Some schools are easier than others.” Another stated,

In my area, teachers don’t want my help with STEM programming, they either don’t have the time to let me in their classroom, won’t do the activities that are left for them or are too busy teaching other subjects to provide STEM education.

Enabling volunteers to use STEM curriculum at a club level (53.84%).

Seven panelists ranked this challenge at a “5” or “6” on the Likert-type scale. Therefore, over half of the educator panelists felt that enabling volunteers to use STEM curriculum at a club level is a challenge faced. However, the only comment provided did not support this item as a challenge. “All of my leaders know that STEM programs are available for them to use and in many cases, I can get a teen leader to go to their meeting and teach it. This is not a problem for me” the panelist stated.

Any challenges that received less than 51% agreement in the second round were removed from further study. Six challenges were excluded from additional investigation (See Table 15).

Table 15

Challenges that Received Less than 51% Agreement in Round Two: Educator Panel (N=13)

Challenges Faced when Teaching STEM Curriculum	% Agreement
Lacking time in schedule for STEM education	46.15
Lacking confidence in subject matter	50.00
Lacking knowledge of subject matter	46.15
Making STEM curriculum applicable to youth	38.46
Making STEM curriculum engaging to youth	38.46

Challenges Faced when Teaching STEM Curriculum	% Agreement
Establishing an interested youth audience	38.46

Lacking time in schedule for STEM education (46.15%).

Six panelists felt they lacked time in their schedules for STEM education and therefore this was a challenge faced when teaching STEM curriculum. “The prep time for STEM makes it more time consuming” compared to other subjects said one educator. Another said, “I don’t have time always to learn the kits I have in my office.” It was also mentioned that, “School teachers have difficulty adding additional material to class time.” Though there was support for this being a challenge, it not reach consensus and was removed from further study.

Lacking confidence in subject matter (50.00%).

Half of the panelists that responded to this statement felt that lacking confidence in the subject matter was a challenge they face when teaching STEM curriculum. “Common comment” said one educator. One panelist felt they lacked confidence with some topics but not others. “I feel like I have to learn everything because I can teach it and this is an area that I have limited knowledge” said another panelist.

Lacking knowledge of subject matter (46.15%).

Less than half of the panelists (46.15%) felt lacking knowledge of subject matter was a barrier to teaching STEM curriculum. One panelist stated this is a “common comment.” Another mentioned, “Just depends on topic/item.”

Making STEM curriculum applicable to youth (34.46%).

Panelists did not reach consensus on this challenge statement, with only 34.46% indicating agreement. One panelist stated, “I haven’t had any problems helping youth that I work with find ways to apply STEM projects to everyday life, and the things that they are interested in.” Another panelist supported this idea by adding “real world examples” to the curriculum. “Most of the curriculum I have seen and worked with helps make the application for you” said an educator.

Making STEM curriculum engaging to youth (38.46%).

Five panelists (38.46%) felt that it was difficult to make STEM curriculum engaging to youth, while the remaining eight panelists did not find this an unsurmountable challenge. “The projects that we have available to teach seem to keep the students engaged” said an educator. Another mentioned, “Most of the curriculum is fun so engagement is not a problem.” One panelist mentioned that adding real world and hands-on examples helps combat this problem.

Establishing an interested youth audience (38.46%).

The majority of participating panelists did not feel that establishing an interested youth audience is a challenge they face when teaching STEM curriculum. “There is lots of interest in science” said one educator. Another stated, “I provide quite a bit of STEM programming at the YMCA and with 4-H’ers and they are always interested.” Others felt that it depends on the environment that it is being presented and that the subject has to click with the already established interest of the youth.

Round Three Findings: Educator Panel

The round three questionnaire sought to assess the agreement of panelists with challenge statements that did not meet consensus in round two but fell within the 51%-74% agreement range (See Table 16). The third round served as a final opportunity for volunteers to address the challenges and provide feedback. The questionnaire was sent to the 13 panelists who completed round two. Responses were received from all panelists, resulting in a response rate of 100%.

Table 16

Frequencies and Percentages Presented in Round Three: Educator Panel (N=13)

Statement	Strongly Disagree		Disagree		Slightly Disagree		Slightly Agree		Agree		Strongly Agree	
	%	*f*	%	*f*	%	*f*	%	*f*	%	*f*	%	*f*
Funding for supplies/ equipment	0.00	0	7.69	1	15.38	2	38.46	5	30.77	4	7.69	1
Accessing resources/ supplies	0.00	0	0.00	0	15.38	2	30.77	4	38.46	5	15.38	2
Making STEM curriculum appropriate for wide age ranges	0.00	0	15.38	2	7.69	1	23.08	3	38.46	5	15.38	2
Youth associating the name STEM with subject difficulty	0.00	0	15.38	2	23.08	3	53.85	7	7.69	1	0.00	0
Communicating with school teachers	0.00	0	7.69	1	23.08	3	15.38	2	46.15	6	7.69	1
Enabling volunteers to use STEM curriculum at a club level	0.00	0	15.38	2	7.69	1	38.46	5	15.38	2	23.08	3

A six-point Likert-type scale was provided for panelists to rank their level of agreement with each challenge statement (Ramsey, 2009; Shinn et al., 2009; Siegfried, 2011): 1 = Strongly Disagree, 2 = Disagree, 3 = Slightly Disagree, 4 = Slightly Agree, 5 = Agree, 6 = Strongly Agree. Additionally, panelists were provided the opportunity to offer descriptions and clarifications of their rankings. If 75% or more of the panel ranked the challenge a “5” or “6” on the scale it was determined that consensus was achieved (Knight, 2017). No challenge statements met consensus in this round (See Table 17).

Table 17

Challenges that did not Receive 75% or more Agreement in Round Three: Educator Panel (N=13)

Challenges Faced when Teaching STEM Curriculum	% Agreement
Funding for supplies/equipment	38.46
Accessing resources/supplies	53.84
Making STEM curriculum appropriate for wide age ranges	53.84
Youth associating the name STEM with subject difficulty	7.69
Communicating with school teachers	53.84
Enabling volunteers to use STEM curriculum at a club level	38.46

Funding for supplies/equipment (38.46%).

Five panelists (38.46%) felt that funding for supplies/equipment was an issue. One educator said, “With county budgets so tight it is hard to find funding to begin new programs. We have done so much fund-raising that businesses are starting to wince when we come through their doors.” Another panelist did not see funding as an issue, “Usually I am able to find funds to use for projects” they said.

Accessing resources/supplies (53.84%).

While it did not reach consensus, over half of panelists felt that access to resources/supplies was a challenge faced when teaching STEM curriculum. Rural location limiting this access was brought up by two panelists. One stated, “It can be challenging in total Oklahoma to buy some of the supplies, but with proper planning it is manageable.” Another said, “Tougher to locate in small rural counties.” “I have not had any issues finding resources needed for any programs so far,” said another educator.

Making STEM curriculum appropriate for wide age ranges (53.84%).

Overall, panelists did not agree that making STEM curriculum appropriate for wide age ranges was an issue they faced. However, seven panelists did indicate their agreement with the statement by ranking it a "5" or "6" on the Likert-type scale. Two panelists, while indicating agreement, did provide ways in which they have attempted to address the perceived challenge. "I prefer to have different STEM projects based on age. It is hard to make something simple enough got young kids and still keep the teens attention," one panelist said. Another mentioned, "With the wide range of ages in 4H it has been helpful to be able to direct the activity towards a specific age group."

Youth associating the name STEM with subject difficulty (7.69%).

In the third round, only one panelist (7.69%) felt youth associating the name STEM with subject difficulty was a challenge faced. The remaining 12 panelists only felt slight agreement or disagreement with this challenge statement. "STEM is becoming a fairly common acronym," said one panelist.

Communicating with school teachers (53.84%).

Panelists felt that communicating with school teachers is only a slight challenge faced when teaching STEM curriculum. Those indicating agreement stated, "Our teachers are not open to outside projects, activities, etc. until they have completed their state testing, at that point they are do what you want." Another panelist said, "Teachers have a hard time letting us in or building in time for STEM." A third panelist stated, "It is important to communicate with school teachers as they may have materials available or invite you to come and teach with your material if it fits what they are currently doing."

Enabling volunteers to use STEM curriculum at a club level (38.46%).

Five panelists (38.46%) indicated agreement to the challenge statement, while eight panelists felt that enabling volunteers to use STEM curriculum at a club level was not a challenge. One educator mentioned, “The kids don’t automatically think STEM is tough but the volunteers do!” Another said, “Volunteers should be able to have access to the STEM curriculum.”

Educators chose not to supply any final comments, thoughts, or suggestions related to this study. After three rounds of questionnaires concluded, two challenges met consensus and were determined to be challenges faced by educators when teaching STEM curriculum to Oklahoma 4-H youth (See Table 18).

Table 18

STEM Curriculum Challenges within Oklahoma 4-H Identified by Oklahoma 4-H Educators

Challenges Faced when Teaching STEM Curriculum
Feeling adequately trained
Competing with other activities for youths’ time

Comparison of Volunteer and Educator Panels

The question of, “What challenges do you face when teaching STEM curriculum?” was presented to two Delphi panels. At the conclusion of three rounds of questionnaires, the volunteer panel had identified two challenges faced when teaching STEM curriculum. The educator panel also identified two challenges faced when teaching STEM curriculum. Comparison of these perceived challenges is presented in Table 19.

Table 19

Comparison of Perceived Challenges Identified by 4-H Educator and 4-H Volunteer Panels

Challenges Identified by Educators	% Agreement	Challenges Identified by Volunteers	% Agreement
Competing with other activities for youths' time	75.00	Competing with other activities for youths' time	75.00
Feeling adequately trained	75.00	Funding for supplies/equipment	87.50

Both panels identified, "Competing with other activities for youths' time" as a challenge they face when teaching STEM curriculum. This statement met consensus for both panels. Distinct challenges were also identified. The educator panel recognized, "feeling adequately trained" as a perceived challenge, with 75% of the panel indicating agreement. The volunteer panel recognized, "funding for supplies/equipment" as a perceived challenge, with 87.50% of the panel indicating agreement. Challenge statements that did not reach consensus after three rounds of questionnaires are presented in Table 20.

Table 20

Comparison of Perceived Challenges Identified by 4-H Educator and 4-H Volunteer Panels that did not reach Consensus

Challenges Identified by Educators	% Agreement	Challenges Identified by Volunteers	% Agreement
Accessing resources/supplies	53.84	Accessing resources/supplies/ equipment	42.86
Making STEM curriculum appropriate for wide age ranges	53.84	Making STEM curriculum appropriate for wide age ranges	37.50
Lacking confidence in subject matter	50.00	Lacking confidence in STEM subject matter	25.00
Lacking knowledge of subject matter	46.15	Lacking knowledge of available curriculum	50.00

Challenges Identified by Educators	% Agreement	Challenges Identified by Volunteers	% Agreement
Lacking time in schedule for STEM education	46.15	Lacking time in schedule for STEM education	50.00
Establishing an interested youth audience	38.46	Establishing an interested youth audience	50.00
Youth associating the name STEM with subject difficulty	7.69	Associating the name STEM with subject difficulty	37.50
Communicating with school teachers	53.84	Youth prefer quick experiments	71.43
Enabling volunteers to use STEM curriculum at a club level	38.46	Lacking parental support	42.86
Funding for supplies/equipment	38.46	Receiving help from parents/community members	25.00
Making STEM curriculum applicable to youth	38.46	Curriculum design is too structured	12.50
Making STEM curriculum engaging to youth	38.46	Rural location limiting access to training	12.50

Summary

Volunteer Panel

The volunteer panel consisted of tenured 4-H volunteers who had served, or are currently serving, on the Oklahoma 4-H Volunteer Board. The majority of volunteer panelists were female (78.57%), Caucasian (78.57%), and have served as a 4-H volunteer for 11-15 years (64.29%). No volunteers were under the age of 30. The majority of volunteers fell within the 40-49 and 50-59 age ranges for a collective percentage of 78.57%. Panelists represented all four Oklahoma Extension districts (the Northeast, Northwest, Southeast, and Southwest) and had varying levels of education.

Invitations were sent to 28 potential panelists, and 14 responded to the first round questionnaire. Participants were asked the open ended question, “What challenges do you face when teaching STEM curriculum?" Responses were analyzed and 28 concepts developed into 14 challenge statements, which were then presented to panelists in round two.

Eight panelists responded to the round two questionnaire. Panelists were able to view the thematic analysis, and see anonymous comments provided in the first round. The volunteers were able to offer comments relating to each challenge statement, to clarify their stance. In the second round, two challenge statements met consensus with 75% or more of the panel ranking the challenge at a "5" or "6" on a Likert-type scale. Challenge statements that received 51%-74% agreement were sent in a third-round questionnaire. Any challenges that received below 51% agreement were removed from further study. After the second-round, three challenge statements were sent in a third-round questionnaire, and nine statements were removed from further consideration.

Seven panelists responded to the third-round questionnaire, which included the three challenge statements that fell within the 51%-74% agreement range in round-two. Panelists were again able to view anonymous comments from the previous round and provide their own remarks to clarify their stance on each challenge. No additional challenges met consensus. Therefore, two perceived challenges faced by Oklahoma 4-H volunteers when teaching STEM curriculum were identified after three rounds of study. The challenges were, funding for supplies and equipment and competing with other activities for youths' time.

Educator Panel

The educator panel consisted of Oklahoma Cooperative Extension educators deemed "expert" by their respective district program specialists, and with at least a half-time 4-H appointment. The majority of educators were female (63.64%), Caucasian (77.27%), and have served 0-5 years as an Extension educator (59.09%). The majority of educators fell within the 20-29 and 30-39 age ranges for a collective percentage of 59.09%. Panelists represented all four

Oklahoma Extension districts (the Northeast, Northwest, Southeast, and Southwest). The majority of educators held a Bachelor's degree (68.18%) with the remainder (31.82%) holding Master's degrees.

Twenty-eight potential panelists received invitations and 22 responded to the first round questionnaire. Educators were asked the open ended question, "What challenges do you face when teaching STEM curriculum?" Responses were analyzed and 33 concepts developed in to 14 challenge statements, which were then presented to panelists in round two.

Thirteen panelists responded to the round two questionnaire. Panelists were able to view the thematic analysis, and see anonymous comments provided in the first round. The volunteers were able to offer comments relating to each challenge statement, to clarify their stance. In the second round, two challenge statements met consensus with 75% or more of the panel ranking the challenge at a "5" or "6" on a Likert-type scale. Challenge statements that received 51%-74% agreement were sent in a third-round questionnaire. Any challenges that received below 51% agreement were removed from further study. After the second-round, six challenge statements were sent in a third-round questionnaire, and six statements were removed from further consideration.

Thirteen panelists responded to the third-round questionnaire, which included the six challenge statements that fell within the 51%-74% agreement range in round-two. Panelists were again able to view anonymous comments from the previous round and provide their own remarks to clarify their stance on each challenge. No additional challenges met consensus. Therefore, two perceived challenges faced by Oklahoma Cooperative Extension educators when teaching STEM curriculum were identified after three rounds of study. The challenges that met consensus were, feeling adequately trained and competing with other activities for youths' time. Competing with other activities for youths' time was a challenge that also met consensus with the volunteer panel.

CHAPTER V

CONCLUSIONS, IMPLICATIONS, AND RECOMMENDATIONS

Conclusions Related to Objective One

Objective One: To identify demographic characteristics of selected tenured Oklahoma 4-H volunteers and Oklahoma Cooperative Extension educators.

Volunteer Panel

The volunteer panel consisted of 14 tenured volunteers who are currently serving, or have previously served, on the Oklahoma 4-H Volunteer Board. The typical panelist was a Caucasian female at least 40 years old. The typical panelist also had 11-15 years of service as a 4-H volunteer, attained a bachelor's degree or higher, and received a science-related degree or other formal or in-formal science training.

Educator Panel

The educator panel consisted of 22 OCES educators who were nominated by their respective DPS and considered to be "expert" in the area of 4-H youth development. The average educator panelist was a Caucasian female under 40 years old. Panelists typically had served 0-5 years in their role as an OCES educator and attained a bachelor's degree, which is a requirement of OCES employment in the role of an educator (DASNR, 2018). The typical panelist also had received a science-related degree or attended formal or in-formal science training.

Comparison

While both panels were primarily Caucasian females, the volunteers were older and had provided more years of service to 4-H than the OCES educators. The majority of both panels held at least a bachelor's degree. Around 12% of each panel had not received any form of science training (11.76% volunteer and 12.12% educator). Representation from all four Extension districts (Northeast, Northwest, Southeast, and Southwest) was present on each panel.

Conclusions Related to Objective Two

Objective Two: To discover challenges faced when teaching STEM curriculum by selected tenured Oklahoma 4-H volunteers and Oklahoma Cooperative Extension educators.

Volunteer Panel

The volunteer panel met consensus on two challenge statements:

1. Funding for supplies/equipment
2. Competing with other activities for youths' time

Volunteers felt that funding for supplies and equipment as well as the competition with other activities for youths' time were the biggest challenges faced when teaching STEM curriculum and implementing science programming within Oklahoma 4-H.

Funding for supplies/equipment.

Funding for Oklahoma Extension has decreased drastically in the past seven years (27%) according to Trapp (2017). This has led to changes in staffing structure that will continue to effect Extension within the state. Volunteers may not be able to offset personal expenditures for supplies and other items used for their 4-H activities. While fundraisers can occur for club accounts, as one panelist said,

> It seems the deeper we get into the STEM projects, the more funding is needed. If the club runs on very little funding and must constantly do fundraisers, the members lose interest as well as the parents frown on all the fundraising we already must do for various events. – Panelist.

It is not uncommon for volunteers to spend personal money to benefit 4-H youth (Pleskac, 2009). It is also worth noting Extension educators do fundraising within their counties, as well. Though funding for supplies/equipment did not meet consensus on the educator panel. There was a comment made by an educator stating businesses are starting to wince when they walk through the door, because so much fundraising has been done due to tight county budgets. STEM programs, while some can be done cheaply, can also require significant investments compared to other program areas.

A Delphi study by Knight (2017), examined educators', volunteers', and 4-H parents' perceptions of challenges facing Oklahoma 4-H within the next five years. Budget decline was a common finding for all panels. One parent noted the budgetary state of OCES has reduced county funding, and, in turn, county programs have "less funds given to volunteer club leaders" (p.75). Without additional funding, STEM programming within Oklahoma 4-H could be impaired. If club leaders struggle to provide the materials necessary to implement STEM curriculum, and counties or state staff are not in a financial position to assist, STEM programming will be set aside for curriculum that is more affordable and easy to access.

Educator Panel

The educator panel met consensus on two challenge statements:

1. Feeling adequately trained
2. Competing with other activities for youths' time

Feeling adequately trained.

Training is essential for educators to increase scientific knowledge and is one of the Partnership for 21st Century Learning's support systems to achieve organizational success (P21, 2015; Smith, 2008). Finding time to attend training, and having sufficient funds to do so, have been reported as obstacles in receiving science training (Riley & Butler, 2012; Turnbull et al., 2013). However, many educators lack competence and confidence in science subject matter, and therefore it is crucial to provide quality training (Haugen, Stevenson, & Meyer, 2016; Turnbull et al., 2013). One educator mentioned, "I have several kits I have no idea what to do with because they were there before me." Another mentioned, while trainings are held and attended, any STEM activities beyond those completed at the training are a struggle. "I am often challenged by how to start." – Educator Panelist. Though lack of confidence in STEM subject matter did not reach consensus with the educator panel, it is still worth considering in the context of feeling adequately trained. Without proper training, educators may not teach STEM curriculum due to lack of confidence and understanding.

Common Challenge among Panels:

Competing with other activities for youths' time.

Competition with other activities is not a new phenomenon to 4-H member retention (Albright & Ferrari, 2010; Astroth, 1985; Meelks-Baney & Jones, 2013; Harder, Lamm, Lamm, Rose, & Rask, 2005). This was recognized as a challenge by both the volunteer and educator panels. As youth get older, time conflicts can arise with jobs and other out-of-school organizations such as organized sports (Albright & Ferrari, 2010; Harder et al., 2005). Meeks-Baney and Jones (2013) contend youth want to participate in organizations that meet their needs for affiliation (relationships) and achievement (recognition). Youth also want to hold meaningful roles and utilize time wisely, and if needs are not met, youth will leave a program (Albright &

Ferrari, 2010). One volunteer panelist stated, “Once members reach a certain age, it doesn’t matter if they like STEM or not, they get into sports and FFA which takes over their time schedule…” An educator panelist stated, “Kids are busy and they have to pick and choose their activities and STEM sometimes does not make the cut. But for those who choose STEM, it is very rewarding.” Without a focus on youth needs and motivations, the competition with other activities for youths’ time will result in more youth leaving 4-H for programs that attend to the needs we may be overlooking. By intentionally appealing to youths’ motivations, the retention rate could be increased within the Oklahoma 4-H program.

The challenge of competing with other activities for youths’ time was consistent with, and supports, findings in Knight (2017) where competition with other activities was found to be a challenge that met consensus with all panels.

Recommendations for Future Practice

To inform Oklahoma 4-H practice and policy, each challenge was assessed in the context of utilizing this knowledge to guide us in to the 21st century.

Competition with other Activities for Youths’ Time

With the knowledge that youth leave 4-H due to other activities meeting intrinsic needs, time constraints, and job requirements, educators and volunteers should support youth within these areas. Albright and Ferrari (2010) suggest that modern youth want to participate in programs which meet their interests, provide ownership and choice of activities, establish social relationships, and offer flexibility. By working closely with other organizations that are vying for youths’ time and developing strategies to assist each other, 4-H members can experience affiliation and success within more than one organization and increase satisfaction and retention

(Albright & Ferrari, 2010; Meeks-Baney & Jones, 2013). Club structure could also increase in flexibility to allow for youth participation in other activities (Harder et al., 2005). To address the interests of participating youth, and allow for ownership of project choice, group leaders could conduct a needs assessment of their club membership (Harder et al., 2005). By allowing group input, recognizing its value, and putting results in to practice youth will feel empowered, which can encourage continued participation in 4-H (Meeks-Baney & Jones, 2013; Harder et al., 2005). STEM curriculum could also be tied to current project areas youth are participating in to increase interest and provide some ownership over project choice.

Funding for Supplies/Equipment

During times of financial stress, it is imperative organizations demonstrate their impact to stakeholders (O'Neill, 1998; Workman & Scheer, 2012). As a public program, Extension relies on outside sources to provide funding, and must prove to university administrators, taxpayers, and legislators that it is worth the investment (O'Neill, 1998). With funding in Oklahoma diminishing, documentation of 4-H's impact in the state is vital to receiving recognition and funding for the sake of positive youth development (Workman & Scheer, 2012). Historic data and solitary success stories, while worthwhile, are not enough to convince stakeholders in modern society to provide funding. If at all possible, dollar amounts and other economic impact data are useful (O'Neill, 1998). Measures for impact should be included in evaluations utilized by educators and volunteers and a high priority should be placed on conducting evaluation by all levels of Extension staff (O'Neill, 1998; Workman & Scheer, 2012).

Feeling Adequately Trained

A need exists to provide STEM training for Extension staff and volunteers (Haugen et al., 2016, Smith (2008). "Effective science programming needs effective science educators," stated

Schmitt-McQuitty, Carlos, and Smith (2014). Delphi participants on the educator panel felt they lacked adequate training to teach STEM curriculum.

The responsibility of educator and volunteer training ultimately rests with 4-H academic and program staff (Schmit-McQuitty et al., 2014). In Oklahoma, 4-H state staff provide a minimum of five science in-services per year. However, with input from this study, state Extension staff can look at ways to more accurately address the needs of educators (Sinasky & Bruce, 2007). Many adults do not feel confident in their abilities to guide STEM workshops appropriately (Turnbull et al., 2013). While it did not meet consensus, half of educators questioned agreed, lacking confidence in STEM subject matter is a barrier faced when teaching STEM curriculum. Numerous educators commented on feeling confident in teaching the STEM workshops covered in professional development trainings, but not knowing how to proceed with a science curriculum on their own. Specific content should be covered within these professional development sessions, however, additional time should be spent on pedagogical practices and learning strategies that can aid in youth engagement and educator understanding (Haugen et al., 2016; Riley & Butler, 2012).

Examining the Partnership for 21st Century Learning's support system category of professional development can aid Extension state staff in providing quality training for educators and volunteers (P21, 2015). A focus should be placed on creating innovative communities where educators and volunteers can learn from each other, possibly through lesson study or communities of practice guidelines. Skills and tools to aid educators in integrating 21st century skills into pedagogical practices can also be shared and developed (P21, 2015, Schmitt-McQuitty, 2014). Utilizing blended communication avenues can also be helpful in promoting training that addresses educator and volunteer needs and should be utilized by Oklahoma 4-H. Vines et al. (2018) reported Extension educators preferred face-to-face training for hands-on activities, but for time sake, preferred virtual avenues if a hands-on component was not present. A panelist on the volunteer panel stated, “We shouldn’t have to travel for the training, since the option to log on to the internet and be trained in our homes [exists].”

Recommendations for Future Research

The investigator recommends further research be conducted to examine the STEM training needs of both educators and volunteers within Oklahoma 4-H. This research should evaluate current practices and address preferred methods of adult education. Research should also be done on effective evaluation techniques to demonstrate impact with a statewide Extension system. To address youth motivators towards STEM education, research should be conducted to determine preferred subjects and methods of dissemination. Additionally, further research should be done on STEM curriculum challenges of Oklahoma 4-H volunteers. The volunteer panel of the current study did not result in a reliable sample size. However, the qualitative comments provided by this panel were rich in information and ideas for future practice. These ideas need to be examined further to determine if pursuit of policy change is wise.

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APPENDICES

APPENDIX A

INSTITUTIONAL REVIEW BOARD APPROVAL

Oklahoma State University Institutional Review Board

Date:	Friday, August 4, 2017
IRB Application No	AG1739
Proposal Title:	STEM Curriculum Challenges within Oklahoma 4-H: A Delphi Study
Reviewed and Processed as:	Exempt

Status Recommended by Reviewer(s): Approved Protocol Expires: 8/3/2020

Principal Investigator(s):

Hannah Branscum	Jeff Sallee
	205 4H Youth Development
Stillwater, OK 74078	Stillwater, OK 74078

The IRB application referenced above has been approved. It is the judgment of the reviewers that the rights and welfare of individuals who may be asked to participate in this study will be respected, and that the research will be conducted in a manner consistent with the IRB requirements as outlined in section 45 CFR 46.

☐ The final versions of any printed recruitment, consent and assent documents bearing the IRB approval stamp are attached to this letter. These are the versions that must be used during the study.

As Principal Investigator, it is your responsibility to do the following:

1. Conduct this study exactly as it has been approved. Any modifications to the research protocol must be submitted with the appropriate signatures for IRB approval. Protocol modifications requiring approval may include changes to the title, PI advisor, funding status or sponsor, subject population composition or size, recruitment, inclusion/exclusion criteria, research site, research procedures and consent/assent process or forms.
2. Submit a request for continuation if the study extends beyond the approval period. This continuation must receive IRB review and approval before the research can continue.
3. Report any adverse events to the IRB Chair promptly. Adverse events are those which are unanticipated and impact the subjects during the course of the research; and
4. Notify the IRB office in writing when your research project is complete.

Please note that approved protocols are subject to monitoring by the IRB and that the IRB office has the authority to inspect research records associated with this protocol at any time. If you have questions about the IRB procedures or need any assistance from the Board, please contact Dawnett Watkins 219 Scott Hall (phone: 405-744-5700, dawnett.watkins@okstate.edu).

Sincerely,

Hugh Crethar, Chair
Institutional Review Board

APPENDIX B

INSITUTIONAL REVIEW BOARD MODIFICATION – ROUND TWO

Oklahoma State University Institutional Review Board

Date:	Wednesday, November 29, 2017 **Protocol Expires: 8/3/2020**
IRB Application No:	AG1739
Proposal Title:	STEM Curriculum Challenges within Oklahoma 4-H: A Delphi Study
Reviewed and Processed as:	Exempt **Modification**

Status Recommended by Reviewer(s) **Approved**

Principal Investigator(s):

Hannah Branscum	Jeff Sallee
	205 4H Youth Development
Stillwater, OK 74078	Stillwater, OK 74078

The requested modification to this IRB protocol has been approved. Please note that the original expiration date of the protocol has not changed. The IRB office MUST be notified in writing when a project is complete. All approved projects are subject to monitoring by the IRB.

☐ The final versions of any printed recruitment, consent and assent documents bearing the IRB approval stamp are attached to this letter. These are the versions that must be used during the study.

The reviewer(s) had these comments:

add round 2

Signature :

Hugh Crethar, Chair, Institutional Review Board

Wednesday, November 29, 2017
Date

APPENDIX C

INSITUTIONAL REVIEW BOARD MODIFICATION – ROUND THREE

Oklahoma State University Institutional Review Board

Date:	Wednesday, December 20, 2017 **Protocol Expires: 8/3/2020**
IRB Application No:	AG1739
Proposal Title:	STEM Curriculum Challenges within Oklahoma 4-H: A Delphi Study
Reviewed and Processed as:	Exempt **Modification**

Status Recommended by Reviewer(s) **Approved**

Principal Investigator(s):

Hannah Branscum	Jeff Sallee 205 4H Youth Development
Stillwater, OK 74078	Stillwater, OK 74078

The requested modification to this IRB protocol has been approved. Please note that the original expiration date of the protocol has not changed. The IRB office MUST be notified in writing when a project is complete. All approved projects are subject to monitoring by the IRB.

☐ The final versions of any printed recruitment, consent and assent documents bearing the IRB approval stamp are attached to this letter. These are the versions that must be used during the study.

The reviewer(s) had these comments:

The following modifications are approved:
1. Addition of Round 3 Delphi Questionnaire
2. Approval of Round 3 Recruitment Process
3. Approval of Round 3 Participant Information Form

Signature :

Hugh Crethar, Chair, Institutional Review Board

Wednesday, December 20, 2017
Date

APPENDIX D

INSTITUTIONAL REVIEW BOARD MODIFICATION- ADDITIONAL EMAIL

Oklahoma State University Institutional Review Board

Date:	Tuesday, December 12, 2017	**Protocol Expires:**	**8/3/2020**
IRB Application No:	AG1739		
Proposal Title:	STEM Curriculum Challenges within Oklahoma 4-H: A Delphi Study		
Reviewed and Processed as:	Exempt **Modification**		

Status Recommended by Reviewer(s) **Approved**

Principal Investigator(s):

Hannah Branscum
Stillwater, OK 74078

Jeff Sallee
205 4H Youth Development
Stillwater, OK 74078

The requested modification to this IRB protocol has been approved. Please note that the original expiration date of the protocol has not changed. The IRB office MUST be notified in writing when a project is complete. All approved projects are subject to monitoring by the IRB.

☐ The final versions of any printed recruitment, consent and assent documents bearing the IRB approval stamp are attached to this letter. These are the versions that must be used during the study.

The reviewer(s) had these comments:

mod to send a third email reminder

Signature :

Hugh Crethar, Chair, Institutional Review Board

Tuesday, December 12, 2017
Date

APPENDIX E

ROUND ONE EMAIL SCRIPTS

First email to Educator panel:

Hello (insert name),

My name is Hannah Branscum and I am a graduate student at Oklahoma State University. I am currently conducting a research study to determine the challenges faced by Oklahoma Cooperative Extension Educators when teaching science, technology, engineering, and mathematics (STEM) curriculum to 4-H youth.

For this study I am putting together a panel of experts in the area of 4-H Youth Development. Based on your experience and success in leading 4-H youth, you have been nominated, by your District Program Specialist, as an excellent candidate for this panel. I would appreciate if you would participate in my study and serve on the panel of Extension Educator experts from around the state. Your opinion is extremely important.

The study will take place over a six to eight week period. You will be asked to fill out three online questionnaires that should take no longer than 10 minutes each to complete. Please see the attached participant information sheet for more information regarding the study.

By serving on the panel of experts you will be helping the Oklahoma State 4-H Youth Development office identify the challenges faced when teaching STEM curriculums. We can then address these challenges and provide more efficient and valuable training in the future.

If you wish to participate, please follow the link below to the first questionnaire. If you chose to decline then you may close this email at any time.

Questionnaire LINK HERE:

Thank you for your consideration,

Hannah Branscum

First email to Volunteer panel:

Hello (insert name),

My name is Hannah Branscum and I am a graduate student at Oklahoma State University. I am currently conducting a research study to determine the challenges faced by Oklahoma 4-H Volunteers when teaching science, technology, engineering, and mathematics (STEM) curriculum to 4-H youth.

For this study I am putting together a panel of experts in the area of 4-H Youth Development. Based on your experience and success as a 4-H volunteer, as well as, your service on the Oklahoma 4-H Volunteer Board you have been selected as an excellent candidate for this panel. I would appreciate if you would participate in my study and serve on the panel of 4-H volunteer experts from around the state.

The study will take place over a six to eight week period. You will be asked to fill out three online questionnaires that should take no longer than 10 minutes each to complete. Please see the attached participant information sheet for more information regarding the study.

By serving on the panel of experts you will be helping the Oklahoma State 4-H Youth Development Office identify the challenges faced when teaching STEM curriculums. We can then address these challenges and provide more efficient and valuable training in the future.

If you wish to participate, please follow the link below to the first questionnaire. If you chose to decline then you may close this email at any time.

Questionnaire LINK HERE:

Thank you for your consideration,

Hannah Branscum

First follow-up email for both panels during round one:

Hello,

An email was recently sent seeking your participation in a research study focused on the challenges of teaching science, technology, engineering, and math (STEM) curriculum to 4-H youth in Oklahoma. I have yet to see a response from you and was hoping that you would be willing to participate. Your input is valuable and would be greatly appreciated.

If you wish to participate, please follow the link below to the first questionnaire. If you chose to decline then you may close this email at any time.

Questionnaire LINK HERE:

Thank you,

Hannah Branscum

Second follow-up email for both panels during round one:

Hello,

Your input is still sought for a research study regarding the challenges of teaching science, technology, engineering, and mathematics (STEM) curriculum to 4-H youth in Oklahoma. The opportunity to participate is closing on {insert date here}. With your expertise in Oklahoma 4-H, we would truly appreciate your insight on this matter.

If you wish to participate, please follow the link below to the first questionnaire. If you chose to decline then you may close this email at any time.

Questionnaire LINK HERE:

Thank you again,

Hannah Branscum

APPENDIX F

IRB APPROVED- PARTICIPANT INFORMATION SHEET

PARTICIPANT INFORMATION

Title: STEM Curriculum Challenges within Oklahoma 4-H: A Delphi Study

Investigator: Hannah Branscum, Graduate Student, Oklahoma 4-H Youth Development

Purpose: The purpose of this study is to determine the challenges faced by tenured 4-H volunteers and Cooperative Extension Educators when teaching STEM curriculum to 4-H youth in Oklahoma.

Procedures: Participants are asked to complete three short online questionnaires over a period of six to eight weeks. The first questionnaire will ask for demographic information and for you to list the challenges that you face when teaching STEM curriculum to 4-H youth. The second and third questionnaires will ask you to rate your agreement with STEM curriculum challenge statements that were generated in round one. Each questionnaire should take no longer than 15 minutes to complete.

Risks and Benefits: There are no risks associated with this project which are expected to be greater than those ordinarily encountered in daily life. There are also no expected personal benefits associated with this study. However, your participation will help the Oklahoma 4-H program identify challenges faced by educators and volunteers when teaching STEM curriculum. We can then address these challenges to provide more effective training and to ensure stronger 4-H science programming for Oklahoma 4-H youth in the future.

Confidentiality: All personal information will be kept confidential and will not be released. Necessary information will be stored, in a secure file on a password protected computer, in the Oklahoma 4-H Youth Development office and only the researcher and those responsible for research oversight will have access to any collected information. Results from the study may be shared in written word or presented at professional meetings but will not include any information that will identify you individually. Data will be destroyed two years after the completion date of the study.

Contacts: You may contact any of the researchers at the following addresses and phone numbers, should you desire to discuss your participation in the study and/or request information about the results of the study: Hannah Branscum, 205 4-H Youth Development Bldg., Stillwater, OK 74078, 405-744-4141; Jeff Sallee, 205 4-H Youth Development Building., Stillwater, OK 74078, 405-744-8885. If you have questions about your rights as a research volunteer, you may contact the IRB Office at 223 Scott Hall, Stillwater, OK 74078, 405-744-3377 or irb@okstate.edu

Voluntary Participation: Your participation in this research is voluntary. There is no penalty for refusing to participate. You are free to skip any questions or withdraw your consent and participation in the study, at any time, without explanation.

By following the survey link and/or entering your email address in the box below, you are consenting to participate in this study. If you decide not to participate, please close your browser.

APPENDIX G

ROUND ONE QUESTIONNAIRES

Round One Questionnaire- Educator Panel

Default Question Block

PARTICIPANT INFORMATION

Title: STEM Curriculum Challenges within Oklahoma 4-H: A Delphi Study

Investigator: Hannah Branscum, Graduate Student, Oklahoma 4-H Youth Development

Purpose: The purpose of this study is to determine the challenges faced by tenured 4-H volunteers and Cooperative Extension Educators when teaching STEM curriculum to 4-H youth in Oklahoma.

Procedures: Participants are asked to complete three short online questionnaires over a period of six to eight weeks. The first questionnaire will ask for demographic information and for you to list the challenges that you face when teaching STEM curriculum to 4-H youth. The second and third questionnaires will ask you to rate your agreement with STEM curriculum challenge statements that were generated in round one. Each questionnaire should take no longer than 15 minutes to complete.

Risks and Benefits: There are no risks associated with this project which are expected to be greater than those ordinarily encountered in daily life. There are also no expected personal benefits associated with this study. However, your participation will help the Oklahoma 4-H program identify challenges faced by educators and volunteers when teaching STEM curriculum. We can then address these challenges to provide more effective training and to ensure stronger 4-H science programming for Oklahoma 4-H youth in the future.

Confidentiality: All personal information will be kept confidential and will not be released. Necessary information will be stored, in a secure file on a password protected computer, in the Oklahoma 4-H Youth Development office and only the researcher and those responsible for research oversight will have access to any collected information. Results from the study may be shared in written word or presented at professional meetings but will not include any information that will identify you individually. Data will be destroyed two years after the completion date of the study.

Contacts: You may contact any of the researchers at the following addresses and phone numbers, should you desire to discuss your participation in the study and/or request information about the results of the study: Hannah

Branscum, 205 4-H Youth Development Bldg., Stillwater, OK 74078, 405-744-4141; Jeff Sallee, 205 4-H Youth Development Building., Stillwater, OK 74078, 405-744-8885. If you have questions about your rights as a research volunteer, you may contact the IRB Office at 223 Scott Hall, Stillwater, OK 74078, 405-744-3377 or irb@okstate.edu

-

Voluntary Participation: Your participation in this research is voluntary. There is no penalty for refusing to participate. You are free to skip any questions or withdraw your consent and participation in the study, at any time, without explanation.

-

By entering your email address in the box below, you are consenting to participate in this study. If you decide not to participate, please close your browser.

Email address:

4-H District you are associated with:

How many years have you served as an Extension Educator?

Gender:

- Female
- Male

Age:

Race/Ethnicity:

- ○ African American
- ○ Asian
- ○ Caucasian
- ○ Hispanic/Latino/Chicano
- ○ Native American
- ○ Other: ______

Please select the highest educational degree that you have earned:

- ○ GED
- ○ High-school diploma
- ○ Associate's degree
- ○ Bachelor's degree
- ○ Master's degree
- ○ Doctoral degree
- ○ Other: ______

Have you received any formal or informal training in science? Please check all that apply:

- ☐ I received a degree or certification in a science-related field. Please list: ______
- ☐ I have attended science workshops/science training. Please list estimated number of workshops attended in the last five years: ______
- ☐ I have no training
- ☐ Other: ______

Please consider the following definitions and then answer the subsequent question:

Challenge: a task or situation that tests someone's abilities

STEM: "STEM stands for science, technology, engineering, and mathematics- the four core disciplines crticial to the development of America's technological innovations today and in the future" (Tsupros & Kohler, 2008).

What challenges do you face when teaching STEM curriculum? (Please be thorough in your responses).

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Round One Questionnaire- Volunteer Panel

Default Question Block

PARTICIPANT INFORMATION

Title: STEM Curriculum Challenges within Oklahoma 4-H: A Delphi Study

Investigator: Hannah Branscum, Graduate Student, Oklahoma 4-H Youth Development

Purpose: The purpose of this study is to determine the challenges faced by tenured 4-H volunteers and Cooperative Extension Educators when teaching STEM curriculum to 4-H youth in Oklahoma.

Procedures: Participants are asked to complete three short online questionnaires over a period of six to eight weeks. The first questionnaire will ask for demographic information and for you to list the challenges that you face when teaching STEM curriculum to 4-H youth. The second and third questionnaires will ask you to rate your agreement with STEM curriculum challenge statements that were generated in round one. Each questionnaire should take no longer than 15 minutes to complete.

Risks and Benefits: There are no risks associated with this project which are expected to be greater than those ordinarily encountered in daily life. There are also no expected personal benefits associated with this study. However, your participation will help the Oklahoma 4-H program identify challenges faced by educators and volunteers when teaching STEM curriculum. We can then address these challenges to provide more effective training and to ensure stronger 4-H science programming for Oklahoma 4-H youth in the future.

Confidentiality: All personal information will be kept confidential and will not be released. Necessary information will be stored, in a secure file on a password protected computer, in the Oklahoma 4-H Youth Development office and only the researcher and those responsible for research oversight will have access to any collected information. Results from the study may be shared in written word or presented at professional meetings but will not include any information that will identify you individually. Data will be destroyed two years after the completion date of the study.

Contacts: You may contact any of the researchers at the following addresses and phone numbers, should you desire to discuss your participation in the study and/or request information about the results of the study: Hannah

Branscum, 205 4-H Youth Development Bldg., Stillwater, OK 74078, 405-744-4141; Jeff Sallee, 205 4-H Youth Development Building., Stillwater, OK 74078, 405-744-8885. If you have questions about your rights as a research volunteer, you may contact the IRB Office at 223 Scott Hall, Stillwater, OK 74078, 405-744-3377 or irb@okstate.edu

-

Voluntary Participation: Your participation in this research is voluntary. There is no penalty for refusing to participate. You are free to skip any questions or withdraw your consent and participation in the study, at any time, without explanation.

-

By entering your email address in the box below, you are consenting to participate in this study. If you decide not to participate, please close your browser.

Email Address:

4-H District you are associated with:

How many years have you served as a 4-H volunteer?

Gender:

- Female
- Male

Age:

Race/Ethnicity:

- ○ African American
- ○ Asian
- ○ Caucasian
- ○ Hispanic/Latino/Chicano
- ○ Native American
- ○ Other

Please select the highest educational degree that you have earned:

- ○ GED
- ○ High-school diploma
- ○ Associate's degree
- ○ Bachelor's degree
- ○ Master's degree
- ○ Doctoral degree
- ○ Other:

Have you received any formal or informal training in science? Please check all that apply:

- ☐ I have received a degree or certification in a science-related field. Please list:
- ☐ I have attended science workshops/science training. Please list estimated number of workshops attended in the last five years:
- ☐ I have no training
- ☐ Other:

Please consider the following definitions and then answer the subsequent question:

Challenge: a task or situation that tests someone's abilities

STEM: "STEM stands for science, technology, engineering, and mathematics- the four core disciplines critical to the development of America's technological innovations today and in the future." (Tsupros & Kohler, 2008).

What challenges do you face when teaching STEM curriculum? (Please be thorough in your responses).

APPENDIX H

ROUND TWO EMAIL SCRIPTS

Emails to Participants in Round Two

First email to both Educator and Volunteer panels – Round Two

Hello,

Thank you so much for participating in the first round of the STEM Curriculum Challenges within Oklahoma 4-H study! Your feedback was greatly appreciated.

Analysis of the panel feedback resulted in 14 challenge statements that have been compiled into the round two questionnaire of the study. In this round, you will rank your level of agreement with each of the challenge statements. Again, your input is extremely important as we attempt to reach consensus on challenges that you face when teaching STEM curriculum.

If you wish to participate, please follow the link below to the second questionnaire. If you chose to decline then you may close this email at any time.

QUESTIONAIRE LINK HERE:

Thank you,

Hannah Branscum

First follow-up email for both panels during round two:

Hello,

An email was recently sent seeking your participation in a research study focused on the challenges of teaching science, technology, engineering, and math (STEM) curriculum to 4-H youth in Oklahoma. I have yet to see a response from you and was hoping that you would be willing to participate in Round Two. Your input is valuable and would be greatly appreciated.

If you wish to participate, please follow the link below to the first questionnaire. If you chose to decline then you may close this email at any time.

Questionnaire LINK HERE:

Thank you,

Hannah Branscum

Second follow-up email for both panels during round two:

Hello,

Your input is still sought for a research study regarding the challenges of teaching science, technology, engineering, and mathematics (STEM) curriculum to 4-H youth in Oklahoma. The opportunity to participate is closing on (insert date here). With your expertise in Oklahoma 4-H, we would truly appreciate your insight on this matter.

If you wish to participate, please follow the link below to the first questionnaire. If you choose to decline then you may close this email at any time.

Questionnaire LINK HERE:

Thank you again,

Hannah Branscum

3rd Reminder Email to Both Panels – Round Two

Good Morning,

I wanted to take a minute of your time and, again, ask for your participation in Round Two of the STEM Curriculum Challenges within Oklahoma 4-H research study.

Input from Round One was greatly appreciated and has been compiled in to a quick second questionnaire. This round will take approximately five minutes to complete. Your insight is valuable and your participation will help Oklahoma 4-H strengthen their science programming.

If you wish to participate, please follow the link below to the questionnaire. If you choose to decline then you may close this email at any time.

Questionnaire LINK HERE:

Thank you again for your consideration,

IRB Office
Approved: 12-12-17
Expires: 08-03-20
IRB#: AG-17-39

APPENDIX I

ROUND TWO QUESTIONNAIRES

Round Two Questionnaire- Educator Panel

Default Question Block

Thank you for your participation in Round One of the STEM Curriculum Challenges within Oklahoma 4-H study!

In Round One you were asked to list the challenges that you face when teaching STEM curriculum to 4-H youth. Based on this feedback the researcher performed a thematic analysis and 14 challenge statements were derived for the second round of the study. The feedback from the first round and the thematic analysis are available for you to view at the links below.

For Round Two, please read the statements and rank your level of agreement with each of the perceived STEM curriculum challenges with Oklahoma 4-H. Feel free to enter comments, details, or clarification related to your thoughts on each challenge in the space provided below the statement.

If you have any questions regarding this study please contact the researcher at: hannah.branscum@okstate.edu.

Thank you!

Educator Panel Feedback- Round One

Educator Panel- Thematic Analysis

Please enter your email address:

	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
Funding for supplies/equipment	O	O	O	O	O	O

Please enter any comments you have regarding the previous statement:

	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
Accessing resources/supplies	O	O	O	O	O	O

Please enter any comments you have regarding the previous statement:

	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
	O	O	O	O	O	O

	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
Feeling adequately trained						

Please enter any comments you have regarding the previous statement:

	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
Lacking time in schedule for STEM education	O	O	O	O	O	O

Please enter any comments you have regarding the previous statement:

	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
Lacking confidence in subject matter	O	O	O	O	O	O

Please enter any comments you have regarding the previous statement:

	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
Lacking knowledge of subject matter	O	O	O	O	O	O

Please enter any comments you have regarding the previous statement:

	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
Making STEM curriculum applicable to youth	O	O	O	O	O	O

Please enter any comments you have regarding the previous statement:

	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
Making STEM curriculum engaging to youth	O	O	O	O	O	O

Please enter any comments you have regarding the previous statement:

	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
Making STEM curriculum appropriate for wide age ranges	O	O	O	O	O	O

Please enter any comments you have regarding the previous statement:

	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
Establishing an interested youth audience	O	O	O	O	O	O

Please enter any comments you have regarding the previous statement:

	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
Youth associating the name STEM with subject difficulty	O	O	O	O	O	O

Please enter any comments you have regarding the previous statement:

	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
Competing with other activities for youths' time	O	O	O	O	O	O

Please enter any comments you have regarding the previous statement:

	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
Communicating with school teachers	O	O	O	O	O	O

Please enter any comments you have regarding the previous statement:

	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
Enabling volunteers to use STEM curriculum at a club level	O	O	O	O	O	O

Please enter any comments you have regarding the previous statement:

Please provide any other comments, thoughts, or suggestions related to this study below:

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Round Two Questionnaire- Volunteer Panel

Default Question Block

Thank you for your participation in Round One of the STEM Curriculum Challenges within Oklahoma 4-H study!

In Round One you were asked to list the challenges that you face when teaching STEM curriculum to 4-H youth. Based on this feedback the researcher performed a thematic analysis and 14 challenge statements were derived for the second round of the study. The feedback from the first round and the thematic analysis are available for you to view at the links below.

For Round Two, please read the statements and rank your level of agreement with each of the perceived STEM curriculum challenges with Oklahoma 4-H. Feel free to enter comments, details, or clarification related to your thoughts on each challenge in the space provided below the statement.

If you have any questions regarding this study please contact the researcher at: hannah.branscum@okstate.edu.

Thank you!

Volunteer Panel Feedback- Round One

Volunteer Panel- Thematic Analysis

Please enter your email address:

	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
Funding for supplies/equipment	O	O	O	O	O	O

Please enter any comments you have regarding the previous statement:

	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
Accessing resources/supplies/equipment	O	O	O	O	O	O

Please enter any comments you have regarding the previous statement:

	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
	O	O	O	O	O	O

	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
Lacking time in schedule for STEM education						

Please enter any comments you have regarding the previous statement:

	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
Lacking confidence in STEM subject matter	O	O	O	O	O	O

Please enter any comments you have regarding the previous statement:

	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
Lacking knowledge of available curriculum	O	O	O	O	O	O

Please enter any comments you have regarding the previous statement:

	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
Lacking parental support	O	O	O	O	O	O

Please enter any comments you have regarding the previous statement:

	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
Making STEM curriculum appropriate for wide age ranges	O	O	O	O	O	O

Please enter any comments you have regarding the previous statement:

	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
Establishing an interested youth audience	O	O	O	O	O	O

Please enter any comments you have regarding the previous statement:

	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
Competing with other activities for youths' time	O	O	O	O	O	O

Please enter any comments you have regarding the previous statement:

	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
Associating the name STEM with subject difficulty	O	O	O	O	O	O

Please enter any comments you have regarding the previous statement:

	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
Curriculum design is too structured	O	O	O	O	O	O

Please enter any comments you have regarding the previous statement:

	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
Receiving help from parents/community members	O	O	O	O	O	O

Please enter any comments you have regarding the previous statement:

	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
Rural location limiting access to training	O	O	O	O	O	O

Please enter any comments you have regarding the previous statement:

	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
Youth prefer quick experiments	O	O	O	O	O	O

Please enter any comments you have regarding the previous statement:

APPENDIX J

ROUND THREE EMAIL SCRIPTS

First email to both Educator and Volunteer panels – Round Three

Good Morning,

Thank you for your input in the second round of the STEM Curriculum Challenges within Oklahoma 4-H study! Your response was greatly appreciated.

This email is sent to request your participation in the third and final round of the study. In the third round you will find challenge statements that did not reach a consensus ranking (75% agreement or above) in the second round, but did reach an agreement percentage between 51% and 74%. Challenge statements that were within this range are being sent back to you for one final look.

Please spend less than five minutes of your time and help Oklahoma 4-H discover the challenges that you are facing when teaching STEM curriculum!

If you wish to participate, please follow the link below to the third questionnaire. If you chose to decline then you may close this email at any time.

Questionnaire Link Here:

Thank you,

Hannah Branscum

IRB Office
Approved: 12-20-17
Expires: 8-3-20
IRB#: AG-17-39

First follow-up email for both panels- Round Three:

Hello,

You recently received an email requesting your participation in Round Three of the STEM Curriculum Challenges within Oklahoma 4-H study. I have yet to see a response from you and was hoping that you would be willing to participate. The questionnaire will take less than five minutes of your time and your input would be greatly appreciated!

Questionnaire Link Here:

Thank you for your consideration,

Hannah Branscum

Second follow-up email to both panels- Round Three

Good Morning,

Your input is still sought for the STEM Curriculum Challenges within Oklahoma 4-H study.

Please spend less than five minutes of your time to help Oklahoma 4-H discover the challenges that you are facing when teaching STEM curriculum! The opportunity to participate is closing on (insert date here). With your expertise in Oklahoma 4-H, we would truly appreciate your insight on this matter.

Please follow the below link if you wish to participate.

Questionnaire Link Here:

Thank you,

Hannah Branscum

APPENDIX K

ROUND THREE QUESTIONNAIRES

Round Three Questionnaire- Educator Panel

Default Question Block

Thank you for your participation in Round Two of the STEM Curriculum Challenges within Oklahoma 4-H study!

In Round Two you were asked to read challenge statements and rank your level of agreement with each. You may view the feedback from Round Two in the attachment labeled: Educator Feedback- Round Two. The percentage of agreement was calculated and those statements that received 75% or more agreement were considered to have met consensus. Challenges that received 50% agreement or below were excluded from further study. The challenges that fell between 51% and 74% agreement are being sent to you in Round Three. There are a total of six challenge statements for you to review.

Please consider these six perceived challenges and rank your level of agreement with each one more time. Feel free to enter comments, details, or clarification related to your thoughts on each challenge in the space provided below the statement.

If you have any questions regarding this study please contact the researcher at: hannah.branscum@okstate.edu.

Thank you!

Educator Feedback- Round Two

Please enter your email address:

	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
Funding for supplies/equipment	O	O	O	O	O	O

Please enter any comments you have regarding the previous statement:

	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
Accessing resources/supplies	O	O	O	O	O	O

Please enter any comments you have regarding the previous statement:

	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
Making STEM curriculum appropriate for wide age ranges	O	O	O	O	O	O

Please enter any comments you have regarding the previous statement:

	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
Youth associating the name STEM with subject difficulty	O	O	O	O	O	O

Please enter any comments you have regarding the previous statement:

	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
Communicating with school teachers	O	O	O	O	O	O

Please enter any comments you have regarding the previous statement:

	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
Enabling volunteers to use STEM curriculum at a club level	O	O	O	O	O	O

Please enter any comments you have regarding the previous statement:

Please provide any other comments, thoughts, or suggestions related to this study below:

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Round Three Questionnaire- Volunteer Panel

Default Question Block

Thank you for your participation in Round Two of the STEM Curriculum Challenges within Oklahoma 4-H study!

In Round Two you were asked to read challenge statements and rank your level of agreement with each. You may view the feedback from Round Two in the attachment labeled: Volunteer Feedback- Round Two. The percentage of agreement was calculated and those statements that received 75% or more agreement were considered to have met consensus. Challenges that received 50% agreement or below were excluded from further study. The challenges that fell between 51% and 74% agreement are being sent to you in Round Three. There are a total of three challenge statements for you to review.

Please consider these three perceived challenges and rank your level of agreement with each one more time. Feel free to enter comments, details, or clarification related to your thoughts on each challenge in the space provided below the statement.

If you have any questions regarding this study please contact the researcher at: hannah.branscum@okstate.edu.

Thank you!

Volunteer Feedback- Round Two

Please enter your email address:

	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
Accessing resources/supplies/equipment	O	O	O	O	O	O

Please enter any comments you have regarding the previous statement:

	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
Lacking parental support	O	O	O	O	O	O

Please enter any comments you have regarding the previous statement:

	Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
Youth prefer quick experiments	O	O	O	O	O	O

Please enter any comments you have regarding the previous statement:

Please provide any other comments, thoughts, or suggestions related to this study below:

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VITA

Hannah Branscum

Candidate for the Degree of

Master of Science

Thesis: STEM CURRICULUM CHALLENGES WITHIN OKLAHOMA 4-H: A DELPHI STUDY

Major Field: Agricultural Education

Biographical:

Education:

Completed the requirements for the Master of Science in your Agricultural Education at Oklahoma State University, Stillwater, Oklahoma in December, May, 2018

Completed the requirements for the Bachelor of Science in Agricultural Business at Arkansas Tech University, Russellville, Arkansas in 2013.

Experience:

4-H STEM Coordinator for Oklahoma 4-H Youth Development
September 2017- Present

Graduate Assistant for Oklahoma 4-H Youth Development
August 2015-August 2017

Real Estate Management Specialist for Commissioners of the Land Office
July 2013- June 2015