What Components of a Curriculum Lead to Authentic Service-learning by Youth?

By

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ABSTRACT

Utilizing a sequential explanatory mixed methods study design, this investigation assessed whether knowledge and skills acquired through the use of an experientially-based 4-H science curriculum that included a service-learning component helped participating 4-H youth develop the information, means, and opportunities to implement an authentic service-learning project related to the curriculum's subject matter of predation and depredation. The study drew upon quantitative and qualitative data from outcome testing with participating 4-H youth from a county in Northern California. Results from pre-/post-surveys, retrospective surveys, a focus group, and individual and pair interviews showed an increase in 4-H participants' content knowledge and skills, and in their ability to apply learned material to authentic contexts. This was evident in real-world contexts through improved animal husbandry methods on their home premises, an informational video they developed as part of a service-learning project, and the demonstration of their knowledge by sharing the video with the broader community. In addition, participants provided specific feedback on the constructivist-based curriculum activities that aided most in their content knowledge acquisition and the service-learning project. This study can serve as a model for the intentional incorporation of constructivist-based methods and service-learning in future 4-H curricula. It also contributes to service-learning research, particularly in non-formal settings with youth audiences, which has been limited.

CHAPTER 1: INTRODUCTION

The application of learned materials in real-world contexts is the primary purpose of education (Dewey, 1938). This is an aim of the 4-H Youth Development Program, one of the largest nonformal positive youth development (PYD) organizations in the United States (National 4-H Council Annual Report, 2017). The 4-H Program emphasizes "learning-by-doing" through the use of inquiry-based curricula and programming to promote PYD, apply the knowledge and skills that relate to learners' individual contexts, and increase scientific literacy to help youth make positive contributions to their communities (Campbell, Trzesniewski, Nathaniel, Enfield, & Erbstein, 2013; Smith, Worker, Ambrose & Schmitt-McQuitty, 2015). One strategy to help youth apply learned materials to authentic contexts is service-learning.

Service learning is an experiential process that involves youth in the development and application of knowledge and skills through a thoughtful, organized, and active approach to address community needs (Billig, 2000; Furco, 2013; Smith, 1997). Service-learning offers youth the opportunity to apply their learning directly to their communities (Berger-Kaye, 2010; Dolgon, Mitchell & Eatman, 2017; Fox & LaChenaye, 2016; Smith, 1997). There are four main approaches to service-learning – direct service, indirect service, advocacy and research, or sometimes combinations of these (Lake, Jones & Kaye, 2011). Furthermore, the type of service and format of a project will vary based on the context and community needs. As explained in Fox and LaChenaye's Emergent Theory of the Role of Context in Service-Learning Practice model, the community, resources, environment, time and other factors need to be considered when designing a service-learning program to make sure it is a good fit for the community (2016).

Regardless of the approach to service-learning, the process is constructivist-based whereby learners construct knowledge through experience. Constructivism is a learning theory based on the understanding that youth are active participants in their own development by constantly establishing and testing new ideas and understandings (Dewey, 1933; Flavell, 1992; Fosnot, 1996; Piaget, 1964). Through interacting with physical and social environments, individuals can cultivate authentic, and meaningful understanding (Nichols, 2002; Smith et al., 2017). This type of active learning is supported by the experiential learning cycle that has three keys steps: concrete experience, reflection and application (Enfield, Schmitt-McQuitty, Smith, 2007). Service-learning can aid and be utilized in each of the experiential learning cycle steps (Smith, 1997).

Advancing scientific literacy among the K-12 youth population in the United States is an important educational and societal goal (National Academy of Sciences, National Academy of Engineering, & Institute of Medicine, 2010; Smith et al., 2015; UC ANR, 2009). Scientific literacy is not only essential for youth to succeed scholastically, but also to participate fully as adults in society and in the growing number of science-related career opportunities (Falk, Randol & Dierking, 2011; Miller, 2012; National Academy of Sciences, National Academy of Engineering, & Institute of Medicine, 2010).

To help advance youth scientific literacy, there are different learning settings where youth science programs can be offered: formal, nonformal, and informal (Bell et al. 2009; Fenichel & Schweingruber 2010; National Research Council, 2009). Formal learning settings are typically school-based environments that have a compulsory curriculum and are teacher led (Eshach, 2007). Nonformal and informal learning occur outside of school time. Rather than a

mandated curriculum, individuals engaged in nonformal or informal education participate in free-choice learning where intrinsic motivation guides their participation (Eshach, 2007; Falk & Derking, 2010). Nonformal learning contexts frequently take place in an organization outside of school that has educators who facilitate projects like an after-school program (Eshach, 2007). By contrast, informal learning settings provide for more self-directed learning that is often unstructured and spontaneous (Eshach, 2007). A museum is an example of an informal learning environment (Falk & Derking, 2010).

The 4-H Youth Development Program offers educational opportunities in a nonformal learning setting to youth aged 5-19. The 4-H Program is administered through land grant universities in every state in the United States, has approximately 6 million youth members and 600,000 volunteer educators in rural, suburban, and urban areas, and also has members worldwide (National 4-H Council Annual Report, 2017). The University of California is the state's land grant university and oversees the administration of and research on 4-H programming in California (Campbell et al., 2013; UC ANR, 2009).

A cornerstone of 4-H programming is PYD. The objective of PYD is to provide motivation and engagement for youth by building on their assets and recognizing their essential roles in their own development and in society (Arnold, 2018; Campbell et al., 2013; Larson, Dubois & Rhodes, 2006). There are numerous PYD frameworks, including the Thrive model, the Search Institute's developmental assets, the six C's, and the four essential elements (Campbell et al., 2013). California 4-H currently utilizes components of The Thrive model for its PYD framework (4-H Framework, 2017; Miner, personal communication, 2017). This framework incorporates organizational, development and educational practices to aid youth in developing the skills and

opportunities to thrive in today's society (4-H Framework, 2017). However, the most current framework in 4-H is the 4-H Thriving Model which has four main factors: developmental context, thriving trajectory, developmental outcomes and long-term outcomes (Arnold, 2018).

Another foundational element of youths' 4-H experience is service, which has grown in prominence in 4-H programming since the late 1980's (Hairston, 2004). In fact, community and civic engagement are included in multiple state and national 4-H initiatives, foci, and core areas (Silliman, 2007; UC ANR, 2009). In California 4-H, the UC Division of Agriculture and Natural Resources' (UC ANR) Strategic Vision 2025 emphasizes the need to develop programs for 4-H youth that include opportunities for community service and service-learning (UC ANR, 2009). Engaging youth and community members in service-learning can help support sustainable changes in communities (Billig, 2002; Dolgon et al.,2017); as such, it would be beneficial if service-learning were incorporated directly into 4-H programming (Fox & LaChenaye, 2016; Smith, 1997).

Nonformal learning settings can be effective science learning environments (Falk & Dierking, 2010), and advancing youth scientific literacy is a priority goal within 4-H in California and nationally (Regents of the University of California, 2009). Nationally, the 4-H Science Mission Mandate, established in 2008, focuses on advancing youth scientific literacy through improved 4-H education programming (Smith et al., 2015). The California 4-H Program emphasizes interest-driven science programming framed around four "Anchor Points": I. science content; II. scientific reasoning skills; III. interest and attitude; and IV. contribution through applied participation (Smith et al., 2015). Specifically, Anchor Point IV, contribution

through applied participation, lends itself to service-learning opportunities with its emphasis on context-relevant youth engagement that targets authentic, community-based issues.

One approach to using service-learning to address community needs is citizen science (Ballard, Dixon & Harris, 2016). The purpose of citizen science is to help individuals contribute to society and solve every day problems by offering authentic opportunities to understand and practice science (Ballard et al., 2016; Meyer et al., 2014; Rudolph & Horibe, 2016). Community science experts (CSEs) can be viewed as citizen scientists. Community Science Experts are individuals who are committed to making an impact in their communities through sharing and applying scientific knowledge (Barton, Birmingham, Sato, Tan & Barton, 2013). 4-H curricula can provide opportunities for youth to become citizen scientists and CSEs.

4-H programs are encouraged to use peer-reviewed, published curriculum materials in their projects and programs. However, there is no one universal definition of curriculum (Smith et al., 2017). This absence of concurrence can lead to confusion and lack of uniformity in curriculum development and 4-H programming. Based on an extensive review of the literature, Smith et al. (2017) developed a definition of curriculum that emphasizes not only sequential learning of concepts over time (vertical organization), but also the connection of those concepts to real-world issues (horizontal organization) (Tyler, 1949, 1977). The adoption of this definition of curriculum across topic areas in 4-H could help improve program development, implementation, and assessments (Smith et al., 2017). Furthermore, with the focus of scientific literacy Anchor Point IV on the application of youths' knowledge and skills to real-world issues, service-learning opportunities could be included as an integral part of a curriculum (Smith, Worker, Ambrose & Schmitt-McQuitty, 2015).

The 4-H curriculum developed and used for this study is entitled *At the Interface between Livestock and Predators: Reducing Depredation through Livestock Husbandry* (Cheung et al. under review). It is currently under peer review for publication through National 4-H Council. This curriculum was developed to address a defined need among 4-H youth participants throughout California who have had issues with predators interfering with their Animal Science projects (Quinn & Vickers, personal communication, 2016; Zediker, personal communication, 2018). Approximately 54,000 4-H youth in California participated in livestock and small animal projects during the 2017-18 program year (Lewis, 2018) revealing the potential widespread nature of the issue. Beyond 4-H, the interface between wild and domesticated animals, predator depredation, and the removal of wild or feral carnivores that pose a threat to livestock or poultry is also a defined community issue (Larson & Salmon, 1988; Larson, McGranahan & Timm, 2016; Morehouse, Tigner & Boyce, 2018).

At the Interface between Livestock and Predators: Reducing Depredation through Livestock Husbandry was developed using a backward design approach, a curriculum development strategy that follows the sequence of identifying learning objectives, determining acceptable evidence of understanding, and planning an activity (Wiggins & McTighe, 2006). There are five modules in the curriculum: *Biomes and Habitats*; *Food Web*; *Predator Identification*; *Mitigation and Risk Assessment*; and *Service-learning and Application*. The activities within each module use guided inquiry strategies embedded in the experiential learning cycle (Marek, 2008). The overarching goal of the curriculum is that youth participants will develop knowledge and skills through experiences and apply what they learn to their communities to address predator depredation issues. Additionally, they will work to encourage

others to become educated and engaged to help make sustainable changes to their communities to mitigate predation risks and decrease depredation. (Smith, Quinn, & Vickers, personal communication, 2016).

Effective curricula are foundational elements of educational programming in Cooperative Extension, including 4-H (Smith et al., 2017). Addressing the issue of youth scientific literacy requires the development, testing, and implementation of effective curricula that address the four Anchor Points of scientific literacy (Smith et al., 2015). However, although most curricula published through National 4-H and UC ANR have experientially-based activities that address relevant content and scientific reasoning skills, few include defined service-learning opportunities (Smith et al., personal communication, 2016).

The purpose of this sequential explanatory mixed methods study was to investigate the use of an experientially-based curriculum that included service-learning opportunities for authentic application of learned materials through engagement by 4-H youth (Creswell, 2013). The first phase of this inquiry was quantitative, using survey data to measure changes in subject matter knowledge of 4-H youth in one county-based program. The second phase of this investigation was qualitative, drawing on data from open-ended surveys and interview questions with study participants to assist in the interpretation and explanation of the survey outcomes and the application of material through service-learning.

The overarching research question for this study is: How, if at all, do the content and pedagogy used in a 4-H curriculum contribute to the application of knowledge and authentic service-learning by 4-H youth? Understanding this could not only help address issues as they pertain to the curriculum developed for and used in this investigation, but could also be applied

to other subject matter areas and help lead to enhanced curriculum development in 4-H science.

Specific to this study, the quantitative phase addressed the following question:

- What influence, if any, does the experientially-based curriculum that uses guided inquiry have on participating 4-H youths' content knowledge related to predator depredation?

The subsequent qualitative research question was based on survey outcomes:

- What aspects of the curriculum contributed to youths' service-learning project and application of learned materials beyond the curriculum?

CHAPTER 2: LITERATURE REVIEW

Service-Learning

Defining Service-Learning

Terms like “community service,” “civic engagement,” and “service-learning” are often used interchangeably (Dolgon, Mitchell, & Eatman, 2017); however, each represents a distinct type of community engagement that can be viewed along a spectrum of involvement. The main distinguishing factors among these types of community engagement on the spectrum are reciprocity, which parties (recipients and providers) are considered, and connection to learning (Furco, 1996). Based on these factors, community service is considered to be at the low end of the engagement spectrum, and service-learning and civic engagement are at the higher end of the spectrum (Furco, 1996; Vogelgesang & Astin, 2000).

Vogelgesang and Astin (2000) conducted a study of 22,000 college students across the U.S. to examine if there were any differences between students who participated in different projects along the community engagement spectrum. The students were divided into three groups: service-learning participants, “generic” community service participants, and non-service participants. 29.9% of the students participated in service-learning courses, 46.5% participated in other forms of community service, and 23.6% did not participate in any type of service (Vogelgesang & Astin, 2000). The study found that students who had engaged in service-learning were more likely to volunteer in the future. Factors like volunteering in high school, being a woman, having commitment to community action programs and attending religious services increase students’ likelihood of participating in a service-learning course

(Vogelgesang & Astin, 2000). The study supports the idea that there is differentiation in outcomes between the various types of community engagement.

For the purposes of this research, the term service-learning will be used. Service-learning refers to the idea of connecting service that addresses community needs to learning and reciprocity (Billig, 2000; Dolgon et al., Furco, 1996; 2017; Kielsmeier, 2011; Lake et al., 2011). Although there is no unified definition of service-learning, examples of definitions include:

1. A general definition: "The method under which students learn and develop through active participation in thoughtfully organized service experiences that meet actual community needs, that [are] integrated into the students' academic curriculum or provide structured time for [reflection, and] that enhance what is taught in school by extending student learning beyond the classroom and into the community" (Corporation for National and Community Service, 1990; Furco, 1996, p. 9).
2. A definition that links service-learning specifically to formal education: "…connects a school-based curriculum with the inherent caring and concern young people have for their world" (Berger Kaye, 2010, p. 8).
3. A definition that can be applied to formal, nonformal, and informal education settings: "A form of experiential learning in which youth apply the subject matter they are learning along with critical thinking skills to address genuine community needs" (Smith, 1997, p. 3).

Types of Service-Learning

There are four main types of service-learning: direct, indirect, research and advocacy. Direct service involves face-to-face contact with people, the environment, or animals (Berger Kaye, 2010). Environmental clean-up and tutoring are examples of direct service. With indirect service, an individual does not interact with the recipient(s) of the service, but their action influences the community (Berger Kaye, 2010). Clothing or food drives are examples of indirect service. Research is "finding, gathering, and reporting on information in the public interest" (Berger Kaye, 2010, p. 11). Collecting input from the community about a pertinent issue or policy is a type of research service. Raising awareness and encouraging action are key components of advocacy (Berger Kaye, 2010). Town halls and community presentations are examples of advocacy. None of these types of service are more effective or better than another. In fact, one can engage in more than one type of service at a given time (Berger Kaye, 2010).

Despite the variations in types of service-learning projects, there are some general guidelines and principles. The National Youth Leadership Council (NYLC) has identified the following standards to help implement high-quality service-learning for K-12 youth: meaningful service, link to curriculum, reflection, diversity, youth voice, partnerships, progress monitoring, duration and intensity (Kielsmeier, 2011). In addition, some common steps to service-learning include: investigation, preparation and planning, action, reflection and demonstration (Berger Kaye, 2010). These steps and standards provide direction and clarity for application and evaluation. There is no single, correct way to conduct service-learning. This is evident in the array of ways service-learning programs can be implemented across contexts and ages (Billig,

2000; Fox & LaChenaye, 2016; Kielsmeier, 2011; Lake et al., 2011). The key to designing and implementing an effective service-learning program is community fit. (Fox & LaChenaye, 2016).

There are five main factors described in the Emergent Theory of the Role of Context in Service-Learning Practice model (Fox & LaChenaye, 2016) needed to support high quality service-learning experiences. The first factor is temporal influences that include a sufficient amount of time to immerse oneself in understanding and engaging with the service-learning project. Human capital, the next factor, consists of skills, experience and knowledge participants possess. Community, adult, and youth support are a part of locus of support, the third factor. Meaning to an individual is the primary concern in the fourth factor of participants' relationship to the topic. This meaning is supported by participant buy-in and interest. The final factor, a culture of a service-learning, should be present in an organization, like 4-H, and the community to support all other factors of service-learning.

Motivators for Service-Learning

A small number of researchers have examined what influences youth to become engaged in service-learning. Ballard, Malin, Porter, Colby, and Damon (2015) examined what motivates civic engagement in adolescents and identified four main motivation subgroups: helping identity, instrumental issues, personal factors, and weak motivation. Clary et al. (1998) also identified six motivators that influence volunteering: enacting one's values, increasing one's understanding, fostering psychological growth, making career-related gains, strengthening social relationships, and meeting personal needs.

Eckstein et al. (2015) created the Civic Voluntarism Model (CVM) to explain factors that influence engagement. These factors include: (1) resources (e.g., time, education, money); (2)

recruitment networks (e.g., family, peers, religious organizations); and (3) psychological engagement with politics (e.g., efficacy, attitudes, interest). This model has been used to predict voting patterns in youth. Eckstein et al. (2015) employed this model to assess civic engagement with immigrant youth in Belgium, Turkey and Germany, validating its use across cultures and contexts. According to this model, social networks and youth organizations were particularly influential for immigrant youth. Financial problems and parent education did not impact engagement for immigrant youth (Eckstein et al., 2015).

Like Eckstein et al. (2015), Ballard et al. (2015) found that community plays a large role in encouraging youth to be involved in service-learning. There are civic subcultures in which youth participate, especially for immigrant populations (Ballard et al., 2015). Motivational differences across generational immigrant groups were also identified. First-generation youth were more likely to have instrumental motivation such as aiding with educational and employment goals; participants shared their need to build skills and education for the future; and concern was the most common motivation for immigrant and nonimmigrant youth (Ballard et al., 2015). The majority of first-generation students were also motivated by specific issues like immigration reform (Ballard et al., 2015). Second-generation immigrants also engaged in more activities for future preparedness like college, employment and leadership (Ballard et al., 2015). In contrast to first- and second-generation immigrant youth, native-born youth whose families have been in the U.S. for at least three generations are more likely to be motivated by remote issues, such as climate change and homelessness (Ballard et al., 2015). Understanding motivators and types of service in which immigrant, refugee, and minority youth participate can

help educational designers develop effective service-learning interventions and programs for diverse populations.

Service-Learning Benefits

Fox and LaChenaye (2016) categorized the benefits of service-learning on individual participants into four main categories: academic, civic, psycho-social development, and career. Problem-solving skills, increased academic motivation, and a positive attitude about school are among the academic benefits of service-learning. Civic benefits include identity development and increased commitment to community. Empowerment, self-efficacy, pro-social skills, developing new relationships, teamwork, and appreciation of diversity are examples of psycho-social benefits. The following are types of career benefits: career exploration, workplace preparation, identifying career paths, and exposure to the "real world of work" (Fox & LaChenaye, 2016, p. 2).

Additional benefits to individuals engaged in service-learning include: higher empathy levels; increased school engagement; academic achievement; lower school drop-out rate; better understanding of academic material; tolerance; multicultural understanding; higher parent and community engagement (Lake & Jones, 2012, Scales et al., 2006, Kielsmeier et al., 2004; Vogelgesang & Astin, 2000). For example, early exposure to service-learning can be influential throughout the lifespan (Campbell, 2000; Scott & Graham, 2015). Studies have found that empathetic reactions during childhood mirrors that in adulthood with respect to emotional cognition, cognitive empathy, and emotional disconnection (Bensalah, 2015). Additionally, it has been shown that individuals involved in service in their youth are more likely to participate in service activities when they become adults (Campbell, 2000).

Furthermore, involvement in service-learning can help teach individuals multicultural understanding and social entrepreneurship. As U.S. society and societies worldwide face continuing conflict and globalization, it is important that youth learn how to apply multicultural understanding and social entrepreneurship (Berthelsen & Karuppiah, 2011; Sarıkaya, & Coşkun, 2015). As adults, youth will be creating policies and programs. If they are not taught empathy and community application skills through programs like service-learning, societies will become more individualistic (Paris, 2015).

The underlying objective of youth involvement in service-learning is to help improve communities and societies. Zaff et al. (2010) developed the idea of active and engaged citizenship to achieve this goal. Active and engaged citizenship refers to "someone who has a sense of civic duty, feeling of social connection to their community, confidence in their abilities to effect change, as well as someone who engages in civic behaviors" (Zaff et al., 2010, p. 737). Active and engaged citizenship is a combination of civic action, civic skills, social connection and duty, which are identified outcomes of service-learning research. Early service-learning involvement can help develop a lifelong active and engaged citizenry.

Scott and Graham (2015) explored the impacts of service-learning in elementary schools, specifically, empathy development and community engagement. The authors hypothesized that empathy levels and community engagement would increase after their five-session pilot study. The types of empathy examined were cognitive and affective. Community engagement was measured through civic awareness and civic efficacy. Increases in empathy and community engagement were found across all ages (Scott & Graham, 2015). Though there

were some differences across grade levels regarding the different types of empathy, both types of empathy increased for persons of all ages (Scott & Graham, 2015).

Service-Learning in K-12 Settings

Service-learning has grown in popularity over the past couple of decades. Although there are now K-12 service-learning programs in every state, they are not widely recognized or researched (Billig, 2000; Furco, 2013). In 2009, 35% of high schools, 25% of middle school and 20% of elementary school implemented some sort of service-learning program (Kielsmeier, 2011). Implementation of service-learning programs varies across school levels. Elementary schools are more likely to have school-wide or grade-wide programs, while higher grade levels are more likely to incorporate electives and individual classes (Billig, 2000). Even though service-learning is offered in all levels of K-12 education, a vast majority of the application and research has focused on higher education (Furco, 2013). Formal learning in a school setting is not the only learning environment where service-learning can be applied or beneficial.

Service-Learning and Nonformal Education

There are three main types of learning settings: formal, nonformal, and informal (Eshach, 2007; Falk & Derking, 2010). A formal learning setting is commonly school-based and teacher-led (Eshach, 2007). Nonformal occurs outside of school in a planned program that is motivated by free-choice learning (Eshach, 2007). An informal learning setting, like a museum, is the least structured learning setting (Eshach, 2007; Falk & Derking, 2010). Informal and nonformal learning environments often focus more on application and authentic learning than formal learning settings like school, where test scores frequently take priority (Barton et al., 2013). A unique characteristic of nonformal and informal learning is that participation is

voluntary. These learning settings often foster everyday application, personal meaning, and personal interest in the content matter (Falk & Dierking, 2010).

The 4-H Youth Development Program is one of the largest nonformal youth education organizations in the U.S. (National 4-H Council Annual Report, 2017). Service has been present in 4-H since its foundation and many county-based programs have regular service-learning projects and clubs (Fox & LaChenaye, 2016). However, a goal of 4-H nationally and in California is to be more intentional about offering opportunities for service, which is where service-learning can be implemented (4-H National Headquarters, 2011; Silliman, 2011).

There have been a limited number of previous studies about service-learning in nonformal education, specifically in 4-H. One 4-H study on service-learning took place in Virginia, where a 4-H Congress planned and assessed 17 service projects (Hairtson, 2004). After completing the various projects, the 4-H youth participants shared the following positive outcomes: altruism, sense of contribution, new skills, teamwork and resources and ideas for future engagement (Hairtson, 2004). All these outcomes align with goals associated with positive youth development (PYD) (Fox & LaChenaye, 2016).

A foundational aspect of the 4-H Program is PYD, an approach to educational programming that focuses on the healthy development of youth participants (Campbell et al., 2013). 4-H has utilized many PYD frameworks over the years including: targeting life skills, assets, the four essential elements, the five Cs (six Cs), and the community action framework for youth development (Arnold, 2018; Heck & Subramaniam, 2009). One of the best known and most utilized PYD frameworks is the six Cs: competence, connection, confidence, character, caring/compassion, and contribution (Lerner et al., 2005). All these C's can support service-

learning, particularly contribution, connection, and caring. Arnold (2018) expands on other PYD models with a new PYD model, the 4-H Thriving Model. The aim of this model is that it be used across 4-H programs to support youth in achieving their potential in the short and long terms (Arnold, 2018).

The 4-H Thriving Model described by Arnold (2018) has four key components: developmental context, thriving trajectory, developmental outcomes, and long-term outcomes. Developmental contexts impact outcomes and thriving. The facilitation of a youth's passion about a particular topic or skill (a "spark") aids in producing a positive developmental context (Arnold, 2018). Additional influences include: relationships with others (adults and youth), meeting quality standards, and youth engagement (more than being physically present). Thriving is a term used to describe growth and a pathway for the future, an ongoing process (the thriving trajectory) driven by internal motivation and passion. The Search Institute (2014) detailed six indicators for thriving: openness to challenge and discovery, transcendent awareness, intentional self-regulation, pro-social orientation, positive emotionality and hopeful purpose. Several of the developmental outcomes identified in the 4-H Thriving Model are similar to those identified by Lerner's (2005) five Cs model of PYD, including competence (socially, emotionally, cognitively and vocationally), personal standards (understanding of right and wrong), connection (positive relationships with others), and contribution (giving back). In addition, three other developmental outcomes are included in the 4-H Thriving Model: academic motivation and success, decrease in risky behaviors, and healthy choices. The four long-term outcomes defined in the 4-H Thriving Model: successful transition to adulthood, economic stability, civic engagement, and health and wellbeing.

Service-Learning and Scientific Literacy

Scientific Literacy

Twenty-first century societies are increasingly influenced by advances in science and technology (National Academies of Science, 2007). Not only is the field of Science, Technology, Engineering and Mathematics (STEM) expanding and opportunities for STEM careers growing, but STEM helps create jobs in almost all other fields (National Academy of Sciences, National Academy of Engineering, & Institute of Medicine, 2010). Additionally, whether individuals are in a STEM field or not, science impacts their everyday lives in ways that will continue to increase as the field of STEM expands further (Falk, Randol & Dierking, 2011; Meyer et al., 2014; National Academy of Sciences, National Academy of Engineering, & Institute of Medicine, 2010).

Given the increasing influence of STEM in modern society, it is widely understood that advancing scientific literacy among the general population is important (National Academies of Science, 2007). According to Miller (2012), there are three types of scientific literacy: consumer, cultural and civic. Consumer scientific literacy pertains to the knowledge needed to make informed choices when purchasing food, medicine, technology etc. to shop (Miller, 2012; Shen, 1975). Cultural scientific literacy is understanding the role and importance of science in society by connecting various forms of knowledge (Miller, 2012; Shen, 1975). Civic scientific literacy is the knowledge individuals need to make informed decisions as they pertain to public policy decisions (Miller, 2012; Shen, 1975). For civic scientific literacy, the minimum should be that an individual is able to understand mainstream articles about science and decide how to react independently without relying on opinions of others. However, according to Miller (2012)

societies should strive to surpass this minimum. Being civically scientifically literate makes individuals more educated voters and members of society (Miller, 2012, National Academy of Sciences, National Academy of Engineering, & Institute of Medicine, 2010). Service-learning can aid in fostering these three types of scientific literacy, particularly civil through education and application (Hill, Muñoz, & Spruck Wrigley, 2012).

Despite the importance of developing a scientifically populace, U.S. youth have scored only average in science proficiency on the Program for International Student Assessment (PISA), an international evaluation of 15-year-old students, when compared to 35 OECD (The Organisation for Economic Co-operation and Development) countries (PISA, 2015). Additionally, results from the National Assessment for Educational Progress (NAEP) revealed that only 38% of fourth grade students, 34% of eighth grade students, and 22% of twelfth grade students in the United States scored at the proficient or advanced levels in science (NAEP, 2015). Furthermore, in state rankings, California fourth graders ranked 47th and California eighth graders ranked 45th out of students in fifty states and territories tested (NAEP California State Profile, 2015).

Service-Learning and Science

Advancing scientific literacy will help youth make informed decisions and engage more effectively in their communities (Miller, 2012). One way for youth to become more engaged is apply their scientific skills and knowledge through service-learning opportunities. Two strategies to achieve this are citizen science and youth participatory action research (YPAR) (Barton, Birmingham, Sato, Tan & Barton, 2013).

Citizen science.

Citizen science is a form of experiential and inquiry-based learning (Meyer et al., 2014). According to Jenkins (1999), citizen science represents a "range of possible solutions in which one might need to draw upon knowledge of science in ordered to successfully negotiate desired outcomes" (Rudolph & Horibe, 2016, p. 807). In other words, the focus is on helping to address community needs through science. Citizen science can include both the production of and use of scientific knowledge (Rudolph & Horibe, 2016). Furthermore, there is a growing movement involving youth in citizen science, and studies have illustrated that youth contributed to STEM in authentic ways through their research questions, data collection, analyses, and sharing their applications of knowledge (Ballard et al., 2016).

Community science experts (CSEs) can be viewed as citizen scientists. Community science experts are individuals who are dedicated to making an impact in their communities by sharing and applying scientific knowledge (Barton et al., 2013). Citizen scientists and CSEs emphasize educating others to initiate and support wider change efforts (Barton et al., 2013). According to Barton et al. (2013) there are three steps to become a CSE: "the need to learn relevant science, identify community issues, and take educated action to improve the community" (p. 27). Community science experts are authority figures and change makers in their communities; additionally, they are connected to an increase in the number of students who are pursuing STEM careers (Barton et al., 2013).

Community-based participatory research and youth participatory action research.

Youth have unique perspectives, skills, and knowledge that cannot be found anywhere else. Their engagement in communities can be facilitated through Youth Participatory Action

Research (YPAR) and Community Based Participatory Research (CBPR). Community Based Participatory Research is a research orientation where equal participation of community members and academics is valued (Jacquez, Vaughn & Wagner, 2013; Minkler & Wallerstein, 2008). Youth Participatory Action Research is a type of CBPR. Both of these approaches have the common objective of applying research to the community to make change (Eng et al., 2013; Cammarota & Fine, 2008). The community is the primary focus, with its goals, aims, interests, and wants at the forefront (Wulfhorst, Eisenhauer, Gripne & Ward, 2008).

One of the principal aims in YPAR and CBPR is to engage marginalized populations. Many consider all youth to be marginalized in the CBPR context, because their perspective and input is largely missing from research (Cammorata & Fine, 2008). In YPAR, young people engage in "identifying problems relevant to their own lives, conducting research to understand the problems, and advocating for changes based on research evidence" (Ozer, 2016, p. 190). In YPAR, there is no one expert; rather, there is a community of researchers (Ritterbusch, 2012). Youth Participatory Action Research gives youth and community members the opportunity to be agents, teachers, and learners, instead of solely objects of research (Minkler & Wallerstein, 2008). All participants help develop research questions and methods, collect data, conduct data analysis, and share their findings (Ashton, Arnold & Wells, 2010; Kirshner, Pozzoboni & Jones, 2011).

Capacity building is another major aim of CBPR and YPAR. In case studies by Ardoin et al. (2013), self-efficacy, increased connection with place, and an increase in confidence and skill development of youth were identified outcomes. Furthermore, a study about a community action project within 4-H found that youth developed research skills such as organization,

communication, and life skills such as confidence, ownership, and partnerships (Ashton et al., 2010).

Service-learning and science in action.

Hayford, Blomstrom and DeBoer (2014) found that service-learning improves scientific literacy levels among college students. The authors assessed three service-learning projects focused on different scientific disciplines (astronomy and environmental) at two colleges in the United States. A mixed methods approach utilizing quantitative surveys and qualitative reflections was used to explore if service-learning promoted students' scientific literacy. Additionally, students' experiences with the different standards of service-learning – links to curriculum, duration and intensity, partnerships, meaningful service, and reflection – were also evaluated (Hayford et al., 2014). Papers, grades, skills surveys, and reflections of students were some of the measures used.

At one of the universities, student participants in service-learning projects were compared to a control group of non-participating students. There were some differences across the projects in the levels of scientific literacy the participants gained. For example, students in the recycling project had higher scientific literacy scores than individuals in the bio-monitoring project at the same university (Hayford et al., 2014). But participation in each of the service-learning projects was found to increase students' scientific literacy. An important limitation of this research study was that scientific literacy was measured differently at the two colleges. Hayford et al. (2014) note that a consistent STEM literacy tool would improve analysis and comparison.

An area for growth in service-learning is the field of STEM, particularly in nonformal and informal learning settings that focus on youth scientific literacy (Hayford et al., 2014; Rector, Lyons & Yost, 2013). Nonformal and informal learning environments often offer greater opportunities for authentic applications of science through context-specific programs that connect with individuals' everyday experiences and interests than formal learning environments (National Research Council, 2009; Rector et al., 2013).

In 4-H, service-learning has been used to help address the need to improve youth scientific literacy and find solutions to environmental problems. For example, a 4-H project in New Jersey entitled *Be the Change* offered youth the opportunity to collaborate with their community (Rector et al., 2013). The community need the project addressed was water contamination. The youth built and sold ten rain barrels and taught the recipients how to use them in order to conserve water. Each rain barrel can save hundreds of gallons of water (Rector et al., 2013). Survey outcomes from this study revealed participants' knowledge of environmental science and service-learning increased.

Learning and Curriculum Development

Learning Strategies

It is widely agreed upon that the desired outcome of education is that youth learn and retain knowledge and skills to later apply to bettering society, becoming effective citizens in their sociocultural context (Dewey, 1938; Gauvin, 1998; Parsons, 1959). However, there is much debate as to how this can best be accomplished. In general, strategies for education can be separated into two broad categories: guided and minimally-guided learning (Kirschner, Sweller

& Clark, 2006). Within each of these categories, there is wide diversity of implementation of the two types of educational programs (Dewey, 1938).

Guided Learning and Minimally-Guided Learning

In guided learning, information, concepts, and processes are explained directly to the student (Kirschner et al., 2006). Guided learning is often associated with traditional classroom-style learning where the student is viewed as a "blank slate", who is there to listen and absorb information (Wilmsen, 2008, p. 9). Lectures and detailed worksheets with instructions are common examples of guided learning (Kirschner et al., 2006). On the other hand, 4-H and many other organizations involved in youth development utilize minimally-guided learning (Torock, 2009). The main premise for minimally-guided learning is that youth will understand concepts more fully if they learn from their own experience rather than solely learning about them in the classroom or in a book (Kolb, 1984).

Minimally-guided learning stems from constructivism, which emphasizes that youth actively participate in their own development by constantly creating and testing new ideas and understandings (Flavell, 1992; Fosnot, 1996; Piaget, 1964). Types of minimally-guided learning include: problem-based learning, inquiry-based learning, experiential learning, service-learning, and constructivist learning (Kirschner et al., 2006). As Piaget explains: "each time one prematurely teaches a child something he could have discovered for himself, that child is kept from inventing it and consequently from understanding it completely" (Piaget, 1970, p. 715). Even when youth reach an accurate understanding or strategy, they continue to explore and construct new ideas (Piaget, 1964; Siegler & Ellis, 1996).

Constructivism and Inquiry-Based Learning

According to the constructivist theory, individuals develop meaning and understanding through interactions with their social and physical environment (Dewey, 1902, 1933; Nichols, 2002; Smith et al., 2017). In constructivism and inquiry-based learning, prior and new knowledge come together to create new understandings and mechanisms (Seigler & Ellis, 1996). This means that educators need to consider the experiences and backgrounds of their students and their contexts to provide "authentic" learning opportunities (Kirschner et al., 2006). Individuals adapt to think in specific contexts (Gauvin, 1998), and the consequences of one's thinking and actions can vary across contexts supporting the idea that learning is situational (Piaget, 1964). The environment is a key influence with all types of learning, but particularly with inquiry-based learning (Dewey, 1902; Dewey, 1938).

There is no agreed-upon definition of inquiry-based learning (Klahr & Nigam, 2004). According to Colburn, inquiry-based instruction is "the creation of a classroom where students are engaged in essentially open-ended, student-centered, hands-on activities" (Colburn, 2000, p. 42). According to Colburn (2000), there are various types of inquiry, including: structured, guided, and open inquiry. Lessons that use structured inquiry are often called "cookbook activities" because educators give specific instructions to learners, but do not share the expected outcome (Colburn, 2000). In guided inquiry, specific directions are not given, and students must use available resources and skills to solve a problem (Colburn, 2000). For open inquiry, students create and solve their own problem. A science fair is a common example of open inquiry (Colburn, 2000). The type of approach an educator utilizes should be based on individual youth and the context (Dewey, 1938).

Much research finds that inquiry-based learning is as effective or more effective than guided learning methods. In fact, high test scores, particularly in science, have been associated with inquiry-based learning (Colburn, 2000; Yanik & Serin, 2016). Problem-based learning, a form of inquiry, is supported by the National Research Council and American Association for the Advancement of Science (Drake & Long, 2009). Inquiry-based learning may impact certain aspects of learning more than others. For example, multiple studies examining the impact of inquiry-based learning have found that science process skills are influenced positively by inquiry-based learning, but there is not a significant influence on content knowledge (Drake & Long, 2009). Application of learning in the real world has also been identified as a benefit of inquiry-based learning. This enhanced learning experience leads individuals to have higher rates of self-efficacy and confidence (Weinberg et al., 2011). All of this is underscored by an increased motivation for learning (Yanik & Serin, 2016). This increased motivation can promote long-term learning and engagement, which eventually lead to the development of collateral learning (Drake & Long, 2009).

Previous research has identified several limitations of inquiry-based and other types of minimally-guided learning (Kirschner et al., 2006). A common limitation cited is that inquiry-based learning does not fully consider cognition. Kirschner, Sweller, and Clark (2006) argue that experientially-based learning can overwhelm working memory, particularly when ideas are novel, causing fewer changes in long-term memory, which in turn diminishes learning. Another barrier of inquiry-based learning could be that misconceptions are formed more often because mental representations are not corrected frequently (Kirschner et al., 2006). Misconceptions can lead to faulty learning and the creation of incorrect structures and representations in

cognitive development (Flavell, 1992; Kirschner et al., 2006). An additional limitation is that not all concepts can be directly experienced, particularly in STEM (Klahr & Nigam, 2004). For example, one cannot experience a black hole.

Past research that does not support the learning outcomes of inquiry-based learning often utilizes short time frames. An example of this is a study completed by Klahr and Nigam (2004) that examined differences in science learning through direct and discovery learning, which took place over approximately two weeks. Ideally, any pedagogical approach would be utilized over a significant period of time before its impacts are assessed. A theory to help justify this is the "splashdown effect", which explains how it can take time for some impacts of learning to be measurable (Stake & Mares, 2001; Weinberg et al., 2011).

Educators often do not utilize inquiry-based learning for the following reasons: it is difficult to facilitate; they believe it is only for high-achieving students; and they lack understanding and training about inquiry (Colburn, 2000). However, there are many recommendations for promoting inquiry such as: correcting misconceptions; considering each person's skills, passions and attitudes; asking open-ended questions; giving time for reflection and pondering; building upon material and methods students are already familiar with; and not giving students answers but guiding them to find the answer on their own (Colburn, 2000). Inquiry activities should be challenging, but achievable. Furthermore, students should always be set up for success and have a positive learning experience (Colburn, 2000).

Experiential Learning and the Learning Cycle

Experiential learning is organized into a cycle which promotes inquiry (Marek, 2008). In fact, Marek (2008) defines the learning cycle as "a way to structure inquiry" (p. 63). The

learning cycle is based on developmental and educational theories and research. While applying the learning cycle, it is essential to consider a child's developmental stages, including each of the four domains of development: physical, cognitive, social and emotional (Schmitt-McQuitty, Smith & Chin Young, 2011).

According to Marek (2008), inquiry occurs in three main phases: exploration, concept development, and expansion. These three phases are sometimes referred to as the three Es. Exploration is the first phase, when a topic is introduced, often through an activity or open-ended questions. Instructors should guide students' experiences, but not do the activity for them (Marek, 2008).

The concept development phase is sometimes referred to as explanation. The instructor aims to help the student physically and mentally grasp the concept. This is often done through discussion. A key component of the concept development phase is to not merely explain the concept to students, but also to help them use inquiry to gain understanding through experiences, observation, and data (Marek, 2008).

The last phase is expansion, which is often misinterpreted and misused. No new material should be introduced in expansion; the goal is to enable students to apply newfound knowledge in various contexts (Marek, 2008). The expansion phase relates to Piaget's thoughts that the true sign of knowledge is being able to act on learned material (Piaget, 1964). This application of knowledge connects back to the purpose of education, where youth are learning to become effective members of society (Dewey, 1938; Gauvin, 1998; Parsons, 1959).

Curriculum

The purpose of a curriculum is "the advancement of learning", which is the goal of most youth education programs, including 4-H (Smith et al., 2017, p. 3). One limitation in curriculum development is disagreement about the definition of curriculum, which can lead to confusion and lack of uniformity in programming (Smith et al., 2017).

Curricula are central to the learning experience. Therefore, it is important to utilize a specific definition. The definition of curriculum used for this research was developed by Smith et al. (2017), specifically for Cooperative Extension programming. A few key aspects of this definition include: relates to a societal need; organized sequentially; developmentally appropriate with tools for application; and has been researched to show predicted learning objectives (Smith et al., 2017). This definition helps to provide consistency and continuity in Cooperative Extension curricula and programming. The power of understanding how youth learn in curriculum design is presented in Smith et al.'s (2017) curriculum definition. Using this curriculum definition shaped the way the curriculum utilized in this study was designed.

The Backwards Design approach to curriculum development begins with identifying desired results, determining how they will be evaluated, and designing learning experiences. The purpose of the first step is to decide what content and expectations the individuals are intended to learn. In this stage, it is essential to consider "linchpin ideas," ideas essential for understanding (Wiggins & McTighe, 2006). In step two, assessment is the focus. Possible assessment methods include: informal checks for understanding; observation/dialogue; quiz/test; academic prompt; and performance task/project (Wiggins & McTighe, 2006). Assessments should be ongoing. In step three, the specifics of the curriculum and curriculum

activities are determined, such as the sequence, teaching methods, and materials (Wiggins & McTighe, 2006).

Lastly, organization of a curriculum is critical. It should be sequential, whereby materials build on one another (Smith et al., 2017; Tyler, 1949,1977). To aid this, emphasis is placed on vertical and horizontal organization. Vertical organization is the relationship between the different modules and sections within a curriculum (Smith et al., 2017; Tyler, 1949). Specifically, information learned in one module or section of a curriculum leads to or informs subsequent modules or sections. Horizontal organization refers to how the learning experiences within a curriculum connect to real-world situations or issues in a broader context (Smith et al., 2017; Tyler, 1949). In service-learning, horizontal organization provides the ideal opportunities for authentic student engagement.

CHAPTER 3: METHODS

Participants

Our sample consisted of seven 4-H participants living in a Northern California county. There were six female participants and one male participant, with ages ranging between 10 and 19. Participants were members of four different 4-H clubs, and each had experience with a variety of 4-H Animal Science projects (livestock and/or poultry). Participants lived in three zip codes representing rural and suburban areas throughout the county. Background information on the participants was collected regarding the type of animals they raised, the numbers of species they raised, and prior issues they had with respect to livestock/predator interactions (see Appendix A).

Procedures

Participants were recruited by the County 4-H Youth Development Program Representative. The 4-H staff member was recruited by Cooperative Extension researchers who also actively solicited participation from other county 4-H programs throughout the state by email and telephone. Specifically, potential county participants were asked if they would like to take part in testing a new 4-H curriculum about predator and livestock/poultry depredation. However, while the purpose of the program received positive feedback, due to time constraints, staff changes, and natural disasters,4-H youth from only one county were able to participate fully. Participation was voluntary for the 4-H staff members and 4-H youth. This study and accompanying measurements were approved by the UC Davis Institutional Review Board (IRB).

The goal of this study was to pilot test a new 4-H curriculum entitled: *At the Interface between Livestock and Predators: Reducing Depredation through Livestock Husbandry* (Cheung et al., under review). The curriculum consisted of five sequential modules: *Biomes and Habitats*, *Food Web*, *Predator Identification*, *Risk Assessment and Mitigation*, and *Service-Learning and Application*. The modules are designed to be taught sequentially with the topics building on one another, a concept referred to as vertical organization (Smith et al., 2017; Tyler, 1977). Please refer to Appendix B for the learning objectives of each module.

A 4-H facilitator in the Northern California county taught the five curriculum modules over a period of approximately two weeks at the normal times and location of the regular meetings with the 4-H youth. After the two-week period, the 4-H youth participants continued to complete and share their service-learning project, a continuation of the final module, for approximately three months. Collectively, participants decided to develop an informational video about predator depredation to share with 4-H clubs and other agricultural groups, like the local women's cattleman chapter, for their service-learning project. Every 4-H youth participant contributed to the development of the video by creating individual sections, which participants who had experience with videography edited and combined. The 4-H county facilitator aided this process.

Research Design

I utilized a mixed methods research approach to answer the research questions. Specifically, I used a sequential explanatory design where quantitative data are collected first, to inform the subsequent qualitative data collection (Creswell, 2003). The quantitative methods focused on providing insights about the understanding of learned material from the curriculum,

while qualitative methods concentrated on the application of learned material and service-learning. It was important for the research methodology to be sufficiently flexible to reflect the participatory nature of youth community engagement research, where questions may change (Creswell, 2003). In each of the measurements, we considered two of the four Anchor Points of scientific learning: I) science content and IV) contribution through applied participation (Smith et al., 2015). The quantitative measurements focused on the first anchor point; the qualitative measurements reflected the last. Multiple measurements were developed, including: pre-/post-survey; five retrospective surveys (one for each curriculum module); a focus group; and individual and pair interviews (refer to Appendix C for timeline of measurements).

Before the youth participated in any of the modules, they completed a pre-survey. The purpose of the pre-survey was to evaluate participants' response to a simulated predation threat, contextual knowledge about their experience with their predator/prey interface, and community impact and involvement. This measurement was developed specifically for this curriculum. The measurement was printed and given to each of the youth to complete independently. A 4-H facilitator was present to answer any clarifying questions, though the youth completed all measurements by themselves.

The retrospective surveys were created for each of the five modules specific to this curriculum. The surveys were modeled after other retrospective surveys utilized in 4-H curriculum outcome testing to support the reliability and validity of the measurement (Kozlowski, Bain, Meehan & Smith, under review). Immediately after completing each module, participants were asked to complete the corresponding retrospective survey (Pratt, McGuigan & Katzev, 2000). An instruction page including examples was included with each survey to

reduce error. To link the youths' measurement reports for each module, each participant was assigned a participant code. The County 4-H Youth Development Program Representative developed these codes, so the youth were anonymous to the UC Davis researchers. Non-identifying information, such as zip code, gender, and age, was collected in the measurements to aid in demographic analysis.

After analyzing the results from the various surveys, interview questions were developed based on data collected (Creswell, 2003). One focus group and a set of individual and small-group interviews were conducted. Depending on what was most appropriate and convenient for participants, these were via tele- or video-conference. The focus group occurred via Zoom video conference in July 2018, immediately after participants completed the five curriculum modules. All participants were invited to take part in the focus group, but due to scheduling conflicts, not all of them were able to present**.** Considering that the participants were beginning their service-learning projects and had just finished the curriculum modules during the first focus group, it was determined that a second focus group was needed to gain greater insights about participants' service-learning experience and application. However, the second focus group was restructured as individual or pair interviews due to logistical and timing challenges. These interviews were conducted via Zoom video conference or telephone with all seven participants in October 2018. At this stage of the project, the service-learning informational video had been completed and was being disseminated.

Measures

Phase I: Quantitative Measures

Pre-/post-survey. Pre- and post-intervention assessments were identical and included two sections (refer to Appendix D for full measurement). The first section was a scenario assessment designed to have youth reflect on a common predator experience of animal tracks they observed. The scenario did not include any references to specific predators or livestock and poultry, so it could be applied across contexts. After completing the scenario, a chart with twenty different responses to the scenario was provided. Examples of response options include: use a night pen, use underground fencing, remove leftover food and water for pet and/or project animal, get a depredation permit, and call local wildlife/animal services. Participants were asked to mark which options they would consider using in the predator and prey interface. All seven participants completed the pre-survey. After finishing all five curriculum modules, all seven youth also completed the post-survey survey.

Retrospective surveys. Retrospective surveys were developed for each curriculum module. Each retrospective survey had four or five questions and was administered immediately after the curriculum module was implemented (refer to Appendix E for list of survey questions). Since the survey was retrospective, participants were asked the same question twice, first asking about their knowledge of specific curriculum concepts after participating in the module, and then asking about their understanding of those concepts before participating. All participants completed the retrospective surveys for modules one through four; for module five, only five youth completed the survey.

Phase II: Qualitative Measures

Pre-/post-survey. Following the scenario assessment, participants completed seven open-ended follow-up questions. Specifically, they were given an opportunity to share additional ways they would respond to the scenario. They were also asked to indicate which method their first choice would be and to explain why.

Topics addressed in the open-ended question section included: types of livestock and poultry raised, motivation to raise these animals, current risk of predator and prey interaction, and how, if at all, depredation impacts their community and recommendations of ways to respond to depredation. An example of an open-ended question in the pre-/post-survey is: "Do you think this situation described above could affect others in your community/neighborhood? Please explain why or why not." A follow-up related question present later in the measurement is: "If you believe that the situation described does affect your community, what, if anything, would you recommend your community do to respond?"

Focus groups/interviews. Results from quantitative measurements were used to develop interview questions (Creswell, 2003). For example, quantitative results revealed that predation on 4-H youths' livestock/poultry, as well as other livestock/poultry in their communities, was common. Thus, one interview question focused on how predation impacted the study participants' community. The focus group and interviews were audio-recorded and transcribed verbatim. Field notes were also taken during the initial focus group and interviews (Krueger & Casey, 2000). Various types of questions, such as opening, introductory, transition, key and ending questions were utilized to facilitate discussion (Krueger & Casey, 2000). Follow-

up and sub-questions were also developed to clarify and gain a further understanding of the main questions.

An example of a key question from the focus group was: “Explain what specific parts of the curriculum, if any, help foster your community engagement” (refer to Appendix F for focus group/interview questions). A follow-up question to a similar key question from the set of interviews was: “Explain what ways you can tell what you learned after participating in the curriculum (e.g. skills, content, application, transfer to other situations)”. Five of the seven 4-H youth who participated in outcome testing of the curriculum participated in the focus group. All the participants were invited to participate, but due to scheduling conflicts not all were able to attend. For the interviews, all the 4-H youth were able to participate. Due to differing schedules, five different interviews took place in a one-week period.

Data Analyses

Phase I: Quantitative Measures

The analysis of quantitative data was conducted in SPSS v25 (IBM,2017). Paired t-tests were completed for retrospective surveys and the chart portion of the pre-/post-survey. A level of significance was established at $p < .05$ for all analyses (see Table 1, Results Chapter). The Likert scale in the retrospective surveys for each curriculum module was converted numerically with 1 being poor and 4 being excellent for statistical analyses. For the predation scenario chart, an animal scientist who was part of the curriculum development categorized the responses as lethal or nonlethal. Missing data were handled using list-wise deletion.

Phase II: Qualitative Measures

For the focus group, interviews and the open-ended question portion of the pre-/post-survey themes were coded using inductive analysis. Themes were identified based on highest frequency of responses (Creswell, 2003). Themes were also identified by recognizing common responses by the 4-H participants and grouping them into categories. The categories were determined by printing out the qualitative data from each measurement (pre-/post-survey focus group, and interviews) and color-coding themes in responses. For the first focus group, themes included: community impacts of predation; application of knowledge and skills; sharing knowledge and skills; specific parts of the curriculum that were useful; and curriculum suggestions.

Threats to Validity

Phase I: A retrospective design was used to minimize issues of response-shift bias, where participants tend to overstate their responses on pre-/post-surveys, and more accurately measure participants' experiences (Raidl et al., 2004). Content validity was addressed by having a subject matter expert review the survey questions.

Phase II: Member checking was employed in both the focus group and interviews to confirm the participants' thoughts on topics identified in the quantitative and qualitative data (Creswell, 2003). Writing detailed descriptions of the findings helped convey participants' experiences (Creswell, 2003).

CHAPTER 4: RESULTS

This study utilized a sequential explanatory mixed-methods approach that involved two different phases to answer the research question of how, if at all, did content and pedagogy used in a 4-H curriculum contribute to the application of knowledge and authentic service-learning by 4-H youth (Creswell, 2003). This chapter reports the quantitative and qualitative findings.

Phase I: Quantitative

***Quantitative research question*:** What influence, if any, does an experientially-based curriculum that uses guided inquiry have on participating 4-H youths' content knowledge related to predator depredation?

***Null hypothesis* (H_0)**: The experientially-based curriculum that uses guided inquiry will have no effect on 4-H youth participants' content knowledge related to predator depredation.

***Alternative hypothesis* (H_1)**: The experientially-based curriculum that uses guided inquiry will have an effect on 4-H youth participants' content knowledge related to predator depredation.

The paired t-tests from the five retrospective surveys, one from each curriculum module, revealed significant increases in mean scores for all curriculum modules (see Table 1). Significance level was set at $p<.05$ (IBM, 2017). The increase in mean scores for all modules from pre- to post-intervention illustrated a self-reported gain in content knowledge understanding (see Figure 1). Based on these outcomes, the null hypothesis that an experientially-based curriculum that uses guided inquiry will have no effect on 4-H youth

participants' content knowledge related to predator depredation was rejected. The alternative hypothesis was accepted.

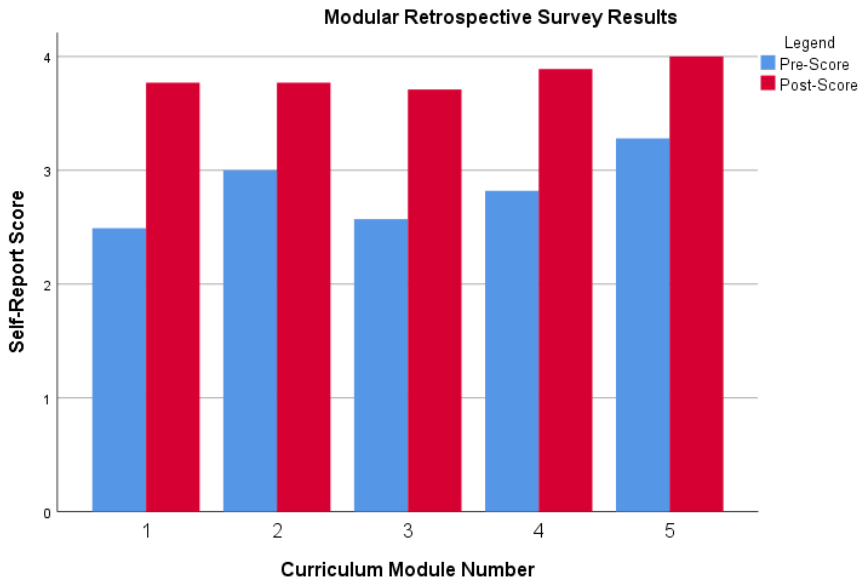
Table 1

Summary of Paired t-tests for Retrospective Surveys

Module Number	Pre *M* (*SD*)	Post *M* (*SD*)	*t*	df	Sig (2-tailed)
Module 1	2.49 (0.92)	3.77 (0.49)	-7.77	34	.000
Module 2	3.0 (0.80)	3.77 (0.59)	-5.41	34	.000
Module 3	2.57 (0.74)	3.71 (0.46)	-8.58	27	.000
Module 4	2.82 (0.61)	3.89 (0.32)	-9.38	27	.000
Module 5	3.28 (0.61)	4.0 (0.00)	-5.87	24	.000

Figure 1

Bar Chart of Retrospective Survey Results



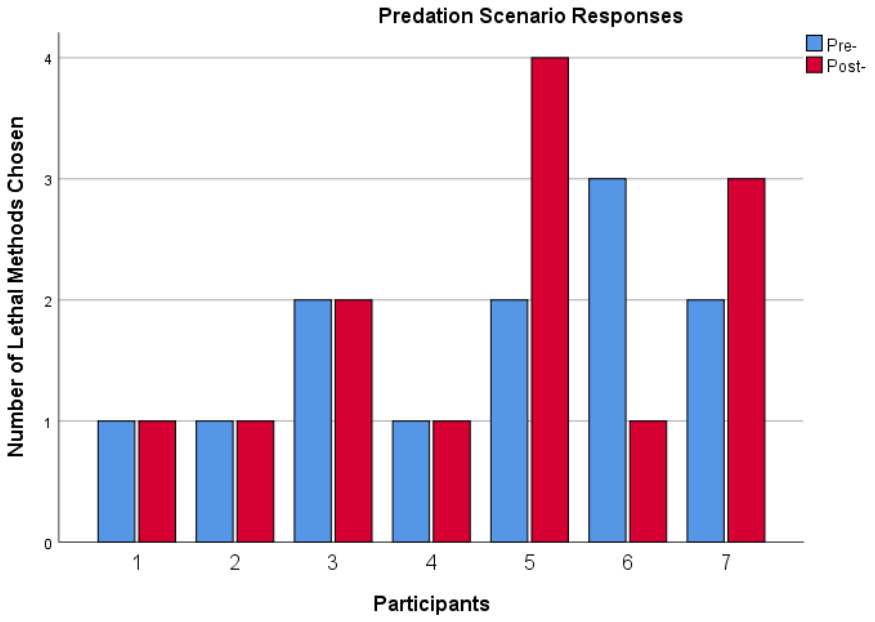
Next, we examined participants' responses to the predation scenario in the pre-/post-survey. A scenario chart (refer to Appendix D) was used to assess possible responses to a predation scenario. It was analysed by comparing the number of lethal and non-lethal options chosen in the pre-survey and post-survey. All categories were marked at least once for the scenario chart section of the pre- and post-surveys. Appendix G includes the categories that

were selected most frequently; Appendix H lists the categories that were selected least. One option ("wait and see what happens)" was selected only on the pre-survey, and one option ("have enclosed housing - 4 walls, no roof") was selected only on the post- survey.

There were some differences in the specific responses of participants regarding the number of lethal depredation choices they selected in the pre- and post-survey. Four out of seven participants selected the same number of lethal choices in the pre-/post- survey. Two participants selected more lethal choices in the post-survey. One participant selected fewer lethal choices in the pre-survey. Figure 2 shows the number of lethal depredation choices selected by each of the seven participants when comparing pre- and post-curriculum intervention. Paired t-tests in SPSS v25 (IBM, 2017) found no significant changes in the use of lethal depredation response methods according to statistical analysis of the pre- and post-measurements ($t(6) = -0.31$, $p < .05$; pre $M = 1.71$, $SD = 0.76$; post $M = 1.86$, $SD = 1.22$).

Figure 2

Bar Chart of Lethal Methods Chosen in Predation Scenario in Pre-/Post-Survey



The retrospective survey results and predation chart responses in the pre-/post-survey had mixed results, indicating support for both the alternative and null hypotheses. This means there is evidence the curriculum impacted 4-H youths' depredation content knowledge. However, some questions remain about the extent of the participants' content understanding and application, particularly after the lack of significance found with the predation chart. Research conducted as part of the qualitative phase explored this further.

Phase II: Qualitative

Qualitative research question: What aspects of the curriculum contributed to youths' service-learning project and application of learned materials beyond the curriculum?

To help answer this question, the study used several qualitative techniques including focus groups, interviews, and open-ended questions in the pre-/post-survey.

Focus Group Interview

A focus group was facilitated immediately after the completion of the curriculum intervention, just prior to the start of the service-learning project. Five major themes were identified from the focus group data: community impacts of predation; application of knowledge and skills; sharing knowledge and skills; specific parts of the curriculum that were useful; and curriculum suggestions. During initial data analysis, additional themes were identified (e.g., how to share the learned material); however, subsequent analysis led to aggregating these into the final, broader categories (Creswell & Plano Clark, 2011).

Community impacts of predation.

Participating youth observed that if predation and depredation impact them, it will also impact their neighbors and community. They also shared their thoughts about the necessity for individuals to work together to reduce depredation. Salient quotes from participants included:

1. *Another thing I wanted to add, I thought about how if my animals were in danger I could help. It wouldn't be much different if my neighbor's animals were in danger too. So, I could help my neighbors and my community with what I learned in the curriculum.*
2. *I think the way this has affected our community is it's important to share what we've learned with our neighbors. In order to keep our animals safe, it's kind of a group project. For example, keeping your animal's food kept away so it doesn't attract predators would protect all of the animals. Especially where I live, it's not as rural compared to other places in the county where people live closer to each other. We need to work together to keep predators out of the area. I feel like especially for people who live-in closer-knit areas, where all of the neighbors are closer to each other we can kind of work together to keep our animals safe.*

Application of knowledge and skills.

One way participants applied the curriculum material was through an informational video they began to develop for their service-learning project. Each member planned to create their own clip about what they felt was important to share with others.

Participants were also implementing or planning to implement specific animal husbandry techniques, such as: installing lights; placing a latch on chicken coop; changing

housing for goats (changing to materials that are harder for predators to damage); and covering animals' feed at night. Relevant quotes included:

1. *"I saw when I went home to my animals and would feed them, I was really looking around at where they lived and how I could help them"*
2. *"Before, I didn't have a latch on my chicken coop. I lost one of my chickens because the door got opened when I didn't have a latch on it. After doing this, I'm glad I learned about that."*

Sharing knowledge and skills.

Participants noted several groups with whom they would like to share material from the curriculum, including: new 4-H members, 4-H clubs, neighbors, friends, people selling livestock and anyone with animals. The following is a representative quote:

"I think I would've like to know this for my first year showing how I know it now because it would've really helped me."

The youth also identified various ways to share their new learned knowledge, such as: posters at schools and throughout the community, formal presentations to other 4-H clubs, PowerPoint presentations, materials like the informational video uploaded to the 4-H website, and talking to friends, family members, and neighbors. Representative quotes included:

1. *"You can make a page and put it onto the 4-H website maybe. It talks about what we learned and put it on the website."*
2. *"We can do posters around our community or school. If someone is wanting to build a new pen, they can contact the 4-H office or us who did this program."*

3. *"If we're having a dinner or a party at our house, we can talk to them (referring to neighbors)."*

Specific parts of the curriculum that were useful.

Participants stated that specific curriculum activities were particularly helpful to aid them in understanding and applying concepts: the food chain activity; skull and track activity; scenarios; and the risk assessment tool. Many participants shared that the skull and track activity would help them identify whether a predator was present and determine what kind of predator it was. According to the 4-H youth, the scenario and risk assessment tool helped them connect the material to their own environment and situation. Related quotes included:

1. *"It was nice to go back to my house and look at the problems I could potentially have with predators with my shelter and stuff."*
2. *"The track curriculum was pretty cool because we learned how to identify tracks from other animals."*

Curriculum suggestions.

The 4-H youths' suggestions for improving the curriculum included: presenting the service-learning material at the beginning of the curriculum, clarifying and simplifying questions in the curriculum modules and accompanying measurements, and changing some of the pictures (i.e. skulls) so they would be to scale. A few suggestions made by youth were:

1. *"I think having it (referring to service-learning module) earlier would be helpful. That way you have it in the back of your mind as you work through the project."*
2. *"The only issue I thought was sometimes there were questions that could be a little clearer. I interpreted it one way, but others interpreted it another."*

Post-Implementation Interviews

Three months after the first focus group was completed, interviews were conducted with each of the participants, individually or in pairs. A second focus group was planned, but due to logistics and timing, this was replaced by individual and paired interviews. At this time, the service-learning project had been completed and was being shared by the youth with other members of the community. The questions developed for these interviews were influenced by analysis of quantitative measures and the focus group held previously. The themes identified from the interview data included: service-learning process, application of knowledge and skills, curriculum components that were useful for the service-learning project, and curriculum suggestions. In the beginning of the analysis more themes were identified (e.g. sharing the video). To simplify the analysis process and to compare the data to other qualitative findings more easily, some themes were aggregated to form the final four.

Service-learning process.

All participants provided very similar descriptions about how they decided to develop the informational video. The 4-H facilitator presented the idea of a video and all agreed. The group then decided that everyone would have an individual section sharing what they wish they would have known about prior to their participation in this curriculum. Topics that participants mentioned they would have liked to have known included: placing latches on chicken coops, utilizing technological deterrents, examining openings in fences, birds of prey attacking small livestock/poultry, pet dogs injuring poultry, and rattlesnakes as predators of rabbits. When asked how the curriculum and service-learning experience impacted them and

the community, several participants shared that they thought it would help their community. One participant offered:

> *So, I hear a lot of stories about people losing their animals because of predators. People letting their rabbit roaming around the grass then going to get something from their kitchen and walk out and it's gone. I think this would be very valuable for people to know because they can be prepared for these things. You may not want to leave your rabbit out on your lawn while you go look for something; maybe bring it with you or have someone watch it while you look for something. I feel like it'd be very valuable if people would learn about this and actually figure out, oh maybe I shouldn't have done that in the past and maybe I should watch it in the future.*

Several youth described sharing the video and related information. A few participants had presented the informational video to their 4-H clubs and family members and friends. In addition, one participant had completed and presented a school report on the topic. Another youth articulated a desire to share the information with a veterinary class in the area. Participants also expressed a desire to present the video to chapters of the California Cattlewomen's Association and their neighbors. All participants voiced plans to further share the information, and three participants mentioned it would be helpful to have it on the 4-H website. Participants expressed that creating the video aided them in remembering the curriculum material and connecting the material to their personal lives. Salient quotes included:

1. *"We all got to have a little part in the video where we talked so it kind of made it personal."*

2. *"My favorite part about sharing the video was letting people know about the stuff that could happen if you don't do this or you don't do that."*

Application of knowledge and skills.

Interview data revealed changes in animal husbandry practices by the participants. Among the practices adopted included: placing a latch on chicken coops, changing housing and fencing (location and more sturdy material), using motion lights (adding new ones and replacing old ones for a family member), and continuing to use the curriculum risk assessment tool to review their own environment. The participants reported having implemented more changes than in the focus group. Two applications described included:

1. "*We've put a little more fencing around my pen and it helped a lot more because the dogs were getting in the pen*."
2. *I liked how they included you can use motion lights and how the motion lights when you move a sound goes off. I liked that because my grandma had that idea, but it didn't work because they were too old. So, we tried it, but they were too old, so we had to get another pair. But yeah next year we're going to get some ones that have more sound on it.*

Curriculum components useful for the service-learning project.

Specific activities from the curriculum modules that assisted with developing and sharing the video were the food chain activity, predator and prey activity, scenarios, skulls and tracks activity, and risk assessment tool. Participants' experiences with some of these activities were communicated:

1. *Just being able to think about the scenario and what was wrong helped me to go back to my animals' shelter and see my fence is kind of low, and there are some holes where my dog has dug in it. Just reminding me to keep an eye out for things around my animals were the most beneficial parts for me.*
2. *What also helped me was the risk assessment tool, and I still have that paper actually . . . I used it when I so my goats is supposed to have a baby so we're putting an extra house, its fully closed, a fully enclosed shelter and it very well planted in the ground so no predators can get in and it has a high fencing and the gate latches, it's very secure, very closed.*

Curriculum suggestions.

Participants also shared suggestions for improving the curriculum and video, such as including more details in the video (i.e. having each person pick two things), developing an animal flashcards activity, and adding more interactive activities and games. Specific suggestions included:

1. *"Each person picks two things that everyone can learn more about what we've learned."*
2. *"I would've liked to see more games . . . we could play on the ideas they were trying to teach."*

Summary

The retrospective surveys for each curriculum module illustrated that participants were found to have significant gains in content knowledge regarding predator depredation. The focus group, interviews, and service-learning video revealed that youth participants were aware of

predator issues and likely to be engaged in community efforts concerning this issue after participation in the curriculum. In addition, participants' specific input about the curriculum's successes and suggestions for improvement from the focus groups and interviews provided clues about which aspects of the curriculum influenced the service-learning project.

CHAPTER 5: DISCUSSION

Purpose of Study

The overall research question for this study was: How, if at all, do the content and pedagogy used in a 4-H curriculum contribute to the application of knowledge and authentic service-learning by 4-H youth? To answer this question, a sequential explanatory (quantitative then qualitative) mixed methods design was used (Creswell, 2003). The aim of the quantitative phase was to explore what influence, if any, an experientially-based curriculum using inquiry has on participating 4-H youths' content knowledge related to predator depredation. The focus of the qualitative phase was to examine which aspects of the curriculum contributed to youths' service-learning project and application of learned materials beyond the curriculum.

There were two main conclusions drawn from this investigation. The first major conclusion is that the constructivist-based science curriculum used in this study helped participants understand content material and aided them in the service-learning process. The second major conclusion is that service-learning provides opportunities for the 4-H youth to apply learned material from the curriculum to authentic contexts.

Interpretation of Findings

Theoretical Support of Research Outcomes: Constructivist Curriculum Activities Increased Participants' Content Knowledge and Aided in Service-Learning Experience

Retrospective survey outcomes from each curriculum module revealed statistically significant increases in mean scores for all participants (see Table 1 in Results Chapter) (IBM, 2017), indicating that participants' self-identified knowledge of the curriculum content increased. Science content is one Anchor Point of scientific literacy as defined by Smith,

Worker, Ambrose and Schmitt-McQuitty (2015) and is a necessary element to help advance scientific literacy among U.S. youth and the U.S. population overall (Falk, Randol & Dierking, 2011; Miller, 2012; National Academy of Sciences, National Academy of Engineering, & Institute of Medicine, 2010).

Most of the content knowledge gained in the curriculum was centered around understanding and mitigating predator issues in order to decrease depredation. Predator issues are a state, national, and international concern. Development of land and the destruction of natural ecosystems make livestock/poultry and predator interaction more common, leading to a greater risk for depredation (Department of Fish and Wildlife, 2013; Morehouse et al., 2018). For example, there has been an increase in the application for predator depredation permits in California in recent years. In 2015, 248 permits were issued for mountain lions, and 101 mountain lions were killed in California (California Department of Fish and Wildlife, 2016). The coexistence of predators and livestock/poultry is necessary for the ecosystem and economy of California (Morehouse et al., 2018; Ramler et al., 2014). The participants in this study expressed knowledge about the widespread impact of predation through comments related to the effects it has had on their lives, their neighbors' lives, and, more broadly, the field of animal agriculture. For example, one participant shared that they believed "anyone with animals should learn about [predator and depredation issues]."

With respect to constructivist-based learning, participants in this study developed their knowledge through the experientially-based activities in the curriculum. The activities used guided inquiry, a constructivist-based learning strategy (Colburn, 2000); additionally, activities were sequenced in order to help youth build knowledge and skills over time (Tyler, 1949, 1977).

Furthermore, the curriculum included opportunities for youth to apply new knowledge and skills to real-world situations. Known as horizontal organization (Tyler, 1949, 1977), this provided the framework for the service-learning projects that participating youth developed and involved citizen science.

With the evidence that youth increased their content understanding through the curriculum activities, we also endeavored to identify components of the curriculum most beneficial to learning and most helpful for developing a service-learning project. Qualitative outcomes revealed that "learning-by-doing" (Enfield, 2001) activities were most helpful. Again, from a constructivist-perspective, youth developed their knowledge by making meaning from their own experiences (Dewey, 1933; Flavell, 1992; Fosnot, 1996; Piaget, 1964).

The 4-H youth participants shared that experiential-based activities, particularly the scenarios, risk assessment, and mitigation tool, helped them develop the video. In addition, the 4-H youth seemed to be appropriately applying their new knowledge to their livestock and poultry. For example, one participant explained how they used the risk assessment tool to care for a new baby goat, considering all the different categories in the tool. Advancing scientific literacy through constructivist activities will help youth make informed decisions and become more effectively engaged in their communities.

Theoretical Support of Research Outcomes: The Emergent Theory of the Role of Context in Service-Learning Practice and Opportunities for Application of Learned Material to Participants' Environment and Community

All participants contributed to the development of the informational video for their service-learning project. The video helped the youth apply and remember the learned material

from the curriculum. The 4-H youth expressed an interest in the information they shared in the video and were able to connect the knowledge and skills to their personal experiences and community issues. For example, a participant shared in the informational video and interview about watching out for stray dogs as possible predators because there are many dogs in their neighborhood. This participant was able to apply curriculum material directly to their personal context.

The Emergent Theory of the Role of Context in Service-Learning Practice (Fox & LaChenaye, 2016) considers the following factors: human capital, temporal influences, locus of support, relationship to topic, and culture of service-learning. Participants making connections to their experience and context reflects a relationship to the topic. The locus of support factor was present in the existing skills and access to equipment for videography the participating 4-H youth possessed. Additionally, the application of learning relates to another Anchor Point of youth scientific literacy – contribution through applied participation – which was evident in the participants' service-learning experience (Smith et al., 2015).

The service-learning process described by participants in this investigation incorporated many of the standards identified by The National Youth Leadership Council (NYLC) to help implement high-quality service-learning for K-12 youth (Kielsmeier, 2011). Three of the NYLC standards, in particular, were present in participants' experience. The first one is meaningful service (Kielsmeier, 2011). The 4-H youth shared that they believed that their video would benefit others e.g., new 4-H members, farmers, ranchers, and decrease depredation and increase non-lethal husbandry methods in their communities. The second standard that was reflected in this study was the link to a curriculum (Kielsmeier, 2011). Concepts and content

from the curriculum were present in the informational video, focus group and interviews. The youth were applying material they learned from the curriculum to their personal contexts. Reflection is the third NYLC standard shown in this service-learning process (Kielsmeier, 2011). The participants were involved in reflection through service-learning reflection forms and developing the informational video.

One notable example of the application of learning to an individual context is when one participant highlighted how they could share their newfound knowledge to aid others in protecting poultry and predators with a new policy in their community. This participant explained:

> *It would be really important, too, because Yreka recently passed a law where people in the city are now able to have chickens in the city limits. So, I think getting information like this out to them, which they may have never had animals in the city before thinking more about predators and stuff getting their animals. They could be in city limits learning more about animals, I think it'd be important.*

The knowledge and experience this participant gained in this study is being applied to real-world situations, not only in their immediate environment but in the wider community. This is an example of civic scientific literacy through serving as a citizen scientist and community science expert (Barton et al., 2013; Rudolph & Horibe, 2016).

As the factors in the Emergent Theory of the Role of Context in Service-Learning Practice (Fox & LaChenaye, 2016) described, a culture of service-learning is something the participants expressed the desire to develop. They conveyed how they would like to continue to share their

informational video, skills, and knowledge with their community and be involved in further service-learning activities.

Opportunities for Future Research and Expanding Youth Engagement

This study presented many opportunities, foreseen and unforeseen, for future research and expanding youth engagement. For example, this study identified participants' passion and interest about predation and depredation in their communities. A youth participatory action research (YPAR) project focused on predation and depredation could help foster and promote this interest while expanding participants' knowledge, skills, and experience (Ardoin et al., 2013). In this way, service-learning experiences could serve as an introduction to YPAR. In nonformal and inquiry-based learning settings like 4-H, it is important to search for and recognize opportunities for future programming to build on youth interests and needs (Arnold, 2018).

In addition, it would be interesting to assess the growth of the participants from this study longitudinally. Will participants' application and sharing of knowledge and skills learned through this project be similar in six months, one year, or two years? Will it increase? Decrease? This information, along with county and state-wide predation and depredation rates could help assess long-term impacts of this project on this authentic community need.

A Thriving Model of Positive Youth Development within 4-H: Advancing Competence, Connection, and Contribution

4-H currently has three national mission mandates: citizenship, healthy living, and science ("About 4-H", n.d., & Silliman, 2007). The findings from this study and curriculum support the citizenship and science mandates. Some of the core areas of citizenship are service,

leadership, civic education, and civic engagement (4-H National Headquarters, 2011). The core areas of the science mandate include: environmental science and natural resources, animal science and agriculture, life science and technology, engineering, consumer science, and applied mathematics (4-H National Headquarters, 2011). The UC ANR's Strategic Vision also emphasizes the need for youth to have more opportunities for engagement, which the participants' service-learning experience from this study reinforces (UC ANR, 2009).

A foundational aim of 4-H programming is positive youth development (PYD) (Arnold, 2018; Campbell, Trzesniewski, Nathaniel, Enfield & Erbstein, 2013; Larson, Dubois & Rhodes, 2006). The PYD framework that supports the findings identified in this study is the 4-H Thriving Model (Arnold, 2018). Within the developmental context of the 4-H Thriving Model, there are three outcomes from this study that connect with the participants' experiences: competence (knowledge and skills), connection (relationships and community), and contribution (giving back) (Arnold, 2018). Specifically, competence is evident through the identified gains in youths' learning and application of knowledge and skills; the participants' consistent pattern of connecting predation and depredation to their own context and communities supports connection; and contribution is shown through the service-learning project and sharing of knowledge and skills about predation and depredation.

Researchers' Reflections

Much like the participants, I gained knowledge and skills directly from my work developing the curriculum and conducting this research. Some key knowledge and skills I gained were: mixed methods, interviews, and backward design. Before this study, I had never intentionally been involved in mixed methods research. Through this experience, I furthered my

knowledge about mixed methods structure, question development, and analysis. In addition, my facilitation and analysis of interviews and my ability to develop open-ended questions improved. The curriculum development and research design process aided me in advancing my backward design skills.

Having over a decade of experience in service-learning as a practitioner, researcher, student, and community partner, I strongly believe in the power of service-learning. This could lead to confirmation bias that may impact the research design and analysis (Kirshner, Pozzoboni & Jones, 2011). My experiences may lead me to overestimate youth impact and engagement.

Limitations

The small sample size (*n*=7) is one of the main limitations of this study. Despite our best efforts, we were not able to have a larger number of 4-H participants. Not only is this sample size small, but it also lacks diversity. For example, only one male participated, and all the participants resided in one county. Due to this small sample size, generalizations beyond the scope of this investigation cannot be made.

One of the reasons for our limited sample size was that only one county 4-H program participated. This was due, in part, to the time of year counties were asked to participate. The 4-H program year typically runs parallel to the K-12 school year, beginning in September and ending in late May (Smith, personal communication, 2018). Much of the recruitment for this study occurred in the winter and spring when youth were already committed to other 4-H projects for the year.

Another limitation was the short duration of curriculum implementation (approximately two weeks). This limitation may explain some of the mixed or unexpected findings we

identified, such as the variety of lethal and nonlethal choices identified in the predation scenario responses in the pre-/post-surveys. It is possible that behavior and attitude changes were not measurable in such a short time frame based on the "splashdown effect," which refers to how it can take time for changes in learning to be measurable (Stake & Mares, 2001; Weinberg et al., 2011). In addition, it was not logistically possible for most individuals to implement multiple new animal husbandry techniques to reduce depredation because of time and resource challenges in just two weeks.

Furthermore, one of the NYLC standards of service-learning is duration (Kielsmeier, 2011). There is debate in the service-learning literature about how long a service-learning project needs to be for positive impact. Previous research by Billig, Hofschire, Meyer and Yamauchi (2006) found that at least 40 hours of exposure to service-learning are needed to see benefits (Scott & Graham, 2015). By the end of this study, the participants in this investigation had not spent 40 hours on their service-learning project, perhaps limiting the potential of learning and further application to the community. However, despite the small exposure to service-learning, it was evident that the youth did gain knowledge and skills that they plan to continue to share with their communities.

One additional challenge with the short duration of implementation was having limited youth and community engagement opportunities. With this short amount of time, the full process of a high-quality service-learning project was not able to be accomplished. For example, the informational video the participants developed as their service-learning project was originally proposed by the adult facilitator instead of through youth voice, which is one of the

standards of high-quality service-learning identified by the NYLC (Kielsmeier, 2011). However, due to multiple other commitments the youth had, this was the best fit for the participants.

Moreover, it might not be reasonable or a goal of the community to have youth fully involved in every step of a service-learning project depending on the context. London (2007) proposes that the primary question to consider in youth's involvement in youth participatory action research (YPAR) should be: "what is the highest degree of participation that our own capacity will allow us to responsibly support over time?" (p. 411). Service-learning facilitators and participants should ask themselves a similar question. The community is at the core of service-learning, so it is essential to do what fits best with the context.

Recommendations for Future Research and Development

To address many of the limitations discussed above, similar studies should be conducted with larger, more diverse samples over longer periods of time. To assure the samples are diverse, the following variables could be considered: geographic location, age, gender, race, ethnicity, and cultural background. Furthermore, diversity is one of the NYLC standards of high-quality service-learning (Kielsmeier, 2011). As has been shown over time in the learning and human development literature, context matters (Dewey, 1902, 1938; Fox & LaChenaye, 2016; Kirscher, Sweller & Clark, 2006; Kolb, 1984). To assess the generalizability and validity of this study, multiple contexts are desirable.

Another area of recommended future research is the intentional application of inquiry-based learning and service-learning to other curricula topics within 4-H statewide and nationally. The service-learning module in the curriculum used in this study could be adapted for use with other subject matter areas and could serve as a model for future 4-H curricula.

In addition to K-12 service-learning research not being widely studied, the research focusing on nonformal education is even more limited (Billig, 2000; Furco, 2013). Other nonformal and youth development organizations could follow similar approaches, pedagogies, and methods from this study to promote and evaluate the application of learned materials to communities through service-learning. Out-of-school time offers invaluable opportunities for authentic learning and application, which are not being utilized fully (Falk & Dierking, 2010). The expansion of service-learning program implementation and research in nonformal learning environments has the potential to help address many contemporary issues in communities through promoting experiential learning and the application of learned material and skills by youth participants.

Conclusion

"Tell me, and I will forget. Show me, and I will remember. Involve me, and I will understand" (Seigel & Rockwood, 1993, p. 67). This quote captures the essence of service-learning and inquiry that participants experienced with applying learned materials from the new 4-H curriculum to their community. The constructivist activities in the curriculum and service-learning experience lead to the authentic understanding and application of learned material to the individual contexts of the 4-H youth (Dewey, 1933; Flavell, 1992; Fosnot, 1996; Piaget, 1964). The curriculum promoted scientific literacy in predation and depredation issues while offering opportunities for implementation in local communities. This promotes positive youth development (Arnold, 2018) and fulfills many of 4-H mandates and focus areas (4-H National Headquarters, 2011; Silliman, 2007; UC ANR, 2009). The curriculum and accompanying research could, potentially, serve as a model for future 4-H curricula across

subject areas for the intentional inclusion of service-learning and inquiry-based learning. With the predation and depredation content knowledge and experience received in the curriculum, the participants can now be citizen scientists and community science experts sharing their knowledge and skills, through service-learning projects like the informational video, and can do more to address authentic needs in their communities.

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Appendix A

Contextual Information from Open-Ended Questions in Pre-/Post-Survey

The open-ended questions in the pre- and post- surveys identified contextual information. For example, each of the participants was raising the same type of livestock and poultry in the pre-/post-surveys. Three out of the seven participants were raising multiple animals. The types of livestock/poultry being raised were: sheep, swine, angus heifer, dairy heifer, goats, chickens and rabbits. Four out of the seven participants shared they were raising an animal because of a family member. Other reasons for raising an animal included personal interest and food. The predators present in the area according to the 4-H youth were: coyote, wolf, bobcat, bear, mountain lion/cougar, owl/other birds, raccoon, and rabid animals.

The communities in which the participants resided varied from rural to suburban. Most lived in somewhat rural locations. Common responses for how the community could get involved were: rebuilding damage, helping improve shelter and fencing, and improving local wildlife services. Five out of the seven participants indicated that depredation like that described in the measurement scenario impacted their community. The main reasons shared about how depredation impacted the 4-H youths' communities were that their neighbors had poultry/livestock and their personal actions (i.e. installing deterrents) would influence their neighbors.

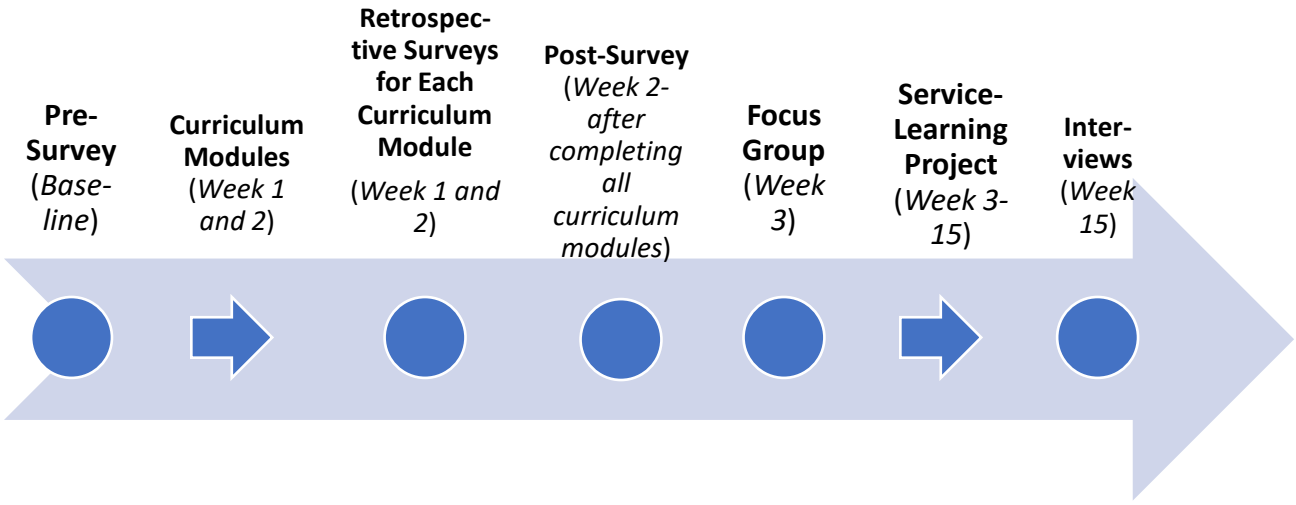
Appendix B

Curriculum Module Learning Objectives

Module Title	Learning Objective(s)
Biomes and Habitats	• To characterize the six terrestrial biomes across the globe • To describe features of different types of plants and animals specific to six terrestrial biomes
Food Web	• To learn and be able to understand the different categories within the food web and how they interrelate • To learn about the connections between predators and prey • To learn about needed organisms in a food web and how they can affect the balance in an ecosystem
Predator Identification	• Youth will gain an understanding of how to identify some predators and prey. They will be able to apply their understanding to help identify animals in the area where they live
Risk Assessment and Mitigation	• Youth will be able to identify factors that may put a 4-H livestock or poultry project at risk for predation and develop a mitigation plan
Service-Learning and Application	• Youth will gain a basic understanding of service-learning including the goals, processes and various types of service-learning and community engagement • Youth will be able to use the knowledge and tools in this module to develop, implement and reflect on service-learning projects in their own community • In the youth's community there will be an increase in awareness about predator and livestock/poultry depredation including an increase in non-lethal animal husbandry practices and decrease in predator and livestock/poultry depredation

Appendix C

Timeline of Measurements



Appendix D

Pre-/Post-Survey

You have been asked to answer these questions because you are participating in a 4-H animal science project (livestock or poultry).

Please imagine the following:

- **Lately, you have seen some animal tracks around your property and have heard a variety of animal calls other than those from your project animal and pets. Your neighbors told you that they have seen and heard similar things. You think this might be a predator.**

- **How would you respond to this situation described above, if at all? The table below provides several options for predator prevention or control. Please circle all the methods you might consider. You can choose as many or as few as you would like. There are no right or wrong answers, but please make your best effort.**

Use a night pen	Set traps (non-lethal).*	Use electric wire fencing	Use barbed wire fencing
Have enclosed housing (4 walls, no roof)	Use a Livestock Protection Animal (LPA)	Move your project animal's housing to a safer location	Fix your project animal's housing if broken
Use light deterrents	Set snares (non-lethal)*	Use underground fencing	Use poison (lethal)
Use sound deterrents	Wait and see what happens	Get a depredation permit	Remove leftover food and water for pets and/or project animal
Have enclosed housing (4 walls and a roof)	Tall fencing	Fix your project animal's fencing if broken	Call local wildlife/ animal services

*Be sure to check local laws/regulations

Additionally, please answer the questions below. Again, there are no right or wrong answers.

We just want to know your thoughts and ideas.

Which of the methods you circled above would be your first choice? Please explain why.

Please share other ideas you might have for predator prevention or control:

Do you think this situation described above could affect others in your community/neighborhood? Please explain why or why not.

What do you think is your community?

If you believe that the situation described does affect your community what, if anything, would you recommend your community do to respond?

What kind of 4-H project animal are you raising?

What made you want to raise this type of a project animal?

Knowing where you live, what type of predator do you think might have access to your property?

Appendix E

Retrospective Survey Questions

Module Title	Retrospective Survey Questions
Biomes and Habitats	A. After participating in this activity my understanding of what biome I live in is: AA. Before participating in this activity, my understanding of what biome I live in was: A. After participating in this activity my understanding of why animals and plants live in certain biomes is: BB. Before participating in this activity my understanding of why animals and plants live in certain biomes was: B. After participating in this activity my ability to identify a biome is: CC. Before participating in this activity my ability to identify a biome was: C. After participating in this activity my understanding of how the climate in the biome where I live might affect my project animal is: DD. Before participating in this activity my understanding of how the climate in the biome where I live might affect my project animal was: E. After participating in this activity, my understanding of how human interventions (e.g. housing developments) might influence a biome and the plants and animals that live there is: EE. Before participating in this activity, my understanding of how human interventions (e.g. housing developments) might influence a biome and the plants and animals that live there was:
Food Web	A. After participating in this activity my understanding of the food web is: AA. Before participating in this activity my understanding of the food web was: B. After participating in this activity, I am able to identify different types of foods an animal eats based on the physical characteristics (e.g., skull; teeth) of the animal: BB. Before participating in this activity, I was able to identify different types of foods an animal eats based on the physical characteristics (e.g., skull; teeth) of the animal: C. After participating in this activity my ability to see the connections of different animals within a food web is: CC. Before participating in this activity my ability to see the connections of different animals within a food web was:

	D. After participating in this activity my understanding of how increasing or decreasing the number of animals of one type or another (e.g., prey; predator) within a food web could affect an ecosystem is: DD. Before participating in this activity my understanding of how increasing or decreasing the number of animals of one type or another (e.g., prey; predator) within a food web could affect an ecosystem was: E. After participating in this activity, my awareness of how human actions could influence a food web: EE. Before participating in this activity, my awareness of how human actions could influence a food web was:
Predator Identification	A. After participating in this activity my ability to use an animal identification field guide is: AA. Before participating in this activity my ability to use an animal identification field guide was: B. After participating in this activity my understanding of strategies to identify a predator is: BB. Before participating in this activity my understanding of strategies to identify a predator was: C. After participating in this activity my ability to observe a predator's footprint and determine what type of predator it belongs to is: CC. Before participating in this activity my ability my ability to observe a predator's footprint and determine what type of predator it belongs to was: D. After participating in this activity my understanding of what predators might live near where I live is: DD. Before participating in this activity my understanding of what predators might live near where I live was:
Risk Assessment and Mitigation	A. After participating in this activity my understanding of depredation is: AA. Before participating in this activity my understanding of depredation was: B. After participating in this activity, I am able to identify what risks of predation my project animals might face are: BB. Before participating in this activity, I am able to identify what risks of predation my project animals might face were: C. After participating in this activity I am able to use husbandry practices to reduce my project animals risk of predation:

	CC. Before participating in this activity I was able to use husbandry practices to reduce my project animals risk of predation: D. After participating in this activity my ability to develop a predator risk mitigation plan is: DD. Before participating in this activity my ability to develop a predator risk mitigation plan was:
Service-Learning and Application	A. After participating in this activity my understanding of service-learning is: AA. Before participating in this activity my understanding of service-learning was: B. After participating in this activity, I am able to identify resources and community partners in my area: BB. Before participating in this activity, I was able to identify resources and community partners in my area: C. After participating in this activity my ability to develop a service-learning plan is: CC. Before participating in this activity my ability to develop a service-learning plan was: D. After participating in this activity my understanding of how my actions may influence my community is: DD. Before participating in this activity my understanding of how my actions may influence my community was: E. After participating in this activity, my belief that I can make an impact on my community is: EE. Before participating in this activity, my belief that I can make an impact on my community was:

Appendix F

Focus Group/Interview Questions

Focus group questions.

- Describe you service-learning project(s).
    - Explain the planning process, implementation (action), reflection and sharing process.
    - Explain how you think your project(s) has or will affect your community.
- *Key Question:* Explain what specific parts of the curriculum, if any, help foster your community engagement. (Briefly describe the modules and activities if needed).
    - Explain what ways can you tell what you learned after participating in the curriculum (i.e. skills, content, application, transfer to other situations).
    - Explain any new animal husbandry methods you learned. Describe if you are planning on implementing any new methods or not.
    - Describe the successes of the curriculum.
    - Describe what improvements could be made to the curriculum.
- Explain, how if at all, you have shared this learning with your community.
    - Explain any future steps you have taken or plan to take in regards to preventing depredation and engaging your community with this topic.
- *Ending Question:* Any other feedback, comments or questions?

Interview questions.

- *Opening Activity*:

- Please fill out the Service-Learning Reflection form. There are no right or wrong answers. Please just respond honestly.
- Describe your service-learning project(s).
- Explain the planning process, implementation (action), reflection and sharing process.
    - Can refer to Service-Learning Reflection form and offer specifics about video, process and timeline if needed.
- Explain how you think your project(s) has or will affect your community.
- *Key Question:* Explain what you learned from the curriculum. What specific parts of the curriculum, if any, influenced your service-learning project? (Briefly describe the modules and activities if needed).
- Explain, what if anything, you gained from the learn-by-doing process in the curriculum?
    - Can offer examples (tracks, scenarios, risks assessment)
- Explain what ways can you tell what you learned after participating in the curriculum (i.e. skills, content, application, transfer to other situations).
- Explain any new animal husbandry methods you learned. Describe if you are planning on implementing any new methods or not.
    - In the past focus group actions about changing housing and fencing (latches, motion sensors) were described
- Explain, how if at all, you have shared this learning with your community.
    - Previously it had been shared that you planned to reach out to other 4-H groups and agriculture groups in the area. Also mentioned you would share with family members, friends and neighbors.

- Explain any future steps you have taken or plan to take in regards to preventing depredation and engaging your community with this topic. (i.e. sharing the video, helping neighbors)
- *Ending Question:* Any other feedback, comments or questions?

Appendix G

Options Most Selected in Predation Scenario Chart in Pre-/Post-Survey

Category	**Number of Times Selected in Pre-Survey**	**Number of Times Selected in Post-Survey**
Tall fencing	7	6
Move your project animal's housing to a safer location	6	5
Call local wildlife/animal services	5	5
Fix your animal's fencing if broken	5	5
Have enclosed housing (4 walls and a roof)	4	6

Appendix H

Options Least Selected in Predation Scenario Chart in Pre-/Post-Survey

Category	**Number of Times Selected in Pre-Survey**	**Number of Times Selected in Post-Survey**
Wait and see what happens	1	0
Use poison (lethal)	1	1
Have enclosed housing (4 walls, no roof)	0	3