Fall 5-2020

Applying Agriculture Curriculum as a Vehicle for Science Learning

Nicole Sorensen
University of Nebraska-Lincoln, nicole.dangelo@huskers.unl.edu

APPLYING AGRICULTURE CURRICULUM AS A VEHICLE FOR SCIENCE LEARNING

by

Nicole L. Sorensen

A DISSERTATION

Presented to the Faculty of

The Graduate College at the University of Nebraska-Lincoln

In Partial Fulfillment of Requirements

For the Degree of Doctor of Education

Major: Educational Studies

Under the Supervision of Professor Julie Thomas

Lincoln, Nebraska

May, 2020

APPLYING AGRICULTURE CURRICULUM AS A VEHICLE FOR SCIENCE LEARNING

Nicole L. Sorensen, Ed.D.

University of Nebraska-Lincoln, 2020

Advisor: Julie Thomas

Agricultural educators in Nebraska are confronting increasing need to integrate science, technology, engineering, and mathematics (STEM) education into agricultural curriculum. Though there are more than 80 agricultural education programs in Nebraska, the state does not provide many state-based curricula options within agricultural education pathways. The purpose of this exploratory survey research is to learn about the viability of an integrated, agriculture and science-based curriculum that is publicly available to agricultural education instructors. The study posed the questions: (1) What is the feasibility of a publicly available, science-integrated agriculture curriculum within Nebraska agricultural education programs? and (2) What are the benefits of a science-integrated agriculture curriculum within Nebraska agricultural education programs?

This study engaged Nebraska agricultural education instructors to explore the viability of a reconstructed companion animal biology course that integrated biology. This companion animal course (originally organized in an online format) included content focused on biological principles, which allowed the alignment of Nebraska College and Career Ready Standards for Science (NCCRS-S) Life Science, and Nebraska Agricultural Education Small Animal Management or Veterinary Science state standards within an animal biology course.

Online survey assessment of a sample unit of the integrated biology and agricultural education course, Companion Animal-Biology, indicated that Nebraska agricultural education instructors found the course allowed successful implementation of both science and agricultural education standards. Through the inclusion of this curriculum into their classrooms, participant Nebraska agricultural education instructors determined this small animal science unit would better prepare students for science learning. Participants also stressed the apparent need for integrated science and agricultural curriculum within the state of Nebraska. In sum, Nebraska agricultural education instructors were newly confident about this resource to teach an integrated science and agricultural education curriculum. This new curricular approach will provide a resource for agricultural educators who are lacking (a) content knowledge in both companion animal and/or core science subject areas, as well as (b) approaches for integrating core sciences into agriculture education. These research results can help inform Nebraska agricultural educators about opportunities for growth and implementation of integrated, science and agricultural curriculum within their classrooms.

Keywords: agricultural education curriculum, integrated science, curriculum alignment

ACKNOWLEDGEMENTS

I would like to thank my family and friends for their support during this journey towards my EdD. Thank you to my husband, Scott, for being the best support system that I could ask for as I chose to continue my education towards my doctorate. Thank you to my parents, Don and Linda, for their encouragement since the beginning of my academic career. Thank you to my friends for making my entire college and EdD experience unforgettable. Finally, I want to express my sincere gratitude to all of my committee members but most especially my advisor Dr. Julie Thomas, for guiding me throughout my EdD process, and to Dr. Lisa Karr, for supporting me from my first day at the University of Nebraska-Lincoln.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

CASE .....Curriculum for Agricultural Science Education

CDE .....Career Development Event

FFA.....National FFA Association, formerly Future Farmers of America

LDE.....Leadership Development Event

NCCRS-S.....Nebraska College and Career Ready Standards for Science

NCLB.....No Child Left Behind

NDE.....Nebraska Department of Education

NSF.....National Science Foundation

SAE.....Supervised Agricultural Experience

STEM.....Science/Technology/Engineering/Mathematics

CHAPTER I.

INTRODUCTION

Overview of the Issues

Throughout their academic career, secondary students are able to take a variety of courses that can influence their learning. Students have expressed that agriculture class is a different kind of class; one that is a different kind of learning and often a break from their regular core subjects of math, science and English. In some instances, students fail to see that there are multiple connections in each agriculture lesson to the subjects that they are "taking a break from." Meyers and Washburn (2008) explained that career and technical educational programs are encouraged in academic settings because they encourage learning in the core areas of math, science and reading and have proven to promote student achievement in such areas. Utilization of career and technical education, specifically agriculture, can facilitate student learning in a non-traditional classroom atmosphere. Further supporting this idea, Thompson and Balschweid (2000) stated, "Students would be better prepared in science after completing a course in agricultural education that integrated science." The literature determined that students, who complete an agricultural education course, had a better understanding of both science and agriculture when weaving both concepts together.

Problem of Practice Overview

Nebraska agricultural education is consistently growing to include students whose interests range from traditional agriculture (ranging from small operations to industrial-sized agriculture) to more modern agriculture (use of more technological advancements, such as drones and robotic systems). Regardless of interest, agricultural education

provides context for core science standards through situational-based learning practices. Simultaneously, the continued growth of Nebraska agricultural education programs indicates a need for more agricultural education curricula.

The proposed curriculum in this study provides teachers and students with the integrated context of companion animal management (agricultural education) to support biological principles (science education) while and the option of a credit in a life science course. The survey data received from Nebraska agricultural education instructors addressed a need to assist all students to achieve a science credit through an agricultural education course, while providing practicing agricultural educators with a public resource to lessen the pressure of teaching and advising FFA.

Statement of the Problem

This exploratory survey research focused on two specific challenges related to agricultural education in Nebraska. The first challenge was to address the increasing momentum of integrated science, technology, engineering, and mathematics (STEM) education programming that prompts Nebraska agricultural educators to incorporate more science-based learning into the agriculture curriculum. Certainly, agriculture houses a natural foundation in science, however agricultural education instructors rarely address science standards in agriculture classes because science is not directly included in the current set of agricultural education standards.

The second challenge was to address limited curricula options; though there are more than 80 agricultural education programs in Nebraska, the state does not provide many state-based curricula options within agricultural education pathways. To combat this issue, Nebraska Agricultural Education offers scholarship-based trainings for the

Curriculum for Agricultural Science Education (CASE) provides complete curriculum trainings are comprehensive and effective within the classroom, but the training costs (and time commitment to a five to ten-day training) often turns instructors away.

Purpose of the Study

The purpose of this exploratory survey research study was to learn about the viability of an integrated, agriculture and science-based curriculum that could be publicly available to agricultural education instructors. In this study an integrated, science and agriculture curriculum model was given to a sample of Nebraska agriculture educators. Participant educators completed an online survey to offer their assessment about (a) the overall viability of the subject matter within their current programs and school district needs and limitations and (b) the likelihood of whether or not they might employ the problem-based, dual-subject curriculum (with animal science being utilized as a science) within their own classroom. This sample unit curriculum, rooted in agriculture education's steadfast animal science objectives, incorporated problem-based learning, will also enable students' learning of science.

These survey data will advise the usefulness of the proposed curriculum unit and inform Nebraska agricultural education leaders about teachers' interest and readiness to plan instruction matched with Nebraska's state agricultural education and science standards. Research results can help inform Nebraska agricultural educators about opportunities for growth and implementation of science and agricultural integrated curriculum within their classrooms.

Research Questions

This dissertation research focused on the survey results from a sample of Nebraska agricultural educators who provided assessment feedback on a sample, integrated unit which specifically addressed both Nebraska science and agricultural education standards. Study results provided Nebraska agricultural education instructors' assessment of science-integrated agricultural curricula.

The following exploratory survey research questions guided this study:

Research Question 1: What is the feasibility of a publicly available, science-integrated agriculture curriculum within Nebraska agricultural education programs?

Research Question 2: What are the benefits of a science-integrated agriculture curriculum within Nebraska agricultural education programs?

In brief, this research reviewed Nebraska agriculture educators' consideration of a modified animal biology curriculum to meet both the small animal management animal science or veterinary science and life science educational standards. This curriculum was designed and implemented to meet these standards with the approval of the agricultural education and science departments within the Nebraska Department of Education. Sample units were created and sent to agricultural educators throughout the state of Nebraska for feedback.

Definitions of Terms

Agricultural Education: Educational course for secondary students which teaches students about agriculture, food and natural resources, while including principles of science, math, communication, leadership and technology (What is Agricultural Education, 2019)

AgriScience: Agricultural instruction that emphasizes the principles, concepts and laws of science and their mathematical relationships as they describe, support and explaining agriculture (Thompson & Balschweid, 2000)

Biology: Science subject consisting of structure and function, independent and dependent relationships in ecosystems, trait inheritance and biological evolution (*Nebraska's College and Career Ready Standards for Science*, 2017).

Career Development Event: Competitive events designed to build on what is learned in agricultural education courses and prepare students for specific career fields (CDE, 2019).

Chemistry: Secondary science curriculum consisting of chemical structures, properties of matter and chemical reactions (*Nebraska's College and Career Ready Standards for Science*, 2017).

Companion (Small) Animal: Domesticated animals that are seen as companions within the home, specifically dogs, cats, small rodents, rabbits etc. (Companion Animal, 2019).

FFA: An intracurricular student organization that encompasses leadership, personal growth and career readiness through hands-on application of agricultural education (National FFA Organization, 2018).

Leadership Development Event: Competitive events that create situations for members to demonstrate their public speaking, decision-making and agricultural literacy (LDE, 2019).

Life Science: Science subject matter that consists of organism structure, generational connections, organismic interactions, living and non-living organisms and their environment and human biodiversity (*Nebraska's College and Career Ready Standards for Science*, 2017).

STEM Education: Educational subjects including science, technology, engineering and mathematics (Science, Technology, Engineering and Math, 2019).

Supervised Agriculture Experience: Three-Circle Model: three component model of agricultural education; includes classroom/laboratory instruction, FFA and Supervised Agricultural Experiences (SAE) (What is Agricultural Education, 2019).

Limitations

Research limitations included concern for school/class population size and the effect that it could have on data. In this, the researcher anticipated student background differences between larger, urban schools and smaller rural schools (which is where a majority of participants taught). Although these backgrounds provided additional insight, they also generated some questions of the data regarding the success of the curriculum. Given a timeframe that did not allow in-depth interviews with practicing agricultural education instructors, these research data were limited to survey responses.

Since this research involved survey feedback, receiving precise and complete data was also of concern. Self-reported data can present inaccuracies in responses or inconsistent and complete answers. To combat this, methods to maximize participant feedback guided inclusion of both Likert-Scale questions and short answer, open-ended questions.

Significance of the Study

Agricultural Education instructors naturally incorporate scientific principles into their daily curriculum, as the nature of agriculture is rooted in the core sciences. As science and technology have been changing over time, the need for strategic science standards incorporation has been growing. Considering the philosophy behind education and the framework for learning, literature has determined that agriculture is a valid context for science education. Not only is the context appropriate, but also the changing technology and the improvements in science facilitate this context for learning (Roberts & Ball, 2009).

Integrated practice has been done informally since the early days of the agricultural education and it has become seemingly more obvious within current teaching practices (Warnick, Thompson & Gummer, 2004). This could be due to the technological advances in both science and agriculture. Employing technology within our everyday lives, and increasing the reliance upon technology, only further supports the integration of science within agriculture. Agriculture is also deemed an instructional vehicle for mathematics and science, due to the emphasis of the subject-specific methods, laws, and

concepts (Thompson & Balschweid, 2002). This relationship can continue to thrive as new curricula is being developed and utilized throughout the United States.

Study Design

This study centered on a converted companion animal biology class, originally offered through the Animal Science department at the University of Nebraska-Lincoln. The converted companion animal biology class curriculum included lessons that focused on biological principles, which allowed the alignment of both the Nebraska State agricultural standards and the Nebraska College and Career Ready Standards for Science (NCCRS-S). This collaboration supported two desires within the Nebraska agricultural education community. First, the sample curriculum unit would provide a source for agricultural teachers throughout the state that integrated state standards for both science and agriculture. Secondly, this course would continue to serve as a resource for teachers who do not have a capstone animal-based course to teach, as well as those who do not currently offer a companion animal course. This course included the new NCCRS-S Life Science and Nebraska Agricultural Education Small Animal Management or Veterinary Science state standards within an animal biology course. Data were collected via participant surveys that was given, along with a sample curriculum unit to agricultural education instructors throughout the state of Nebraska for feedback.

By incorporating science into agricultural education, as was proposed in this research; students will have the opportunity to prepare themselves for the future in multiple content areas. This can shift the mindset of both the student and the instructor from being just an agricultural course or just a science course, to an agriscience course.

Agriscience can be defined as agricultural instruction that emphasizes the principles, concepts and laws of science and their mathematical relationships as they describe, support and explaining agriculture (Thompson & Balschweid, 2000). The relationship between science and agriculture is one that is supportive to both subject matters and enhances content in both areas.

Through the conception of this curriculum, it was anticipated that educators could follow the guidelines and expectations to incorporate life sciences within the agricultural education classroom. This curriculum was expected to provide educators with the ability to integrate the concepts presented in the curriculum across disciplines, contexts and for multiple fields of interest, more specifically, science. In Thomas and Balschweid's (2002) study of teachers who taught integrated science and agriculture, it was shown that the highest-ranking areas include teachers' belief that biology and science understanding is higher than it was ten years ago. Educators revealed that they believe agriculture is a comprehensive vehicle for teaching science subjects. With a literature-supported background, this research provides influential material that fits within both science and agricultural education standards.

In order to compile realistic opinions and reactions to the integrated curriculum, a survey was designed and sent to Nebraska agricultural educators. The survey consisted of questions addressing the curriculum's success or shortcomings of meeting concepts of both agriculture and core science subjects. Questions included options to rank-order the feasibility of the curriculum within Nebraska classrooms and the lessons' ability to meet multiple sets of Nebraska education standards. This survey was deployed via email to the

Nebraska Agricultural Education Listserv, which included a Google Forms survey and a sample unit of the proposed integrated curricula.

Summary

This study endeavored to understand how Nebraska agriculture educators thought about what agricultural education provides for students who struggle to learn core science principles, specifically those that are outlined in the new NCCRS-S and small animal management or veterinary science course standards. This study explored the way agricultural subjects facilitate the learning of core principles of science. In sum, this research, reviewed a method of integrated science learning, specifically through the teaching of different agricultural subjects, and surveyed agriculture education teachers to learn how they determined such integration could possibly contribute to students' learning of science.

CHAPTER II.

LITERATURE REVIEW

History of Agricultural Education

The history of agricultural education can be traced to early North American native indigenous peoples, who passed down cultivation methods to successive generations (Croom, 2008, p.112). These traditions can be seen by some as the most primitive forms of agricultural education. The mid-to-late 18th century was a turning point for early agricultural education, as teaching opportunities to better farming techniques were offered outside of traditional schooling. These offerings, more specifically agricultural fairs and the like, allowed farmers to better their practices (Croom, 2008, p.112). These practices led to the enactment of governmental acts to support agricultural learning.

Throughout the latter portion of 1800s, universities began to offer short courses in farming, agricultural practices and ranching. By 1860, 26 universities in Alabama, Kansas, Massachusetts, Illinois, Iowa, and New Hampshire led the way to agriculture program inclusion (Croom, 2008). Croom (2008) noted that the earliest recorded public school incorporation of agricultural education was in 1858 in Massachusetts. Revolutionizing governmental acts in the history of agricultural education included the Morrill Acts of 1862 and 1890. These acts provided realization that higher education could provide for the common person with interests in the agricultural and mechanical arts areas. The Morrill Acts gave way to public institutions of higher education called land-grant colleges (Barrick, 1989). These acts allowed agriculture to be seen as a different form of education, one that was utilizing the field of agriculture as principles and methods of teaching or learning (Barrick, 1989). Barrick (1989) expanded upon the idea that agriculture is not only an opportunity to apply science, but that formal education

in a collegiate setting could include more than the core subjects of arts literature and language.

Hamlin (1962) wrote that, before the first significant federal funding for agricultural education in 1917, thirty states provided agricultural education programs within their public schooling systems. The Smith-Hughes Act (1917) was an historical landmark for agricultural education as it provided for development of an organization for rural youth to learn best practices of agricultural production, as well as leadership skill development. Following this act, the National Future Farmers of America Organization (FFA) was formed in 1928 (Croom, 2008, p.114). As FFA grew and agricultural education students were taking part in FFA activities, a congressional charter for the National FFA Organizations was proposed in 1950. The charter allowed FFA organizations to, "Create, foster, and assist subsidiary chapters composed of students and former students of vocational agriculture in public schools qualifying for federal reimbursement under the Smith-Hughes Vocational Education Act" (National FFA Organization, para.1, 2006b). Croom (2008) explained that once the FFA was granted a congressional charter, the three-circle model was enacted to improve student performance within the agricultural education system. In the 1970's, the FFA promoted teacher development programs to include the integral, three-circle model of classroom and laboratory instruction as well as Supervised Agricultural Experience (SAE) and FFA.

Agricultural Education in Nebraska

Nebraska began its statehood in 1867, with the establishment of the University of Nebraska-Lincoln following shortly after in 1869 (McCreight, 1973). Thus, 1872 was the first year that agriculture was included within the University of Nebraska-Lincoln [and

occurred shortly after the creation of the College of Agriculture on the university's East Campus (Apel, 2017)]. In addition to the creation of the college of agriculture, a three (turned four) year secondary school was added onto the campus from 1895-1930 (McCreight, 1973). McCreight (1973) remarked that the conception of the secondary school paved way for the 1912 legislative act that funded secondary schools to have agriculture programs throughout the state. The Mallery Act of 1915 continued the state's support for vocational education as it provided funding for schools to offer such programs (McCreight, 1972).

Hastings and Scottsbluff were the first two secondary agriculture programs in the state of Nebraska, beginning in 1917 (McCreight, 1973). By 1971, there were 113 agricultural education programs in Nebraska, with 147 agricultural education instructors. As programs progressed, districts were formed throughout the state. As of 2018, there were twelve districts that span the state of Nebraska and help to congregate schools for both competition and leadership events (About Agricultural Education, 2018).

Agricultural Education Within the Nebraska School System

The primary reason for offering agricultural education within the Nebraska school system has been to connect agricultural education and career preparation. Throughout their agricultural education courses, Nebraska students prepare themselves for the possibility of entering an agricultural industry that will increase by over 2.5 billion people within their lifetime (N. D. of E., 2019). By introducing real-world concepts and applications of science, Nebraska agriculture educators are providing students with an opportunity to visualize a possible career goal. As of 2019, 189 Nebraska secondary schools (out of the possible 268) offer agricultural education (and in some instances, FFA

programs) at the middle school level (N. D. of E., January 2019).

Nebraska public schools have shifted to meet the demands of students who are ready to begin their career education in secondary schools. In addition to the agricultural education programs, secondary schools in urban Nebraska have created multiple career academies to facilitate the early steps of a student's career, mostly through dual credit options. These career academies not only prepare students for careers in agriculture, but also in medicine, technical education and many other diverse areas of study (N.D. of E., September 2019). In 2017, 25.6% of courses in agricultural education were offered as dual credit courses (Nebraska Department of Education, 2017).

The Evolution of Agricultural Education

Further changes in education have led to an academic emphasis on core subject knowledge (i.e., math, language, science, etc.). Consequently, agricultural education programs have been adjusting accordingly to scholastic, state and national changes (Roberts & Ball, 2009). Research literature attests to the adaptability of agricultural education programs throughout the years as it has proven to be beneficial. As Dreyfus (1986) explained, agriculture's continuous evolution has enabled its vitality amidst changing needs of the human population. A Content Based Model for Teaching Agriculture (Figure 2.1) describes the idea of how agricultural education provides a context for content, specifically sciences, to be taught and learned by the student (Roberts & Ball, 2009, p.84).

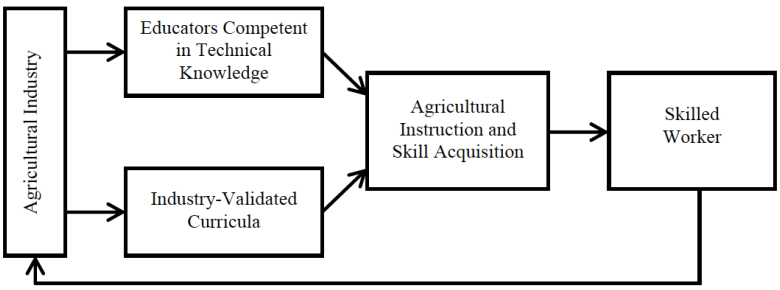


Figure 2.1 A Content Based Model for Teaching Agriculture (Roberts & Ball, 2009)

While agriculture was originally perceived as the enrichment component of science education, it is now seen as science that better corresponds to socio-human needs and agro-technical viewpoints (Dreyfus, 1986). The need for educators to be competent and well versed in both science and agriculture is a crucial component of student success. As noted above in *Figure 2.1*, the educator is a key link between industry knowledge and skill acquisition. Balschweid (2002) found that studies, conducted and replicated regarding science integration, supported findings that students taught by integrating agricultural and scientific principles demonstrated higher achievement than did students taught by traditional approaches (p.56). This higher achievement is attained primarily through the support of knowledgeable and experienced educators. As Roberts and Ball (2009) remarked, agricultural education teachers must be competent in industry-validated knowledge and skills. This valid idea suggests that agriculture instructors know a wide-vary of skills-from welding, to plant and animal science, to chemistry and beyond.

Resources and Curricula for Agricultural Education in Nebraska

Nebraska Agricultural Education standards exhibit a stronger scientific presence and career-readiness component in secondary agricultural education than there has been ever before. Each course pathway begins with an introductory course, leads to a focused area

of study (animal, plant or mechanical sciences) and ends with a capstone course to be completed in the high levels of a student's secondary education (CTE, 2019). The last major revision of the standards was completed in 2018, which dramatically changed the standards written in 2014, as shown below in Figure 2.2 (CTE, 2019).

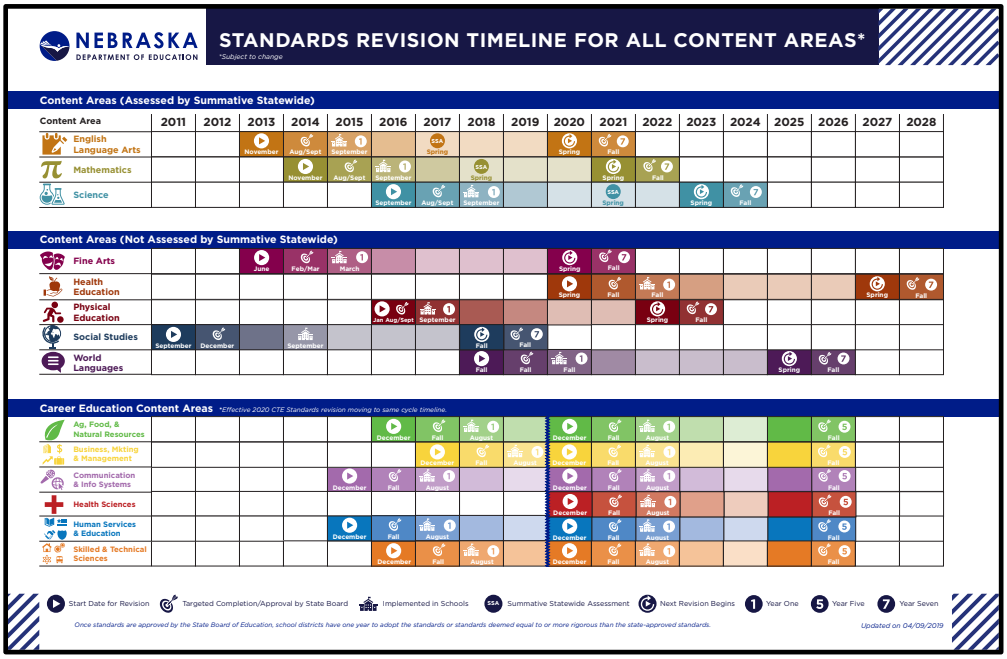


Figure 2.2 Standards Revision Timeline for Nebraska Dept. of Education Content Areas

These standards are on a five-year rotation and adjust to current trends in education and teaching practices. Rather than providing course guidance, the new standards reflect a similar tone in each course, echoing career preparation and exploration. (CTE, 2019).

Unlike other states, such as Colorado and Georgia, Nebraska does not currently offer a state-supported curriculum for agricultural education instructors (N. D. of E., 2019). Pre-packaged curricula are becoming more popular in classrooms due to their key connections between agriculture and national science standards. Provision of complete lesson plans, standards alignment, and material resources greatly benefits instructors' time and planning on a regular basis (Ulmer, Velez, Lambert, Thompson, Burris & Witt,

2013). Thus, Curriculum for Agricultural Science Education (CASE) has been popularized in classrooms across the United States due to their inclusion of hands-on learning and integration of science standards within the classrooms. CASE currently offers, “Four Program of Study pathways to increase the rigor of coursework while spiraling and scaffolding content knowledge and technical skills” (CASE, 2019). These pre-packaged curricula have allowed instructors to include more key components of biology, chemistry and physics within their courses. Research shows that prepackaged curricula not only provide instructors with direction, but the resources that they need to better prepare students for a career in the course-relevant field (CASE, 2019). In a 2013 study regarding the effectiveness of CASE curricula, it was found that the CASE curricula impacted teachers in positive ways, whether it was a direct result of the premade curriculum, or the change of philosophy used while teaching said curriculum (Ulmer et al., 2013, p.122).

School Organization Systems

Within Nebraska school systems, agricultural education is seen as an elective course in which students can explore different areas that could conceivably turn into a career field (Hoover and Scanlon, 1991). Historically, a common misperception in schools is linked to the limited understanding of science correlations and science content components within an agricultural education course. Agriculture has not always been seen as science and science has not always been seen as agriculture (Talbert and Balschweid, 2004).

Conversely, agricultural education can be viewed by both students and administration as a class with heavy emphasis on production agriculture (Hoover and

Scanlon,1991). While the United States currently has an agricultural workforce consisting of under 3% of the population, agricultural education can shift to meet the needs and demands of students, the workforce and changing career paths. This number of agricultural education instructors continues to decrease due to the technological evolution that continues to change the American farming industry. This change not only decreases the number of those who are directly engaged in production agriculture, but broadens the number of agricultural occupations and professions (Reis and Kahler, 1997).

The push for vocational education and agricultural education continues to grow throughout the nation. Despite common misconceptions, those involved in FFA and agriculture courses believe that they are being prepared for the future (Talbert and Balschweid, 2004). When polled, agricultural education students (both involved and not involved in FFA) rated agricultural education in the top 45% of courses that are important to take (Talbert and Balschweid, 2004). In a 2019 study completed by *Education Next*, it was determined that "high schoolers who take career and technology education courses achieve the same college success as students who focus on more academic courses" (Anderson, 2019, para. 1). From 2004 to 2018, Nebraska specifically has grown from 128 programs to 189 programs (Kreifels, 2018, p.24).

Agriculture as Supplemental Science Learning

High schools throughout the United States have thought of agricultural courses as different approaches to learning science. The 2001 No Child Left Behind Act (NCLB) can be considered a turning point for testing within the public school system. Testing requirements were increased and teachers were pressured to teach students so that they were able to "pass the test" (Ricketts, Duncan & Peake, 2006). This trend continues to

this day, whether it be for standardized testing or the ACT/SAT college prior exams. Dormody (1993) referenced *agriscience* as the, "Instruction in agriculture emphasizing the principles, concepts, and laws of science and their mathematical relationships supporting, describing, and explaining agriculture", in addition to having a foundation in biological and physical science (p.63). With this idea in mind, one might conclude that agriculture education could help to better these testing scores if a student was to take both courses.

Another approach to students' utilization of agriculture to increase science achievement might focus on offering dual credit science-agriculture courses at the secondary level. Students, who are taught using agriculture to apply science, have reached a very high level of cognitive performance as they can perceive and define problems (Dreyfus, 1986). While the passive inclusion of science in agriculture is evident throughout the United States, studies have found that it is happening intensely in multiple areas. Dormody (1993) found research that proved over half (53.1%) of a sample of teachers from multiple states were already infusing biotechnology into agricultural science courses. Although this is being demonstrated throughout the country, other issues arise regarding the need for teaching materials, funding for equipment and supplies. Johnson's (1996) study of Arkansas agricultural education teachers gave voice to those who believed that students should receive science credit toward high school agriculture courses 88.8% agreed, 6.1% were undecided, and 5.1% were opposed. Dormody (1993) created a table that connects which agricultural education courses can relate to science courses. Table 2.1 below depicts how science is directly integrated into different areas of agriculture.

Table 2.1 Agricultural Courses Receiving Science Credit

Areas of instruction	Course title or roots of title	n	%
Agribusiness	Agricultural Business (5 variations)	5	3%
Ag. mech. and engineering	Agricultural Mach. or Power (5 var.)	5	
	Agricultural Mech. or Eng. (4 var.)	4	
	Agricultural Construction	1	
	Recreational Vehicles	1	
	Small Gas Engines	1	
	Subtotal	12	7%
Agricultural processing	Meat Processing	1	1%
Agricultural production	Animal and/or Plant Science	27	
	Agricultural Production (7 variations)	8	
	Livestock Mgt.. Prod., Sci. or Tech.	4	
	Crop Production or Science	3	
	Veterinary Science	3	
	Aquaculture or Hydroponics	2	
	Dairy or Equine Science	2	
	Plant Parts, Functions & Growth Req.	1	
	Subtotal	50	30%
Likely an ag. production emphasis	Vo-Ag or Ag. I, II, IV and V	25	
	Ag. Science (5 variations)	14	
	Ag. Science and Tech. or Mech.	4	
	Basic, Adv. or Specialized Ag. Skills	4	
	Agricultural Education I. II or III	3	
	Agricultural Biology	2	
	Introduction to Agriculture	2	
	Agricultural Lab Skills	1	
	Occupational Science	1	
	Subtotal	56	34%
Forestry and horticulture	Horticulture (7 variations)	15	
	Forestry or Forest Science (3 var.)	6	
	Greenhouse Mgt. or Tech. (3 var.)	3	
	Landscaping and/or Nursery (3 var.)	3	
	Turf and Garden Management	1	
	Urban Forestry	1	
	Subtotal	29	17%
Resource management	Natural Resources (4 variations)	7	
	Conservation and/or Environ. Sci.	3	
	Wildlife Conservation or Mgt.	2	
	Soil Science	1	
	Subtotal	13	8%
Total		166	

Dormody (1993) argued that, by utilizing agricultural courses (as indicated in Table 2.1 above), educators could better teach science principles to students throughout the United States. To make this change, many teachers felt that their curriculum would not need to experience any major changes. When asked, 66% of Arkansas agricultural education teachers remarked that specific agriculture courses could be counted as science credit without any major revisions to the curriculum (Johnson, 1996). These ideas confirm the concepts of the respective subjects' curricula (agriculture and science) go hand-in-hand with one another.

Perception of Agricultural Education's Inclusion of Science

Agricultural education can be deemed a vehicle for science-learning. Results of studies analyzing science-agriculture integration highlighted the notion that agriculture teachers believe agriculture is an effective delivery method for science agriculture teachers are confident in their ability to integrate science concepts and agriculture classes are often more effective at increasing student science scores than standalone science courses (Smith, Rayfield & McKim, 2015). The natural behavior of both sciences, more specifically their interconnections, are pointed out in research across both agricultural education and STEM curricula. Stevens (1967) wrote that there is a community of scholarship between the natural science of agriculture and the behavioral science of education. as both are applied sciences. Barrick (1989) used the common example of animal science as a vehicle for learning, since it is a discipline that is rooted in the biological sciences. This makes application of the principles of genetics, nutrition, physiology and the like to animals, just as other disciplines apply those same principles to humans or to plants (Barrick, 1989).

Educational Interpretations of Agricultural Education

One of the largest disadvantages that agricultural education faces is the acceptance of agriculture as a science subject (Dormody, 1993). Not only do agricultural education courses typically have the word "science" incorporated into the name, but when aligned, state science standards often match those of core science classes such as biology and life sciences. Importantly, Nebraska's course coding system for agricultural education (as shown in Figure 2.2) reveals that multiple courses are named as science course (2019-2020 CTE, 2019). Despite agricultural education being known as vocational education, the content taught in these courses is based upon relational science. In Parr, Edwards and Leising's (2006) study, it was found that there is a need for school-based reform concerning curriculum integration of science and agricultural education course due to its effectiveness for student learning (p.90).

Student Opinions of Agricultural Education

Due to student perception of agriculture courses, those who choose agricultural education courses are often type-cast as those who do not do well in typical classroom situations. As well, there is a strong perception that the acquisition of a college degree is necessary for success in a student's future career. As students have focused on that idea, agricultural education course has been seen as courses for those who are less academically talented or struggle with core academic courses (Hoover & Scanlon, 1991, p. 2).

Students who thrive in hands-on learning, activity, and engagement-based lessons are often drawn towards agricultural courses due to the relativity of the content. Kinesthetic learners who are drawn to agricultural education typically do not see

themselves as those who thrive in core classes. Brown and Theobald (1998) emphasized activities that connect students to extracurricular activities, specially FFA, would have a strong benefit for students who might be disengaged from typical classroom instruction. Talbert and Balschweid (2004) referenced FFA and agricultural education as they theorized that activity involvement, especially those closely associated with academic outcomes, enhances achievement.

A student's choice to take agricultural education courses can stem from a variety of reasons. Connors, Moore, and Elliot (1990) reported that agricultural education students join their local FFA chapter and take agricultural education courses because of their personal interest in agriculture. Students often take vocational courses, including agricultural education, because of the career exploration options. By providing students with the possibility of taking exploratory courses in high school, they are able to explore their interests in different subject matter before being burdened with the cost of exploring subject in a post- secondary institution (Anderson, 2019). Overall, student perception of agriculture courses can also be based upon the titles of the courses themselves. As previously discussed (see Figure 2.2), course names not only have the word science included, but a specific area of application is included as well. Marshall, Herring and Briers (1992) found that students enrolled in agriculture courses due to the characteristics and topics of the course. Other studies reference personal relationships as the reason that a student might choose to take agricultural education courses. Many students choose the class itself based upon the recommendation of their friends, family, or perception of the instructor (Reis and Kahler, 1997).

Big Picture of Agricultural Education

Agricultural education, also known as vocational agriculture, encompasses multiple aspects of science, mathematics and agriculture. Through application-based learning, provided naturally through agricultural subjects, students are provided with skills that allow them to grow in core subject areas. At the beginnings of our educational system, White (2014) noted that the Morrill Act of 1862 held responsibility for the development of land grant universities that primarily focused upon agricultural training, but later incorporated engineering based training programs. Since the early 2000s, the importance of these subjects has become more prominent within Nebraska school systems.

Three Circle Model

The configuration of agricultural education is one that differs from the core subjects. Unlike English, mathematics or core science courses, agricultural education embodies multiple courses that fit together under the umbrella of agricultural sciences. The three circles referred to were the "traditional three circles depicting the components of an agricultural education program--Instruction, FFA and SAE" (Wilson and Moore, 2007, p.82). These courses are designed to fit within the Three Circle Model of Agricultural Education, as shown in Figure 2.3 (Agricultural Education, 2019).

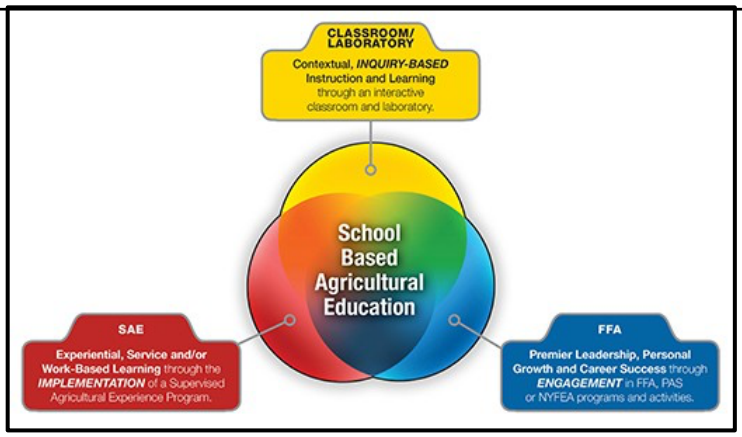


Figure 2.3 Agricultural Education Three Circle Model

This model contains the areas of classroom instruction, FFA and Supervised Agricultural Experiences (SAE) (Wilson and Moore, 2007, P.84). Classroom instruction consists of the school day learning, which can range from horticulture to food science to animal sciences. The National FFA Association described the FFA portion as the area that allows students to put their knowledge to the test in various competitions and leadership roles (Agricultural Education, 2019). More specifically, supervised Agricultural Experiences facilitate opportunities for students to put their knowledge to the test in a project-based learning setting that allows them to test-drive a career area (Agricultural Education, 2019).

Holistic Learning in Agricultural Education

Literature has addressed many aspects of the importance of agricultural education. Balschweid and Thompson (2000) found that the United States Department of Agriculture (USDA) funded a competitive grants program designed to strengthen agricultural education. The intention of this program was to better prepare students who have, “intention of an agricultural-based career through the inclusion of agriscience into

science, business, and consumer education programs" (Balschweid and Thompson, 2000, p.36). This idea has then grown throughout the United States, as schools are offering more and more agriculture-based courses. These courses (such agricultural business) give students real life skills while providing them an end career goal within an agriculture industry.

Balschweid and Thompson's (2002) follow-up study found that it is more effective to integrate science into agriculture curricula. This study determined that the students who had higher achievement in academics were those taught by integrating agricultural and scientific principles. Table 2.2 depicts how teachers rated the integration of science into career and technical education courses, specifically in Balschweid and Thompson's (2002, p.4) study.

Table 2.2 Indiana Agricultural and Business Teachers' Perceptions of Integrated Science

Teaching Integrated Science Item	*Mean*	*SD*
People pursuing a career in agriculture must have a greater understanding of biological science than ten years ago.	4.41	.75
Science concepts are easier to understand for students when science is integrated into the agricultural education program.	4.27	.67
Students are better prepared in science after they completed a course in agricultural education that integrated science.	4.26	.68
Students are more aware of the connection between scientific principles and agriculture when science concepts are an integral part of their instruction in agricultural education.	4.18	.71
People pursuing a career in agriculture must have a greater understanding of physical science than ten years ago.	4.11	.82
Students learn more about agriculture when science concepts are an integral part of the instruction.	4.02	.77

The highest-ranking areas, including teachers' beliefs about the integration of biology and agriculture, were higher than in the previous 10 years. Results also demonstrated that teachers believed agriculture to be a comprehensive vehicle for teaching science subjects

(Balschweid & Thompson, 2002, p.4). Data presented here in Table 2.2 validates teachers' perceptions of student growth in learning via science in agriculture, as well as positive ideology.

Integrated Learning

Integrated learning is a key design while incorporating science into agricultural education courses. Science-based subjects, courses in engineering, technology and biology are often troublesome for students to comprehend. In his New York Times article, *Why Science Majors Change Their Mind (It's Just So Darn Hard)*, Drew (2011) discussed the finding that over 40% of students who begin with an interest in STEM subjects, change their focus or idea of career path due to the content being considered too difficult for comprehension. As a possible solution, Thompson and Balschweid (1999) suggested that incorporating science into Agricultural Education allows students to create connections between various disciplines, allowing the brain to recognize and organize. Research conducted by Stephenson, Warnick and Tarpley (2008) concluded, "Vocational programs have encouraging attitudes toward academic integration and recognize collaborative integration benefits (p.107)."

Some have raised concern regarding instructors who will be integrating the curricula. Agricultural Education instructors expressed a common concern of time management regarding integrating STEM into their lessons (Balschweid and Thompson, 2002). Over 60% of Agricultural Education instructors felt that they lacked the experience to fully integrate STEM concepts into their lessons (Thompson and Balschweid, 1999). Additionally, preservice teachers raised concern about being prepared to teach a fully STEM integrated agriculture course (Thoron, 2010).

Research on STEM Integration into Agricultural Education

Researchers have made multiple connections regarding the benefits of incorporating STEM into Agricultural Education. Incorporation of science into Agricultural Education provides students an opportunity to create connections between various disciplines, allowing the brain to recognize and organize (Thompson & Balschweid, 1999). These connections can lead to higher-order thinking and higher cognitive learning. While students are able to excel in a particular subject area, research shown that incorporating multiple subjects facilitate better information retention for all students (Thompson and Balschweid, 1999).

This increase of science incorporation into agricultural education has given way to students' better understanding of difficult mathematics and science concepts. In a study completed by Warnick, Thompson and Gummer (2004), it was shown that students were more aware of the connection between science and agriculture and science concepts were easier to understand if science was integrated into the agricultural program. Balschweid (2002) confirmed that, "Brain-based theory and the experiential learning theory suggest that the interface between context and content provides students with multiple opportunities for transfer and overlap of complementary concepts (p.57)".

Regarding the push to intensify course rigor, both curriculum standards and school administrators have supported the idea of doing so within Agricultural Education courses. Warnick et al. (2004) referenced that the National Research Council recommends that agriculture courses be expanded to increase scientific and technical content. The authors then strongly suggested that having principal and administration support is key, especially when supporting of science integration into agriculture courses.

Application-Based Learning

Agricultural education facilitates opportunities that take students beyond a simple concept and afford them with a sense of understanding that they can apply to a multitude of situations (Fritsch, 2013). Since students are faced with a world that is consistently growing and improving in technology and science, it is key that they can apply theories from their education to real-word scenarios. Now, in the information age, Americans are living in a transitioning society that facilitates growth in industrial and agricultural careers (Roberts and Ball, 2009). Concrete experiences in agricultural education can become the foundation for abstract concepts that allow students to use what they have learned in previous courses (Fritsch, 2013).

The Role of Supervised Agricultural Experiences in Agricultural Education

As the application portion of the Agricultural Education three-circle model, Supervised Agricultural Experiences (SAEs) are an integral part of the entire program. SAEs provide the hands-on goal, career and academic planning that facilitates student learning outside of the classroom. Examples of SAEs include working in the school greenhouse, having a livestock or any agricultural entrepreneurial business, or working in an agricultural -based local business. Stimson (1919) stated,

> "Neither skill nor business ability can be learned from books alone, nor merely from observation of the work and management of others, both require active participation, during the learning period, in productive farming operations of real economic or commercial importance (p. 32)."

Overall, SAE participation has decreased thereby encouraging studies to be conducted to examine what the influence of learner participation in SAE programs on learner academic

performance in agricultural content assessments and career aspiration (Cheek, Arrington, Carter & Randall, 1994).

Student Skill Development

Agricultural Education in Nebraska has evolved from a production-agriculture focus to a holistic approach of career-readiness. Following the changes made by the National FFA Organization, Nebraska FFA and Agricultural Education has widened its focus to include a more urban student population. Jessica Boehm of FFA.org (2019) updated national FFA chapter enrollment by stating,

> "Although we're primarily known as a rural organization, we're steadily reaching students in urban areas. In fact, [National FFA is] proud to have FFA programs in 24 of the 25 largest cities in the U.S., and approximately 44 percent of our current members are from nonrural communities (para. 2)."

Through the inclusion of courses that address not only livestock and crop sciences, Nebraska FFA now appeals to students of all backgrounds and interests. In addition to a broader range of course offerings, Nebraska FFA and Agricultural Education offers Supervised Agricultural Experiences (SAE) that appeal to students who do not have the means to have a production-based SAE. The National Council for Agricultural Education (2015) recently rebooted the foundation of SAE projects, making a point to identify that SAEs do necessarily need to take on a farm, ranch or other private agricultural enterprise, but for the student to have a SAE which correlates to their classroom instruction and career exploration within one of the recognized Agriculture, Food and Natural Resources (AFNR) career pathways.

The Role of FFA in Agricultural Education

Nationwide, and within Nebraska, agricultural education programs and the National FFA pride themselves on the inclusivity within their programs. Ag Daily (2019) reported,

> "The National FFA Organization provides leadership, personal growth and career success training through agricultural education to more than 700,000 student members who belong to one of the more than 8,600 local FFA chapters throughout the U.S., Puerto Rico and the U.S. Virgin Islands (para. 4)."

At one time, students who held a background in production agriculture were drawn to FFA due to its roots in large animal and crop production (Staller, 2001). As times have shifted, those in the more urban areas of Nebraska are beginning to increase both the number of chapters and the number of members within larger, urban-based agricultural education programs. The annual growth in programs supports the idea that Nebraska FFA and agricultural education is not only for those who have a background or interest in farming, but also those with a curiosity in the new and modernized face of agriculture (Kreifels, 2019).

Brain-Based Learning and Agricultural Education

Brain-based learning theories focus upon the idea that students can learn from a variety of learning styles, practicing their own learning styles that best fit their cognitive structure (Caine and Caine, 1990). This allows students to thrive in the classroom based upon best learning practices, which are facilitated through the presentation methods that the instructor implements within the classroom. The idea of brain-based learning allows

students to associate to the content as they are stimulated by an idea that is familiar to them (Caine and Caine, 1990).

Teaching should be multifaceted to allow students of all learning types to express visual, emotional, tactile and auditory preferences to best comprehend the material being presented (Caine and Caine, 1990). Agricultural educators have supported Glasgow's contentions about problem-based learning (PBL), (i.e., inquiry based instruction and problem-based learning) as substantially similar in intent, process, and anticipated learning outcomes (Parr and Edwards, 2004). Boone (1990) stated, "The problem solving approach to teaching has been widely accepted as the way to teach vocational agriculture (p. 18). He further explained:

> When students solve real problems, use the scientific method to reason through a problem solution, test potential problem solutions, and evaluate the results of the solution, retention of knowledge learned through this activity has to be increased (p. 25).

The delivery method of agricultural education curricula has been an identifying factor throughout the years of its implementation. Historically, learning in agricultural education has been both "hands-on" and "minds-on" in intent, design, and delivery. It is an appealing and robust curriculum in which students can learn scientific laws, concepts, and principles in a contextual fashion (Parr and Edwards, 2004). For students who struggle with learning core subjects, specifically those such as math and science, vocational courses allow them to move away from abstract academics of high school and create a connection to the real world (Anderson, 2019). By offering a context-based

approach, Parr and Edwards (2004) noted that secondary agricultural education instruction inculcates much of what these scholars identify as variables required for cognitive learning to occur effectively, more specifically in the science area (p. 107).

Science-Learning Opportunities in Agricultural Education

Within all agriscience courses, students are presented with key concepts of core science classes that provide context to the ideas that they are learning. Ricketts et al. (2006) referenced several studies that support educator's observations of student success when correlating science and agriculture courses. Whent and Leising (1988) compared agricultural education students with students in general science courses and concluded that those in agriculture courses achieved higher scores on biology tests that those solely enrolled in science. Roegge and Russell (1990) found that students who were instructed in integrated biology with agricultural principles demonstrated higher overall achievement. Support for students receiving science credit for these courses can be drawn from these studies, as students show overall higher science-learning when enrolled in an agricultural course. Since previously mentioned studies were done in years prior to the NCLB Act, Ricketts et al. (2006) conducted a study that analyzed student learning to conclude that determined that students are continuing to achieve higher science scores if they participate in an agriscience course(s) or activity. This is in comparison with those who did not participate in an agriscience course (Ricketts et al., 2006).

Summary

The role of agricultural education in academia has transformed from its original role in the early 1800s. Now seen as a vital workforce industry, the science behind agricultural education is continuing to prove its importance not only in students' science comprehension, but in their overall career-readiness. Research supports that the growth of agricultural education can continue to be advanced by the inclusion of the science subjects. This presence is reflected through the data proven to support agricultural education's role in student academic success and career readiness. The remaining chapters describe the details of this study. Chapter three describes the project study design. Chapter four provides an interpretation and summary of the results, and chapter five highlights implications, applications, and ideas for future study.

CHAPTER III.

METHODS

Introduction

Current challenges in education include student success in core science subjects. The proposed Agriculture education curriculum provided a connection between core principles of science via the vehicle of an animal science course. As this research study began, the researcher first developed a new, integrated science and agricultural curriculum that was modified to meet both the Nebraska State Agricultural Education standards and the Nebraska's College and Career Ready Standards for Science (NCCRS-S) in science. This integrated curriculum, then, provided context for science learning as students proceeded through an agricultural education course. Utilizing a case study approach, the researcher reached out to Nebraska Agricultural Education teachers to learn about their interest in and willingness to integrate science in the agricultural education classroom. Here below, research methods are organized into the following sections: (1) research questions, (2) research design, (3) context, (4) participants, (5) data collection and analysis, (6) design elements, and (7) rationale for intervention.

Problem of Practice

Agricultural education in Nebraska is consistently growing in program size throughout the state. Students who have an interest in traditional agriculture, the technological applications within agriculture, or the companion animal side of agriculture all enroll in agriculture courses enhance their learning and practical application skills. These students can range from higher-achieving science students to those who prefer application-based learning scenarios. For those who learn best through phenomena-based learning, agricultural education provides context for achieving core science standards.

This exploratory survey research study examined the need for Nebraska Agriculture Education curricula that can facilitate non-traditional learners' science learning in an agricultural learning environment. The proposed curriculum organizes the context of companion animal management to help students learn science principles and allows them to receive dual credit. The proposed curriculum addresses a need to assist all students, regardless of learning strengths and type preference, to achieve a science credit through an agricultural education course.

This study was also based in a concern for issues related to Nebraska agriculture education teacher retention. By being a source of reference, it would provide relief to those new to teaching or with limited background in either subjects. In the past seven years, of the 145 Nebraska agricultural education teachers employed in 2012, almost 30% of those teachers are not teaching (Kreifels, 2019). Teachers in this field often are leaving the profession due to the excessive time obligations, teaching and curriculum preparation requirements and the often overwhelming feeling of balancing classroom teachings and extracurricular activities, such as FFA.

In sum, this dissertation provides Nebraska agriculture educators' assessment of a proposed curriculum (that is aligned with Nebraska state standards for both life science and small animal management/veterinary science, intended to be a resource of information and curriculum support). These research results provide teacher feedback on the feasibility and benefits of a publicly available curricula that can assist Nebraska agricultural educators with preparation and standard alignment through an integrated curriculum.

Research Questions

This exploratory survey research study was conducted to answer the central research questions:

> Research Question 1: What is the feasibility of a publicly available, science-integrated agriculture curriculum within Nebraska agricultural education programs?
>
> Research Question 2: What are the benefits of a science-integrated agriculture curriculum within Nebraska agricultural education programs?

With the creation of a companion animal science curriculum, that aligned with both the Nebraska State Agricultural Education standards and the Nebraska College and Career Ready Standards for Science (NCCRS-S), this researcher sought to gather and analyze evaluative feedback from current agricultural education instructors in Nebraska. These research questions addressed all agricultural education teachers, and data were collected regarding their opinion on incorporation of science within a sample unit of the proposed curriculum. In order to draw meaningful conclusions, survey questions were designed to determine the viability and feasibility of integrated science and agriculture curricula within agricultural education classrooms in Nebraska.

Research questions were designed to answer multiple speculations about the curriculum designed by the researcher. Agricultural education instructors were questioned about the usability within their current classrooms, specifically the ease of implementation from an instructor's viewpoint, and the cost effectiveness of the curriculum. Regarding student perception, instructors were questioned about the ability of

their current student population to adapt to such a curriculum, specifically due to the incorporated science standards within each lesson.

Educational Design Research: Exploratory Survey Research

As this exploratory survey research study focused upon agricultural education instructor's perceptions of a modified curriculum, exploratory survey research was the best research approach. When defining the term *survey*, it is generally noted as the selection of a sample of people who are considered of interest regarding the topic being studied. This population provides feedback, giving a small sample of data (Kelley, Clark, Brown and Sitzia, 2003).

This research design followed exploratory survey methods that addressed the needs of teachers for a cohesive, science-integrated agricultural education curriculum. Nardi (2018) described the research plan as the researcher designing their research questions first, then choosing a relevant study method to correspond with the questions. This study method was determined as the best fit for this research due to the research questions, the focused population, and the responses that were needed. As Radhakrishna and Doamekpor (2008) explained, knowing who your subjects and respondents are, prior to distributing the survey, will allow the researcher to better know how they can generalize findings. This was a key aspect in the design process of this dissertation study.

Survey Research Design

Bartlett, Kotrlik and Higgins (2001) determined that an adequate sample, including proper data collection methods, will result in more valid, reliable and generalizable results. Surveys respect external validity because due to their concern of how the findings are obtained for the subjects and if the results can be generalized to a

wider population (Berends, 2006). In this dissertation study, all of these considerations were taken into account when designing the survey questions, specifically based upon the research questions presented in this dissertation.

Each aspect of the survey was designed with purposeful questions to answer the primary and secondary research questions. When designing survey research, specific variables of the population are usually included in a demographic section (Berends, 2006). This can include, but is not limited to, population and school size, location and program description, and other details (e.g., class size). Regarding the population reached within the survey research, Berends (2006) explained that it is essential to distinguish between the ideal population who gives the desired results and the known target population. In this dissertation study, the researcher determined that the ideal population is current agricultural education instructors in Nebraska, which is concurrently the target population as well. This population will provide answers for the pre-determined research questions, as determined by the design of the survey questions.

For this survey research, non-descriptive demographic information was included in the beginning question of the survey. Regarding response times, Radhakrishna and Doamekpor discussed in their 2008 study that if no significant differences are found between the early and late responses, you can statistically conclude that the findings are general to the population being surveyed. Thus, in this dissertation study, with a two-week response time for this survey, the researcher can be confident that the findings can be generalized to the population surveyed. The researcher's use of both open-ended and Likert-scale questions maximized opportunity to collect instructors' opinions and

considerations regarding the integrated lesson and implementation of both science and agriculture education standards.

The survey methods used in this dissertation study provided the context of the research and were determined within the first questions of the survey. More specifically, survey questions asked if participants were Nebraska agricultural education instructors, their teaching location, school size, and program components (Appendix D). Ethical issues were acknowledged via the participant informed consent letter that participants received prior the completing the survey (Appendix C). Complete data quotations were included in the survey results, specifically in the form of the open-ended, short answer responses. The researcher provided the reasoning behind the study in the interview invitation letter (Appendix B), as well as in the IRB application that was approved by the University of Nebraska-Lincoln. Use of these specific characteristics allowed conclusions to be thoughtfully formulated based on the data received from teacher surveys.

Survey Research: Fundamental Elements

Theoretical Framework

The theoretical framework, that this study was centered upon, was primarily social constructivism theory and, more specifically, the inclusion of discovery learning. As explained by Creswell (2013), constructivism was described as the individual construction of knowledge, which is a strong consideration within this research. Utilizing a case study approach can greatly benefit the researcher by providing a more in-depth understanding of the participants, the curriculum and the interpretation of the study curriculum by the participants. By utilizing a case study, a connection to a real situation to that data was provided (Creswell, 2013). This was demonstrated through the first-hand

accounts of practicing agricultural education instructors and their opinions regarding the curriculum.

One of the key components of this study, to provide insight into agriculture's effectiveness as a learning vehicle for science, is that students learn best when they can connect various subject matter together. By following the social constructivism theory, this research was founded upon how students might interact with the integrated curriculum and how their instructors expected such interactions. Social constructivism is established upon the idea of creating ideas from one's prior knowledge and interactions, which is a key element of the combined agriculture and science curriculum (Creswell, 2013). The survey design in this dissertation study echoed social constructivism by presenting questions that tested teacher's interpretations of whether or not the curriculum would allow students to draw connections from prior experiences to improve science and agriculture learning.

Context

This research study engaged agricultural educators across the state of Nebraska. In this process, a sample curriculum unit (that might be used in companion animal science and animal biology classes) and feedback survey, was sent to agriculture educators. These educators completed survey questions to assess the appropriateness of these inquiry-based lessons with lab, lecture, and application components.

Role of the Researcher

At the time of this study, the researcher was a member of the Nebraska Agricultural Education Association and also held a Nebraska teaching license. Mays and

Pope (2000) reported that, “Personal and intellectual biases need to be made plain at the outset of any research reports to enhance the credibility of the findings (p.50).” By exposing the current occupation of the researcher, the researcher admitted to any connections or potential biases that could occur during the study.

Advantages of the role of the researcher included a greater understanding of the participants being researched, as the researcher held the same role as those participating. As a fellow agricultural education instructor, the researcher had previously collaborated and participated with participants in a professional capacity. These instances included FFA competition, professional development events, FFA advisor meetings and teaching partnerships.

Throughout the study, the researcher continued to be aware of any possible bias that could stem from her current role or that of any data collection and analysis. Johnson (1997) posited that qualitative research tends to be exploratory, which can lead to potential bias as researchers review content with the end in mind. To avoid this bias possibility, the researcher had external reviewers confirm the themes that were determined to be prevalent within the data. Johnson (1997) define negative case sampling as, “[Researchers] who attempt carefully and purposefully to search for examples which disconfirm their information” (p.284). This was also practiced, as the researcher found contradictory research-based approaches that could disconfirm their findings. To avoid biases, faculty members of an esteemed university reviewed the questionnaire used in the study for validity and content. Potential bias was also evaded through the confidentiality and anonymity of participant responses.

Participants

Potential participants in this study (agricultural education teachers throughout the state of Nebraska) included 189 Agricultural Education instructors who were all endorsed in the subject of agriculture or transitionally certified and concurrently completing a program to receive full teaching credentials in the subject ("About Agriculture Education", 2018). Further, 17 of the 189 instructors were dual-certified in both agriculture and biology (L. Bell, email communication, September 25, 2018). The dual certifications included additional courses specific to life sciences, as well as student teaching within both subject areas. Potential participants' schools ranged from remote areas (population <500), to those in urban cities (population >250,000).

Purposeful sampling was considered, as all schools are recognized for having a chartered and nationally recognized FFA chapter. Involvement with one's FFA chapter is a crucial component of the Agricultural Education Three-Circle Model and ensures validity of the program. This was key to the researcher's qualitative research approach due to the fact that purposeful sampling allowed her to study information that is detailed and highly in-depth (Patton, 1999). Participants were recruited via the Nebraska Ag Ed listserv, which serves the state of Nebraska and all of the agricultural education instructors. The researcher had access to the participants and their information due to the current role of the researcher as a Nebraska agricultural education instructor.

The process to screen and define participant eligibility was determined by the participants' inclusion in the Nebraska Agricultural Education teacher directory. This directory was also linked to the Nebraska Agricultural Education program listserv. The survey emailed to the listserv included an initial screening question which asked if the

participant was a current agricultural educator in Nebraska (Appendix D). If the answer was yes, the next question would determine their job title in agricultural education. If the answer was no, the survey was void.

Sample Curriculum Unit Development

The sample curriculum unit was created as a comprehensive curriculum unit, complete with lesson plans, essential questions, and teacher's guides. With purposeful consideration, these lessons were designed to be utilized as lesson plans for a course that meets the NCCRS-S Life Science standards as well as either the Nebraska Agricultural Education Small Animal Management or Veterinary Science course standards. For the purpose of this study, the sample curriculum unit provided was the third unit, Parasites, of the fourth module, Companion Animal Health Care. The website link to the entire sample curriculum unit can be found in Appendix I.

Teacher Access

The sample unit curriculum was accessible through a shared Google Folder. This folder was linked via the Google Form survey that each participant completed. Both separate lesson files, as well as a complete unit file, were offered to participants. The Google Folder was the best option for sharing the sample unit curriculum due to ease of accessibility, as well as the possibility to make changes if need be. This sharing method also allows for additions and modifications to any new curriculum that could be provided in the future. Examples of the shared files are found in Figure 3.7 and Figure 3.8.

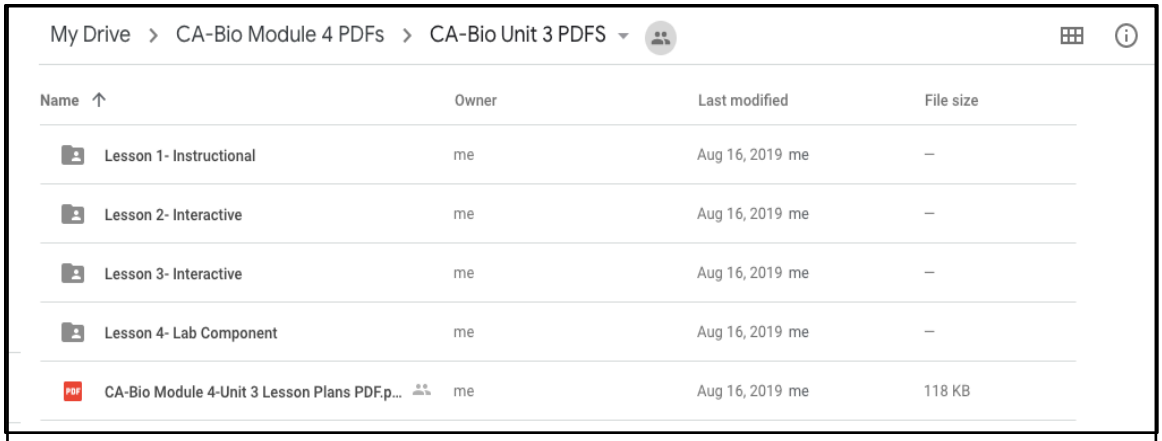


Figure 3.7 Sample Curriculum Unit Shared Files

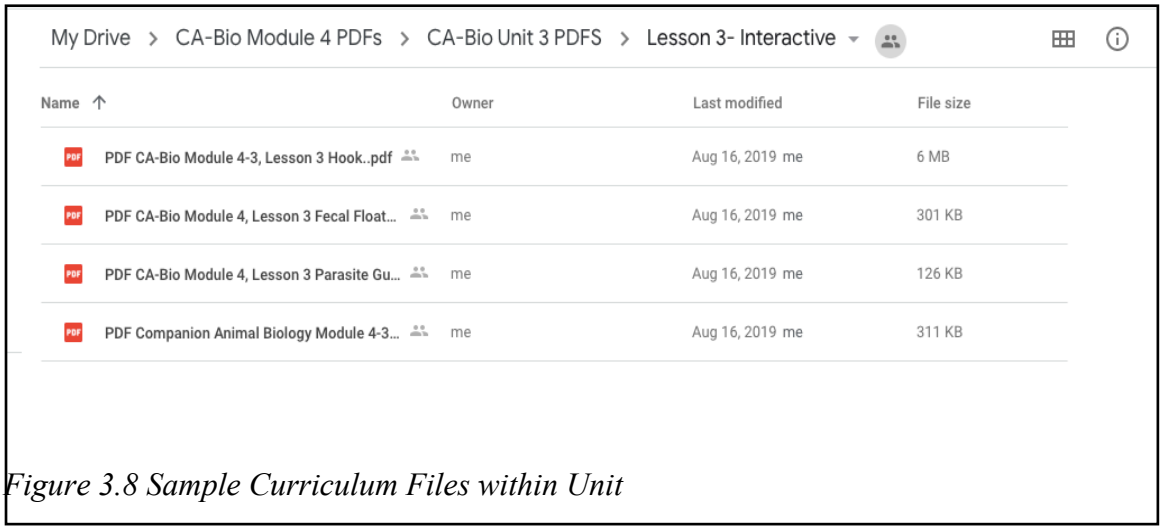


Figure 3.8 Sample Curriculum Files within Unit

Lesson Plans

Each unit of the sample curriculum contained a complete file of lesson plans for instructor use. Lesson plans included a brief description of the unit, lesson details, overview and execution techniques. A lesson plan was provided for each of the four lessons within the sample unit. Figure 3.9 provides an example of the lesson plan document.

Companion Animal Biology Module 4 Lesson Plans

Unit 4-3: Health Care: Parasites

Unit Objective: Students will define and identify internal and external parasites that are commonly found in companion animals.

Lesson One (Instructional Component)

Lesson Preparation	
Lesson Length	One 50-minute class period
Lesson Objective	Students will define internal and external parasites and their life cycle.
Essential Question	What is the life cycle of companion animal parasites?
Teacher Materials	*CA-Bio Module 4-3, Lesson 1 Hook Photo Collage, CA-Bio Module 4-3, Lesson 1 Parasites PowerPoint, CA-Bio Module 4-3, Lesson 1 Parasite Life Cycle Activity, Module 4-3, Lesson 1 Parasite Life Cycle Reference*
Student Materials	*CA-Bio Module 4-3, Lesson 1 Parasites Skeleton Notes, CA-Bio Module 4-3, Lesson 1 Parasite Life Cycle Activity*
Lesson Procedures	
Bell Ringer	What are skin issues that can affect animals? Describe one in detail using two complete sentences.
Hook	Show *CA-Bio Module 4-3, Lesson 1 Hook Photo Collage*. This can also be done with numbered jarred specimens, if they are available. Ask the following: 1. Can you identify the different parasites? 2. Which parasites can occur in dogs? 3. Which parasites can occur in cats? 4. Which happen inside of the body? 5. Which happen outside of the body?
Experience	The primary method of instruction will be a lecture to lay the foundation for terminology that will be used within this unit. 1. Instructor will present *CA-Bio Module 4-3, Lesson 1 Parasites PowerPoint* while the presentation is being given. Students will complete *CA-Bio Module 4-3, Lesson 1 Parasites Skeleton Notes.* 2. At the conclusion of the presentation, students will be asked to define key terms. 3. Upon completion of the lecture, continue with the PowerPoint to watch the video of the parasite life cycle. Students will learn four different life cycles of internal parasites and fill in each of the blanks in Part One of the *CA-Bio Module 4-3, Lesson 1 Parasite Life Cycle Activity*. 4. Students will complete Part Two of *CA-Bio Module 4-3, Lesson 1 Parasite Life Cycle Activity* and create a comic strip of a life cycle of a parasite. 5.
Exit Ticket	What are three similar aspects of the different parasite's life cycles?

Figure 3.9 Example Sample Curriculum Lesson Plan

Teacher's Guides

In addition to the lesson plans, a teacher's guide was provided as an additional resource for instructors. *Figure 3.10* depicts the materials provided within the teacher's guide.

Name: _____ Date: _____

Companion Animal Biology Module 3:

Lesson 3: Fecal Floatation Teacher's Guide

Prior Preparations

Materials needed for the fecal flotation lab are listed below. Many items can be purchased at Walmart, Amazon or may already be in your school's science lab for use.

- Personal Protective Equipment for each student
  - Safety glasses/goggles
  - Non-latex gloves
  - Optional lab aprons
- Samples of fecal matter
  - Each pair of students will need 4-5 grams of fecal matter. Fecal matter can be from livestock, horses, cats, dogs etc. You may choose to collect fecal matter yourself or have students collect it.
  - Collections must be done as soon as possible! More specifically, collection must occur almost immediately after the sample is dropped from the animal.
  - Fecal samples MUST be kept on ice or in a refrigerator post collection and until use in the lab.
  - Be sure that there is minimal, if no, additional shavings, dirt, rubbish etc. in with the sample.
  - OPTIONAL: Email or send a letter home with parents regarding the lab as a courtesy since students will be working with fecal matter.
- Small test tubes with caps
  - Needs to hold at least 15 mL of solution
  - Purchase option:
    - https://www.amazon.com/60-Tube-16x150mm-Clear-Plastic/dp/B004PD9ULS/ref=sr_1_4?keywords=16X150mm+tubes&qid=1562381660&s=gateway&sr=8-4
- Test tube holder
  - Enough to hold the number of test tubes used in the lab activity
  - Purchase option:
    - https://www.amazon.com/60-Tube-16x150mm-Clear-Plastic/dp/B004PD9ULS/ref=sr_1_4?keywords=16X150mm+tubes&qid=1562381660&s=gateway&sr=8-4
- Fecalyzers
  - Could use small containers with lids, does not need to be actual fecalyzers
  - Purchase option (fecalyzer):
    - https://www.shopmedvet.com/product/specimen-container-18ml-w-spoon-push-cap/vials-containers
  - Purchase option (small container):
    - https://www.amazon.com/EDI-Plastic-Disposable-Portion-Souffle/dp/B072MP8JK5/ref=sr_1_23?keywords=small+plastic+containe&qid=1562382160&s=gateway&sr=8-23
- Small popsicle sticks or stir sticks to stir solution
  - Purchase option:

Figure 3.10 Sample Curriculum Teacher's Guide

The teacher's guide provided instructions for detailed lab activities, supply needs, and directions about how to implement each activity. Additional resources and possible purchasing outlets for the supplies were linked within the teacher guides.

Course Outline

The sample unit curriculum was divided into four lesson, each of which focused upon a specific aspect of the module unit.

1. *Lesson 1: Instructional Component:* This lesson provided basic foundational knowledge for the unit. This included a short lecture, as well as an activity including the material provided in the lecture.
2. *Lesson 2- Application Component:* Students build upon the principles of the unit by completing an exploration activity. This activity builds on the basic knowledge laid in unit one and gives students meaning to the material through the scene of small animals.
3. *Lesson 3- Lab Component*: The lab activity provided a hands-on experience for the unit's core teachings. This gives students a real-world experience of how the lesson could use utilized in everyday life.
4. *Lesson 4- Career Component:* As a key component to both science and agricultural education standards, the career exploration was given to align with the ideas of the curriculum unit.

Beginning and Ending Elements

Each lesson provided a bell ringer, hook, and exit tickets. Teachers can utilize the bell ringers as review, as the questions are thought-provoking review inquiries. Each lesson included a hook to engage students in the material. These ranged from video clips to photos that instigate a class discussion. Figure 3.11 shows an example of a hook provided within the sample curriculum unit.

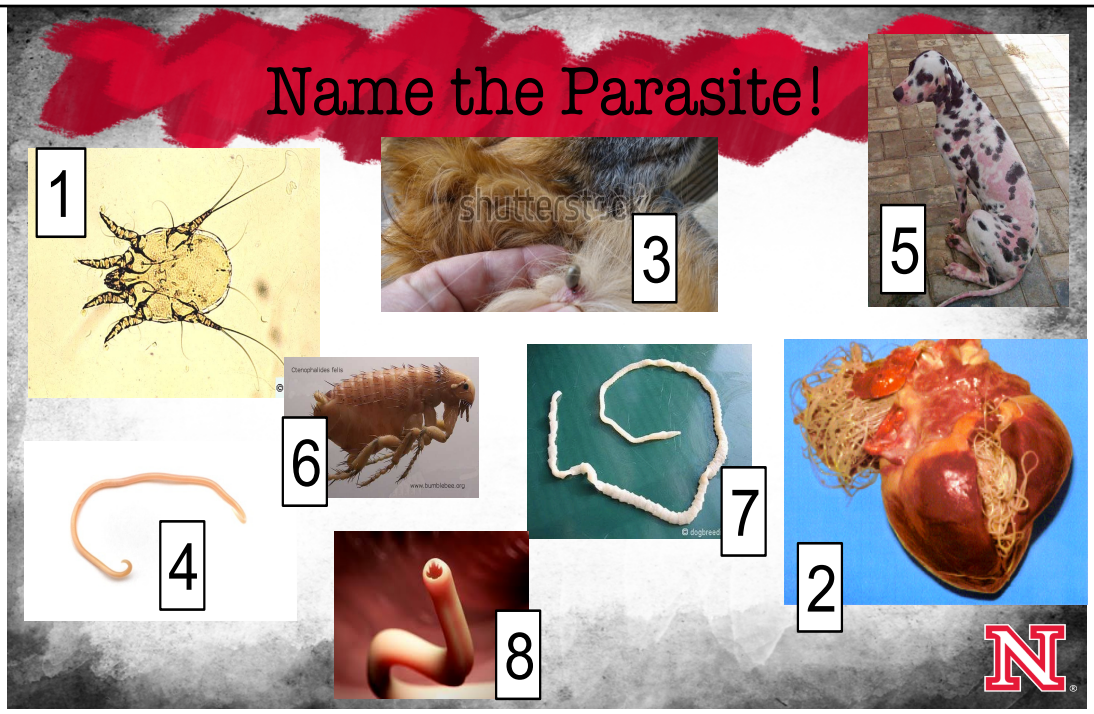


Figure 3.11 Sample Curriculum Unit Hook

Exit tickets are also provided within the lesson plans. The exit tickets provided instructors with feedback reading the lesson, the material presented and student comprehension of the material. This will allow for strategic planning or re-teaching for the next lesson, if needed.

Student Documents

Multiple documents are provided for student use throughout the sample curriculum units. Worksheets, lab directions and skeleton notes were provided as part of the sample to show how students would utilize the material being presented to them throughout the unit. Figures 3.12 and 3.13 are examples of the lab that students would complete in the sample curriculum unit.

Name: _____ Date: _____

Companion Animal Biology Module 3:

Lesson 3: Fecal Floatation Lab Part One

Instructions: Complete the steps below that you will complete to create a fecal slide.

1. Prepare for the lab by putting on your PPE. This includes gloves and safety glasses/goggles.
    a. Lab aprons are optional.
2. Obtain a sample from your instructor or use the one that you brought to class. Your sample will be labeled, record the label below.
    a. Sample Name: _____
3. Measure out 4-5 grams of the fecal sample.
    a. Check the scale to ensure that it is measuring samples in grams.
    b. Place a clean surface (plate/boat/cup) onto the scale.
    c. Zero out the scale.
    d. Using a small spoon or popsicle stick, measure out 4-5 grams of the fecal sample.
4. Place the 4-5 grams of fecal sample into the inner chamber of the fecalyzer (or provided container). You might need to use a popsicle stick to scrape the fecal sample off of the sides of the container.
5. Use a disposable pipette to add fecalyzer solution to the fecalyzer, filling it approximately half full. **DO NOT** contaminate the stock bottle of fecalyzer solution.
6. Mix feces with solution using the spatula attachment of the fecalyzer. It should be of slurry consistency.
7. You will now transfer the solution to a test tube.
    a. Using a test tube rack/holder, stand the test tube upright.
    b. Insert a funnel into the test tube and line the funnel with cheesecloth.
    c. Pour slurry fecal matter into the cheese cloth-lined funnel.
    d. Use additional fecal solution to rinse out remaining fecal matter from the fecalyzer. Use the fecalyzer scoop to agitate the larger pieces in the cheesecloth.
    e. Dispose of cheesecloth, fecalyzer container.
    f. Remove funnel from the test tube and set aside.
    g. Fill test tube with additional fecal solution to reach between 13-14 mL.
8. Place cap on test tube and bring to instructor to place in the centrifuge.
    a. In a balanced centrifuge, the test tubes will be run at 1200 rpm (280 x g) for 5 minutes.
9. Remove test tube and place in test tube holder.
10. Add additional fecal solution so that the tube is filled and a positive meniscus is formed.
    a. Allow test tube to stand <u>undisturbed</u> for **TEN MINUTES.**
    b. Clean up remaining materials per instructor's directions while you wait.
11. Place a coverslip on the test tube.
    a. Allow test tube to stand <u>undisturbed</u> for **TEN MINUTES.**
    b. Complete **part two** of the *Fecal Floatation Lab*
12. Holding the sides, remove the coverslip. Be careful to not allow the fecal solution to drip onto the top of the cover slip!
    a. Place coverslip directly onto microscope slide.
13. Using a microscope at 10x magnification, examine the microscope slide

Figure 3.12 Curriculum Sample Lab Page 1

Name: _____ Date: _____

14. Draw and color any parasites that you see below! Use the provided chart to identify parasites! If needed, you may increase the power up to 40x magnification.

Sample Name:	Sample Name:
Parasite Identification:	Parasite Identification:

15. When instructed, rotate through your classmates' slides and record your findings! Draw and color any parasites that you see below.

Sample Name:	Sample Name:
Parasite Identification:	Parasite Identification:
Sample Name:	Sample Name:
Parasite Identification:	Parasite Identification:

Figure 3.13 Curriculum Sample Lab Page 2

Student documents also included lab activities and practicums that are aligned with the Nebraska State FFA Veterinary Science contest. These practicums provided

hands-on learning activities that are relevant to small animal care, as well as the incorporation of real-world application to the standards being taught within the curriculum. Figures 3.14 and 3.15 illustrate the Nebraska State FFA Veterinary Science Practicum Rubric, as well as a modification of steps to enhance student learning.

Name: _____ Date: _____

Fecal Floatation Lab: Part Three

Veterinary Science CDE Fecal Floatation Practicum Worksheet

Lesson Objective: Students will use a rubric to correctly demonstrate clinical and handling procedures within the Veterinary Science CDE.

Students will complete the assigned practicum while completing the worksheet below. Students will complete the worksheet by filling out:

- *Practicum Step* column: Rewrite the task in your own words to ensure understanding
- *Trigger Tip(s)* column: Add in any tips or tricks to help you remember the steps and tasks for the practicum step.
- Reflection Questions: Complete to your best ability to recall the progress and struggles that you had within this practicum.
- Prior to the Refection Questions, students must receive a teacher signature to proceed.

Clinical Procedures Practicum

FECAL FLOTATION WITH FECALYZER

Participant must talk through practicum steps with judge.

Criteria	Points Possible	Points Earned
The student selects about 1/4 teaspoon of feces and places it into a fecalyzer.	6	
The student adds enough flotation solution to fill the fecalyzer about half full.	6	
The student mixes the feces into solution until no large fecal particles remain.	6	
The student places insert into fecalyzer.	6	
The student fills the vial with more solution until there is a visible meniscus at the top.	6	
The student places a cover slip on top of the fecalyzer.	6	
The student allows the vial to sit undisturbed for 10 to 15 minutes.	6	
The student carefully removes the cover slip without tilting it and places it on a microscope slide.	8	
TOTAL POINTS	50	

Nebraska FFA Veterinary Science State CDE Handbook 2019-2023 (p.37)

Figure 3.14 Nebraska State FFA Veterinary Science Practicum Rubric

Name: _____ Date: _____

Veterinary Science CDE Fecal Floatation Practicum Worksheet

Step	Practicum Step	Trigger Tip(s)
1		Example: Since the container is smaller, a smaller size of the sample will be used.
2		
3		
4		
5		
6		
7		
8		

Which step(s) do you feel that you excelled at?

_____

Which step(s) do you feel that you need to practice?

_____

What are two things that can help you remember the difficult details within this practicum?

1. _____

2. _____

Figure 3.15 Student Practicum Rubric Worksheet

Data Collection and Analysis

Study Instrument

The survey instrument for this study, sent via the Nebraska Agricultural Education listserv, was a Google Forms questionnaire. Teachers were also provided with

the complete unit, including lessons, labs, teacher instruction, and student documents. Through this Google Form, data were collected regarding the instructors' experience with teaching combined agriculture and science curriculum as well as the student-learning potential and their perception of the curriculum.

This study was done as an ex-post facto study, as it looked at instructors who had reviewed the curriculum units. Questionnaires were designed by the researcher and included (a) Likert Scale responses, which assigned a point value to each of the answers, and (b) open-ended questions to allow specific teacher feedback and opinions. Some questions included, but were not limited to:

· Student comprehension of science objectives and standards

· Student comprehension of agriculture objectives and standards

· Teacher perceptions of student understanding

· Application of science objectives into agricultural scenarios, phenomena or case studies

Teacher questionnaires allowed a 1 to 5 scale rating to gauge perceptions and applications of the curriculum. The Likert Scale was the best fit for the research survey (as an attitudinal measurement scale was utilized) and the composite score from this survey was analyzed (Boone & Boone, 2012). The survey also included demographic questions: participants were asked their school size, number of active members of their FFA and agricultural education program, as well as their current teaching status and assignments.

The researcher expected the surveys would take anywhere from 10-30 minutes to complete. Following the initial survey invitation email (Appendix B), the researcher sent two follow-up email reminders (one week and three weeks after the initial survey), pending the participant had not yet responded to the survey.

In order to increase validity and reliability of this study, dually endorsed science and agriculture teachers as well as those solely endorsed in agricultural education, were asked to review the content of the lessons. This allowed experts (who are currently endorsed to teach both sets of standards) to assess the curriculum. Open-ended survey questions, such as those below, encouraged more in-depth answers to the following questions:

- Do you feel that there is a need to deepen science learning within your classroom?
- What would the curriculum be able to provide in your high school?
- Would you be able to provide this curriculum in your high school? Why or why not?
- How would offering this integrated science/agricultural education curriculum effect your student enrollment?
- Please describe the impact of this curriculum if it was to be added to your agricultural education program.

Agriculture educators who completed the survey received a curriculum module to use within their classrooms. This plan managed for “no costs” to the participants or the researcher (with the exception of time the researcher took to create the curriculum). Agriculture educators received the link for a module of the curriculum at the completion of the survey.

Design Elements

Strengths in the design of this study included the fellowship and support from other Nebraska agricultural education instructors. The community of agricultural education instructors within the state was extremely strong and of the helpful nature. This was credited to frequent interactions that agricultural educators have during professional development opportunities, conferences, and FFA events at the district, state and national levels.

Prior to data collection, the researcher took initial steps to align standards, create curriculum, modify lessons, and pilot the curriculum as shown in Table 3.2 Study Timeline.

Table 3.2 Study Timeline

Phase	Objective	Explanation
Phase One	Science and Agricultural Standard Alignment	• Determine science and agricultural standards alignment • Analyze life science and small animal management standards • Align lessons within each set of standards.
Phase Two	Creation of Standard-Aligned Curriculum	• Create curriculum that addresses both sets of subject standards • Create one to three sample units for the study
Phase Three	Pilot to Classroom	• Pilot sample units within researcher's classroom • Gather student response and feedback • Complete edits upon conclusion of the pilot units
Phase Four	Curriculum Edits and Expansions	• Utilize feedback from students to modify sample unit • Create instructor surveys • Send survey information set to possible data collection participants
Phase Five	Utilization in Nebraska Agricultural Education Classrooms	• Send sample curriculum units to Nebraska agriculture classrooms • Receive agriculture educator feedback

Throughout this curriculum development and standard alignment, standards were included from Nebraska Agricultural Education- Small Animal Management, Nebraska Agricultural Education-Veterinary Science and the Nebraska College and Career Readiness Standards for Science (NCCRSS). This curriculum addressed both sets of agricultural education standards, as well as those present in the life science standards of the NCCRSS. This purposeful design allowed teachers from both backgrounds to utilize the curriculum, and ultimately provide a learning platform for students who have interests in both subject areas. Due to the career readiness components, this curriculum can fit multiple course outlines and adds multiple science objectives instead of just the two in Small Animal Management and Veterinary Science.

Analysis Plan for Survey Responses

Upon compilation, data were sorted using themes as defined by both short answer and Likert scale-based questions. Data analysis began with multiple readings of each survey response. This allowed the researcher to determine concrete findings and themes that surfaced amongst the survey responses. Data were coded to highlight specific themes participants revealed as they answered the both the short answer and scaled-based questions. All coding was collaborated from the survey data so that central themes could be developed. These themes were primarily created from the short answer portions of the data, with some also stemming from the Likert Scale questions. Responses were organized to understand what teachers' thought about the curriculum, its alignment to both sets of standards, and its effectiveness within the classroom.

Permissions and Ethical Considerations

Before beginning data collection, there were ethical issues to consider in order to protect the privacy of the participant. First, the researcher completed the CITI and Responsible Conduct of Research training courses through the University of Nebraska-Lincoln. To ensure proper research practices, Institutional Review Board (IRB) approval was sought, and granted, from the University of Nebraska-Lincoln. Participants received informed consent forms before beginning the survey and data collection. Upon IRB approval (Appendix A), participants were asked via email to critique the curriculum and complete the survey. Throughout the survey, participants were allowed to withdraw at any time, without penalty, and without question. No penalty would be enforced if the participant was to leave without notice.

To ensure anonymity, the researcher opened all online responses in a private location, either at the home of the researcher or in the office of the researcher, with no other individuals present. The survey respondent was in control of their location and whether or not they were sharing the survey with others. The survey was conducted using Google Forms, which has protocols to store data on secure servers. The technology security, used by the various school districts of those surveyed, was a vehicle for ensuring data security but IP addresses were not collected. The Wi-Fi used by the researcher was password protected. None of the information gathered was highly confidential. No information about specific students was asked. The survey only inquired about the educators and curricula that serve programs in agricultural education.

Ethical issues that could have come about during this research include the release of the participants' identities and the release of the cooperating school's identity. To

protect the identities previously listed, pseudonyms were created for all participants, the schools, and other possibly-identifying participant information. There were no known risks anticipated. Even in a possible breach of confidentiality, no information being asked was controversial or placed a participant at risk.

Rationale for Intervention

This practice of curriculum development has been done informally since the early days of the agricultural education and it has been become seemingly more obvious within current teaching practices (Warnick, Thompson & Gummer, 2004). This could be due to the technological advances in both science and agriculture. Employing technology within our everyday lives, and increasing the reliance upon technology, only further supports the integration of science within agriculture. Agriculture was also deemed an instructional vehicle for mathematics and science, due to the emphasis of the subject-specific methods, laws and concepts (Thompson & Balschweid, 2002). This relationship can continue to thrive as new curriculum is being developed and utilized throughout the United States.

Agricultural Education instructors naturally incorporate scientific principles into their daily curriculum, as the nature of agriculture is rooted in the core sciences. As science and technology have been changing over time, it is apparent that the need of strategic science standards incorporation has been growing. Looking at the philosophy behind education and the framework for learning, literature has determined that agriculture is a valid context or science education. Not only is the context appropriate, but also the changing technology and the improvements in science facilitate this context for learning (Roberts & Ball, 2009).

Conclusion

This chapter addressed the design and methodology behind this study. The research questions were presented, as well as the design of the exploratory survey research and the fundamental elements that this study used as an approach to research. The context of this study, including the researcher's background and the background of participants involved, provided a foundation for the research that was done. This exploratory survey research study was designed to receive feedback from agricultural educators regarding a curriculum that was designed to meet both science and agricultural education standards; ultimately providing educators with a ready-to-use resource. Chapter four will address the study findings.

CHAPTER IV.

RESULTS

Introduction

This chapter presents the data and findings of this exploratory survey research study regarding the viability of an integrated, agriculture and science-based curriculum that could be publicly available to agricultural education instructors. This curriculum was designed to meet both the NCCRS-S Life Science standards, as well as the Nebraska Agricultural Education Small Animal Management or Veterinary Science standards. This sample curriculum provides a science-enriched curriculum to provide context to core scientific principles in a small animal or veterinary setting. The data presented in this chapter were collected via surveys of Nebraska agricultural education instructors' feedback on review of a proposed curriculum (developed by the researcher) that aligns with both the Nebraska State Agricultural Education standards and the Nebraska's College and Career Ready Standards for Science (NCCRS-S). Further discussion of the results and recommendations for future studies will be addressed in chapter five.

Restatement of Research Questions

This exploratory survey research study followed two central research questions.

Research Question 1: What is the feasibility of a publicly available, science-integrated agriculture curriculum within Nebraska agricultural education programs?

Research Question 2: What are the benefits of a science-integrated agriculture curriculum within Nebraska agricultural education programs?

Data Collection

The survey was distributed via Google Forms on the Nebraska Agricultural Education listserv, which includes all of the Nebraska agricultural education instructors. Data were collected via an electronic form and organized by the Google Form program. Participants were asked to rate and react to a provided sample unit of a combined science and agricultural education curriculum. The sample curriculum addressed both the NCCRS-S Life Science standards, as well as the Nebraska Agricultural Education Small Animal Management/Veterinary Science standards. The survey included the following sections:

1. *Participant and School Information:* Questions regarding the school size, teacher demographics and certifications.
2. *Program Components:* Questions concerning the agricultural education components and courses offered within the participant's school and agricultural education program.
3. *Curriculum Design Assessment:* Questions of the sample curriculum unit design, effectiveness and assessment techniques.
4. *Standards Assessment:* Questions pertaining to the sample curriculum unit's lessons, more specifically the execution and use of both science and agricultural education standards.
5. *Overall Curriculum Interpretations:* Questions of each section of the sample curriculum, specifically the pedagogy and design of each lesson.

Each section provided the participant with multiple choice or short answer questions. Within the Google Form, participants were required to answer all questions in

order to submit and complete the survey. Participation in the survey was not required and could be terminated at any time. By asking both types of questions, participants were able to categorize their thoughts and provide grouping of opinions for the researcher, as well as provide honest and detailed feedback through open-ended questions. Both short answer and open-ended questions were asked within the survey to allow responses that were scaled and facilitated open responses.

Data Analysis

Data was analyzed on both the individual level and collective level across educator responses. Open-ended, short answers were combined into themes to organize central thoughts and ideas of the participants. Themes of continuity within answers were grouped together. Likert scale data was analyzed to determine each participant's opinion about a specific statement regarding the curriculum. Tables and graphics were used to emphasize and organize data into key themes. When organizing themes, the researcher grouped responses based upon their underlying themes. Responses were organized by the major theme of the answer (i.e. specifically what stood out as the main concern or idea of the response).

Results

Participants were limited to those teachers who are part of the Nebraska Department of Education Agricultural Education listserv (which reaches all of the agricultural education instructors in Nebraska). Results were organized to align with the survey sections.

Survey Section One Data: Participant and School Information

Section one of the survey addressed the participant and school information. This information allowed confidentiality while giving information about the participant group and their school size, location, and years of experience. The majority of participants (91.1%) described their location as rural, as compared to being in a non-rural location. Figure 4.1 shows that at 46.6%, almost half of the participants were in their first five years of teaching.

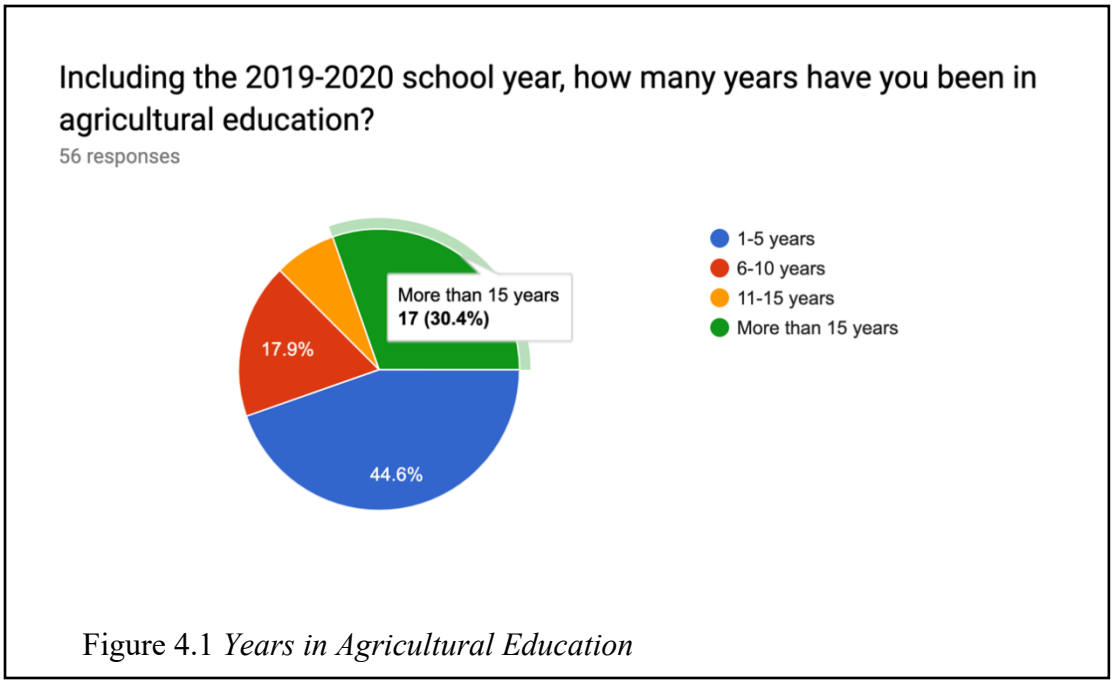


Figure 4.1 *Years in Agricultural Education*

Figure 4.2 explains the large percentage of solely, not dually endorsed or teaching any additional forms of traditional science courses, teaching agriculture.

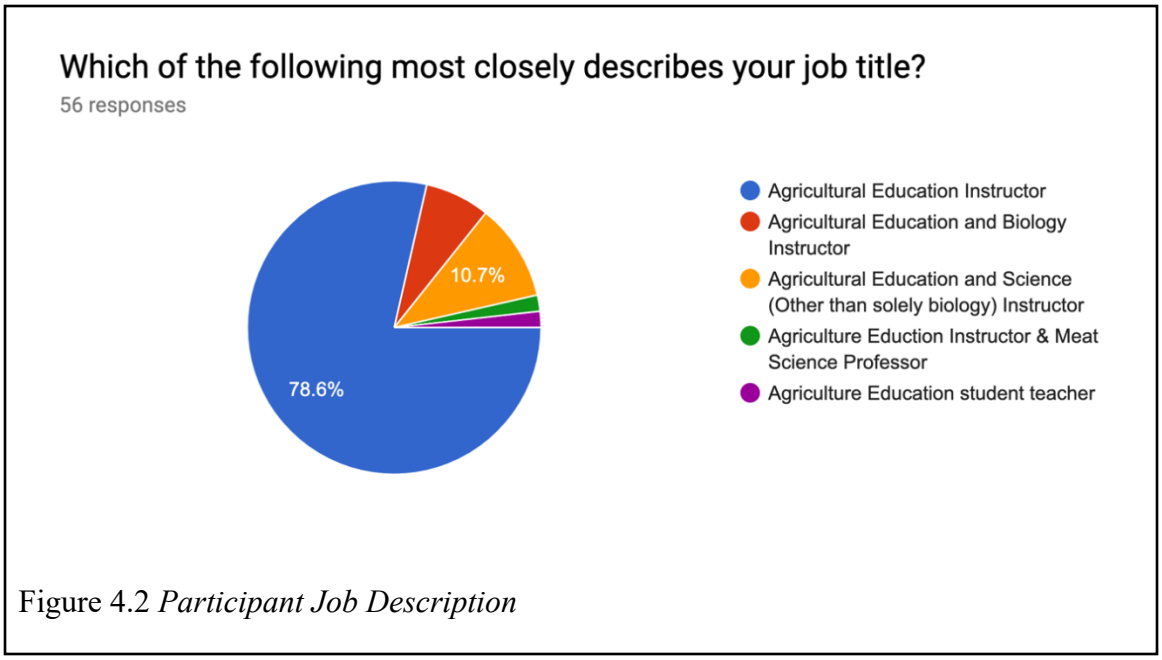


Figure 4.2 *Participant Job Description*

School information, including location, size and description of teaching responsibilities, is described in Figure 4.3, Figure 4.4 and Figure 4.5 below.

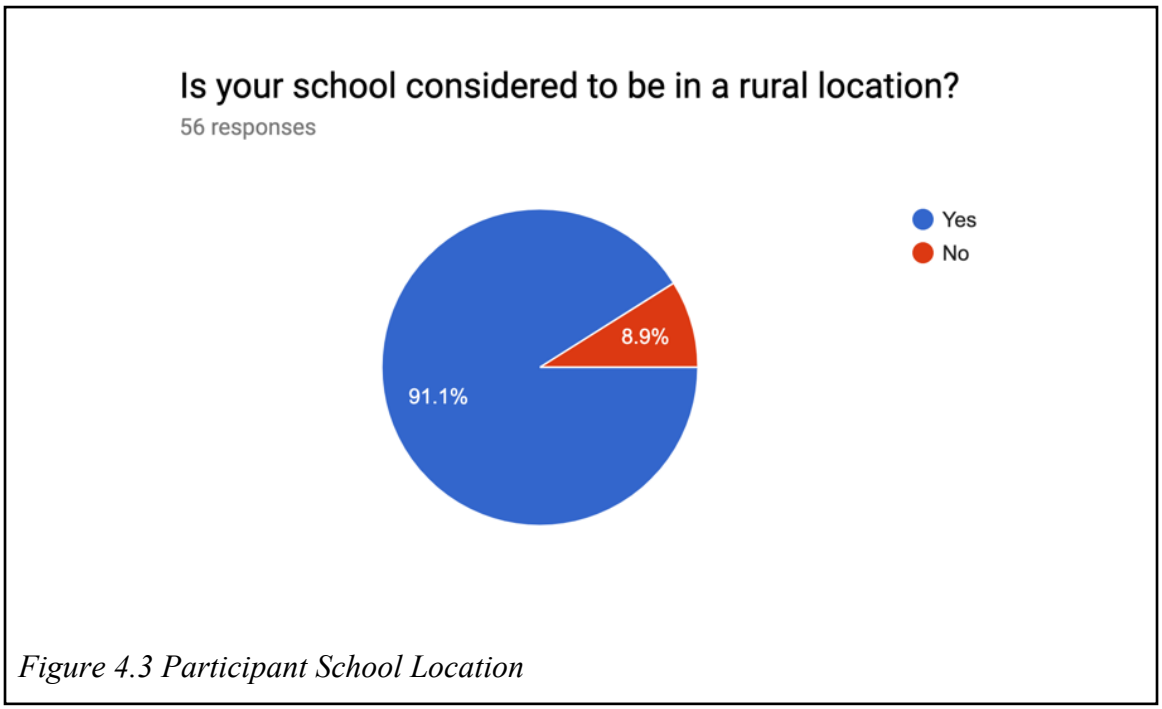


Figure 4.3 Participant School Location

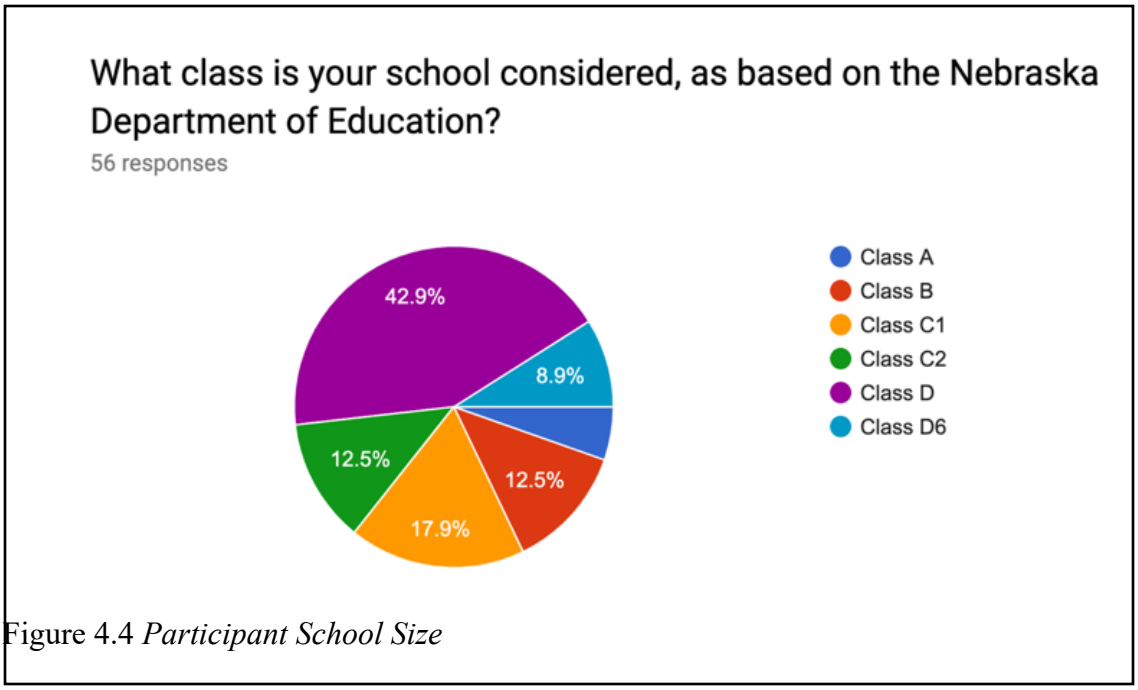


Figure 4.4 *Participant School Size*

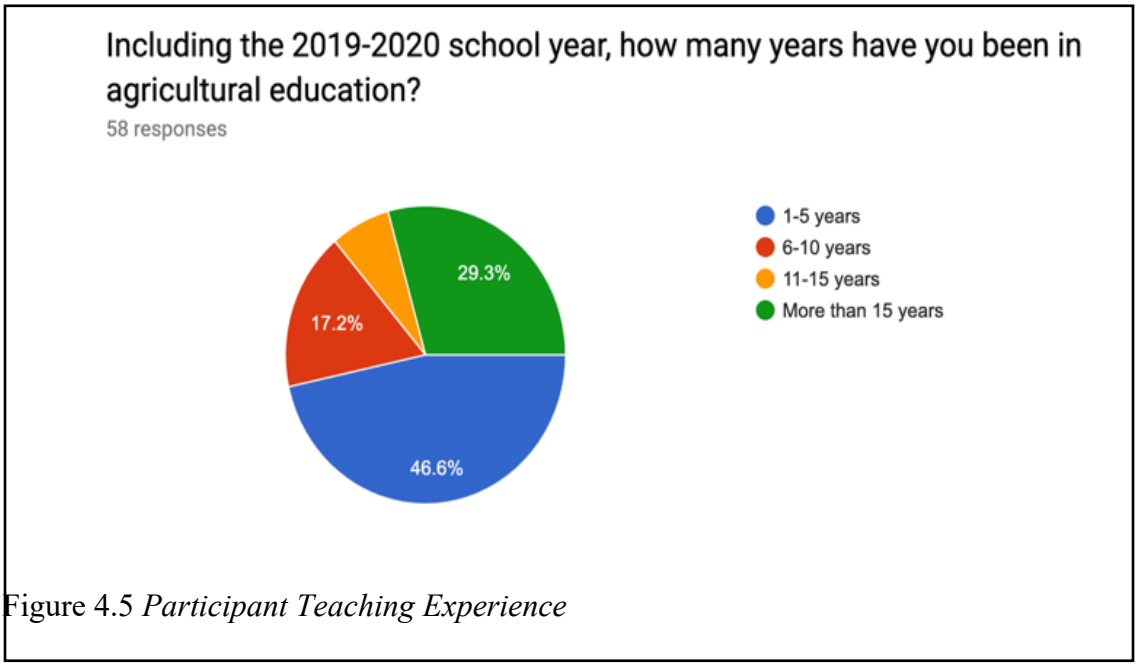


Figure 4.5 *Participant Teaching Experience*

The above figures (Figure 4.4 and Figure 4.5) describe the demographic of the participant, and suggested that the typical participant was an agricultural education instructor, in a smaller school district and working within their first five years of teaching.

Survey Section Two Data: Program Components

Section two of the survey asked participants to describe the roles that they played within their current teaching position. Fifty-six participants completed the survey after reviewing the new, proposed curriculum. These results are limited to the survey data from the 56 respondents who indicated they were agricultural educators. The researcher purposefully chose not to include the responses from the two respondents who indicated they were science educators or student teachers (as they were not agricultural educators. Thus, these study results solely included opinions of those who were agricultural education instructors.

Participants were asked what courses were currently being offered within their agricultural education program (since there is a wide variety on possible course offerings throughout Nebraska agricultural education programs). Figure 4.6 indicates the courses that were surveyed. The following courses were omitted from the table, as they all referenced 1 participant (or 1.7%) who taught the course. These courses are:

- Ag Leadership
- Agribusiness
- 7th and 8th Grade Agriculture
- Wildlife Management
- Farm and Ranch Management

According to Figure 4.6, Nebraska students have access to a wide variety of courses that could potentially be offered within an agricultural education program. The courses that are typically offered, based upon this data, included Introduction to Agricultural and Natural Resources (98.3%), Animal Science (96.6%) and Plant Science (91.4%). Of the

56 participants, 67.9% said that they use pre-made or prepackaged curriculum for the courses listed below.

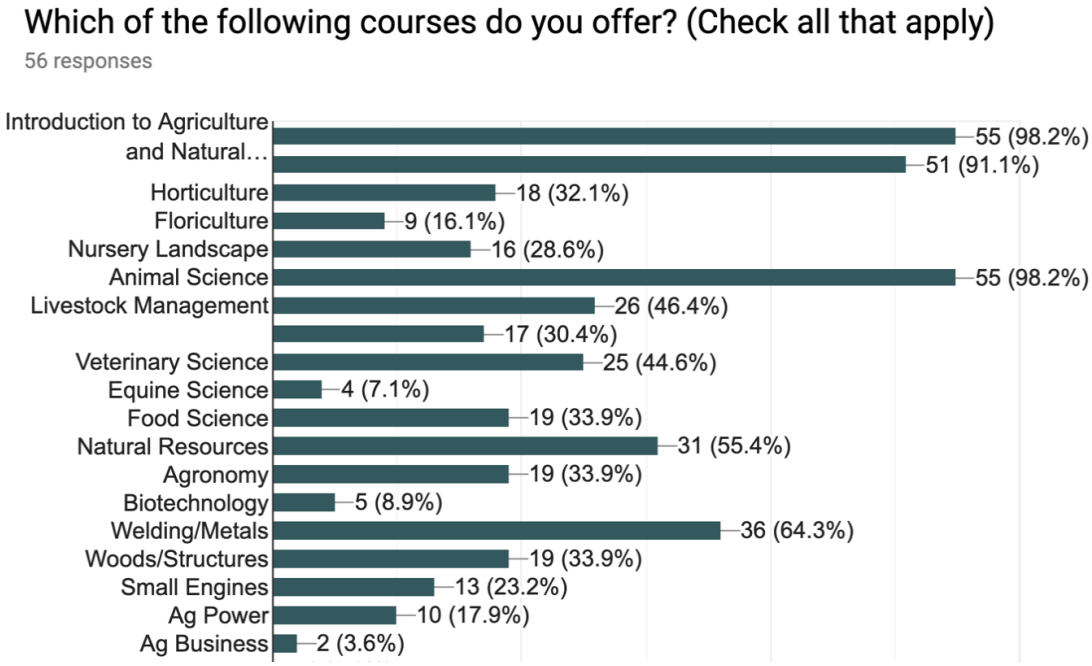


Figure 4.6 *Participants' Program Courses Offered*

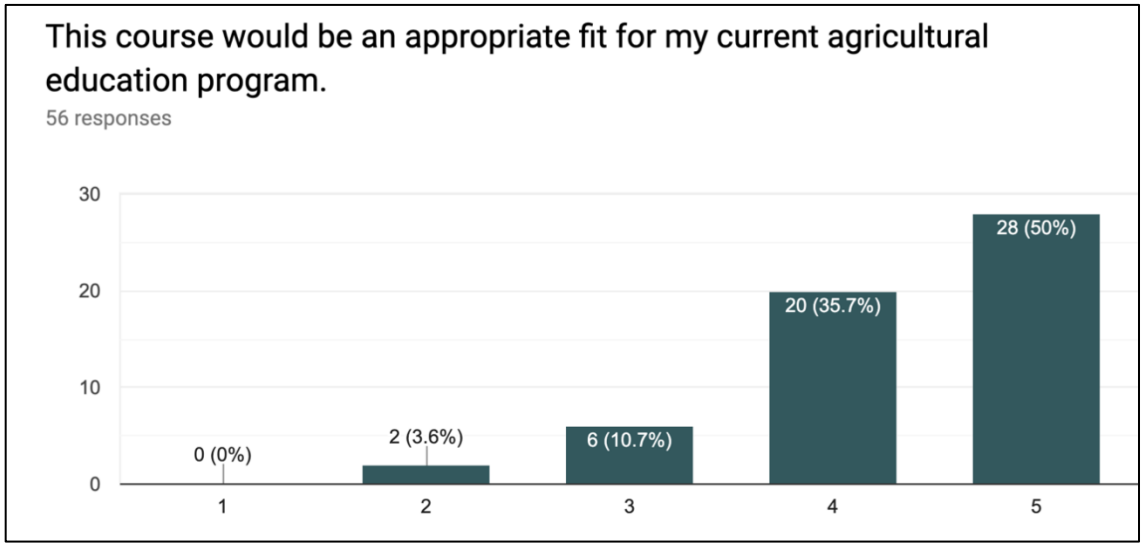
Survey Section Three Data: Curriculum Design Assessment

Section three of the survey asked questions regarding the design and effectiveness of the curriculum. Questions invited participants to indicate their professional opinion and critiques of the curriculum design, value of the lessons, and science connections throughout the entire sample unit. Question responses were organized according a Likert Scale, with a rating of 1 = Strongly Disagree (SD), 2 = Disagree (D), 3 = Neither Agree or Disagree (N), 4 = Agree (A), 5 = Strongly Agree (SA).

When asked if the provided assessment measured student learning, 93% of participants indicated they agreed or strongly agreed. Ninety-five percent of participants also determined the new, proposed instructional strategies and activities included higher

order thinking, problem solving and reasoning. In regards to the participants' opinion of whether the curriculum provided a foundation of science-based curriculum and instruction, 98% of agricultural education instructors answered with agreeance or strong agreeance. As an overarching view of the unit design, Table 4.1 displays participants' opinion about whether or not this course could fit within their current teaching program.

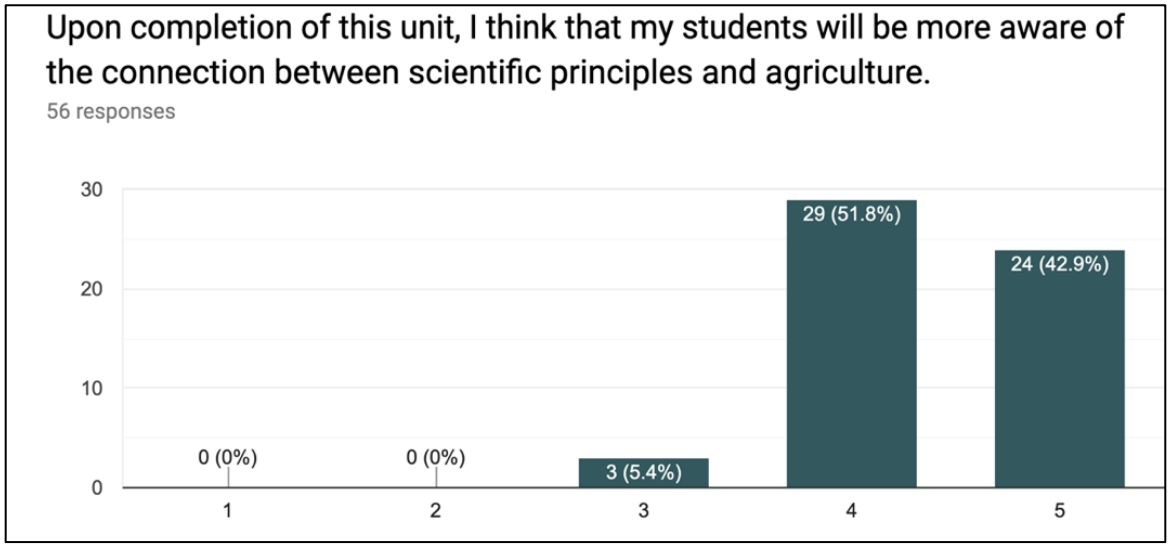
Table 4.1 Course Fit for Ag Ed Programs



Survey Section Four Data: Standards Assessment

Section four of the survey asked for participants' assessment of the standards addressed within the sample unit using Likert scale statements. All Likert Scale statements were rated using a scale of 1 to 5, with 1 = Strongly Disagree (SD), 2 = Disagree (D), 3 = Neither Agree or Disagree (N), 4 = Agree (A), 5 = Strongly Agree (SA). Table 4.2 presents participants' overall sense of the effectiveness of science learning and expectations about whether or not their students would be more aware of the connection between scientific principles and agriculture on completion of this unit.

Table 4.2 Student Science and Agriculture Connection



Participants were asked to rate the degree to which they felt that their students would be more prepared in science after they complete this sample curriculum unit. Ninety-four percent answered that they agreed or strongly agreed with this statement as well as the statement that this curriculum unit would provide students with a deeper science learning. Tables 4.3, 4.4, and 4.5 present teacher participants' assessment of the benefit of the new, proposed curriculum unit.

Table 4.3 Student Science Preparation

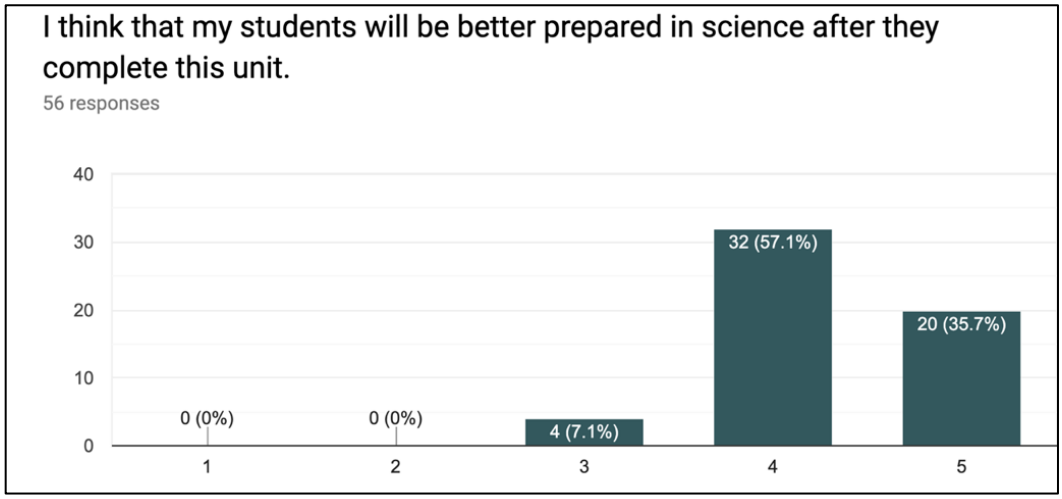


Table 4.4 Student Science Learning

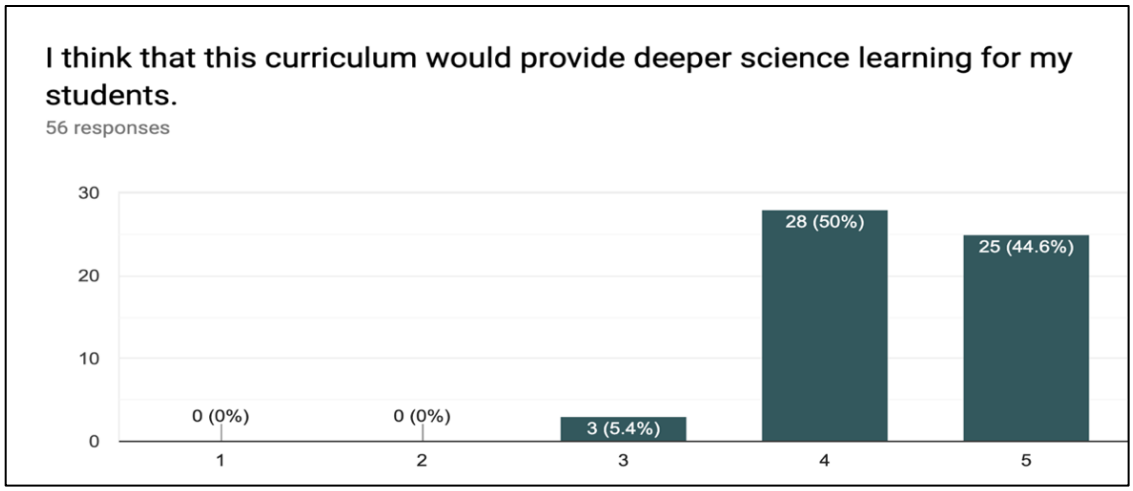


Table 4.5 Student Science and Agriculture Awareness

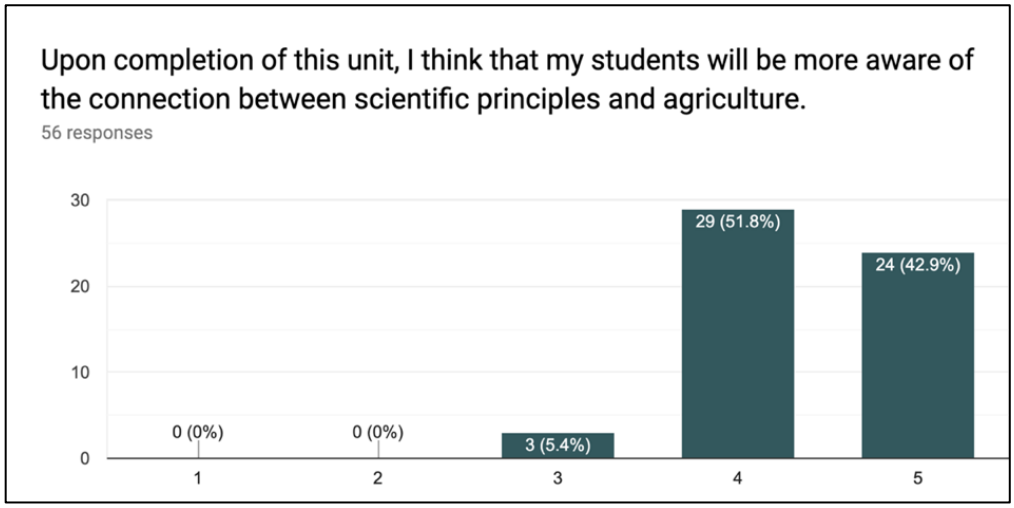
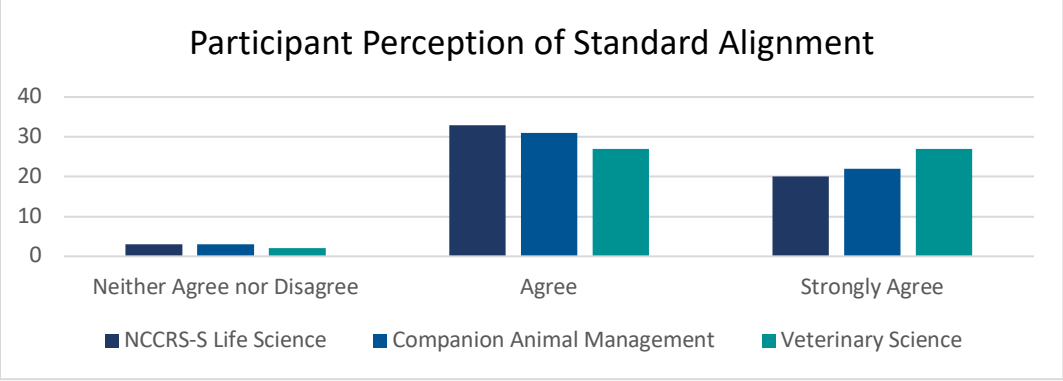


Table 4.6 describes participants' assessment about whether or not the sample unit aligned with either the NCCCR-S, Small Animal Management or Veterinary Science standards. (Note: Appendix G provides a comprehensive list of the NCCCR-S standards; Appendix F provides a comprehensive list of the Small Animal Management standards; and Appendix E provides a comprehensive list of the Veterinary Science standards. All survey responses were rated either a 3 = Neither Agree or Disagree (N), 4 = Agree (A), 5 = Strongly Agree (SA).

Table 4.6 Participant Perception of Standard Alignment



Tables 4.7 and 4.8 present participants' assessment of the way in which the integrated curriculum unit address student achievement concerns related to student motivation, student understanding and student comprehension of science concepts.

Table 4.7 Science Concept Integration

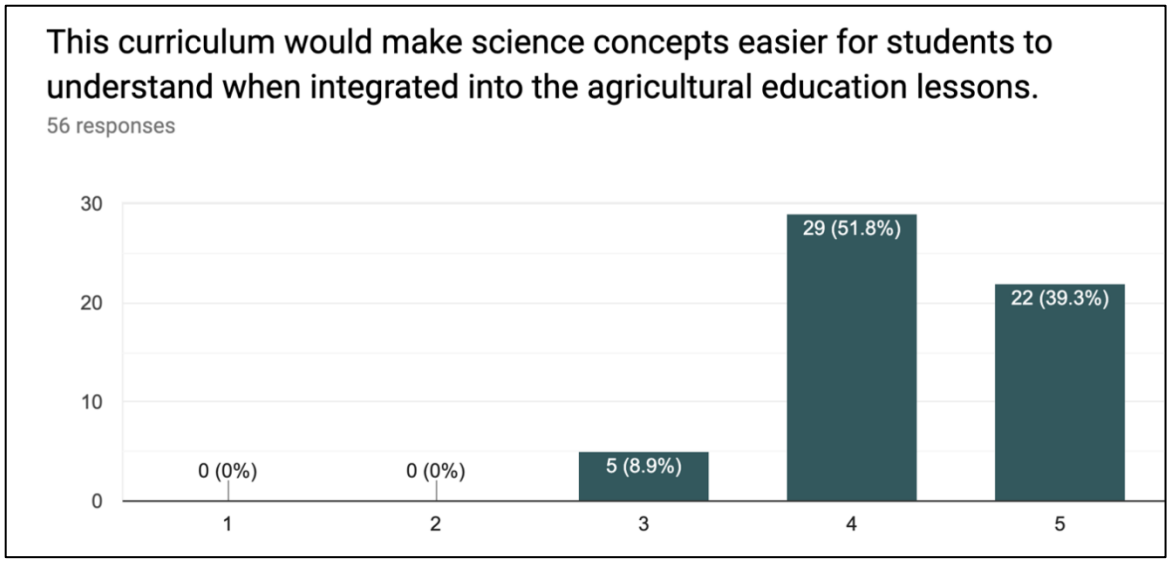
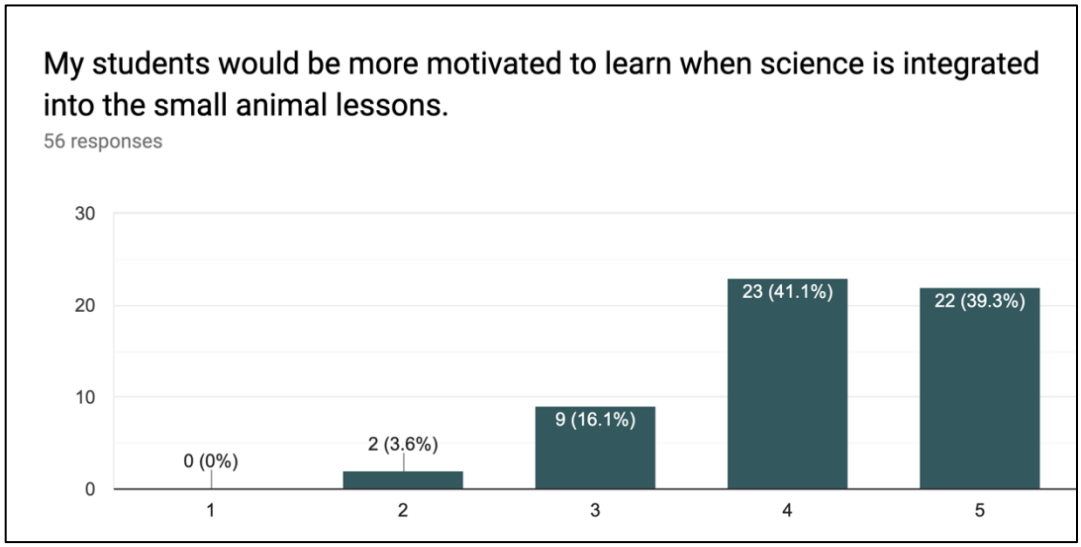


Table 4.8 Science Integration Small Animal Lessons



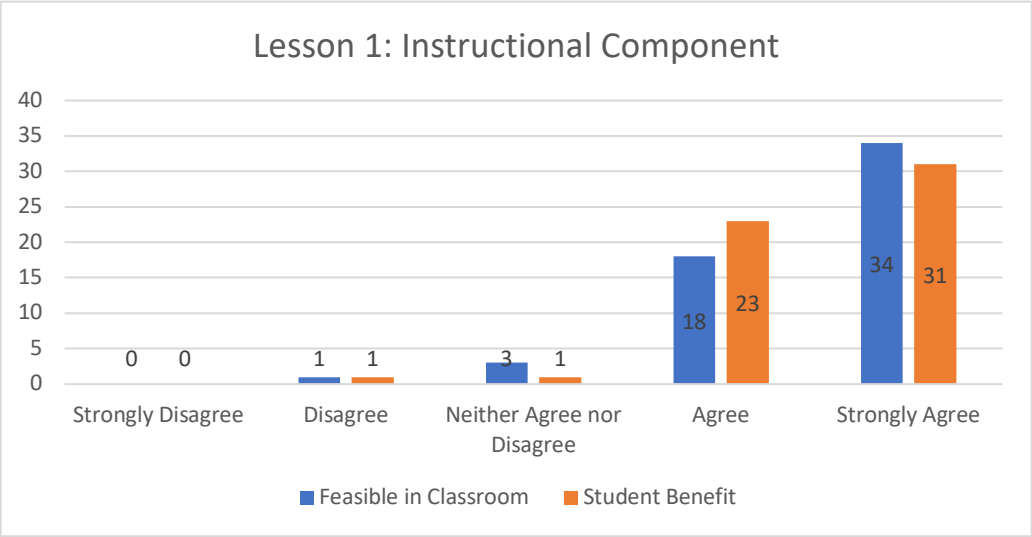
Survey Section Five Data: Overall Curriculum Interpretations

Section five of the survey allowed both Likert Scale and short answer response to obtain a detailed report of the participants' curriculum insights. All Likert Scale questions were rated using a scale of 1 to 5, with 1 = Strongly Disagree (SD), 2 = Disagree (D), 3 = Neither Agree or Disagree (N), 4 = Agree (A), 5 = Strongly Agree (SA). Lessons included within the sample curriculum unit were:

1. *Lesson 1: Instructional Component:* Provides basic foundational knowledge for the unit.
2. *Lesson 2- Application Component:* Students build upon the principles of the unit by completing an exploration activity.
3. *Lesson 3- Lab Component*: Lab activity which provides a hands-on experience for the unit's core teachings.
4. *Lesson 4- Career Component:* Career exploration of a possible vocation that aligns with the ideas of the curriculum unit.

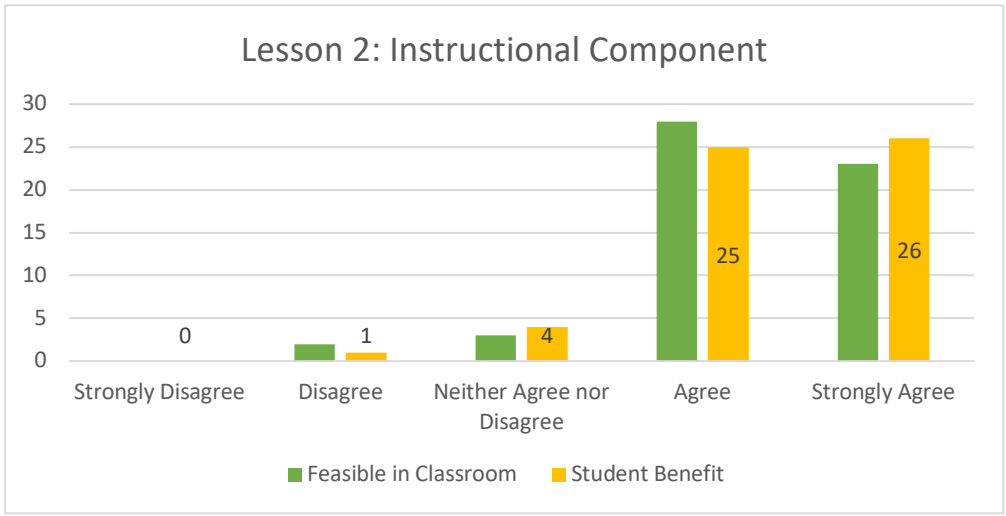
Lesson One survey questions asked about the instructional unit of the curriculum. This unit provided foundational information that the remainder of the unit build upon. Table 4.9 presents participants' assessment of the feasibility of teaching Lesson One within their own classroom and the students benefit from this lesson as a piece of the curriculum.

Table 4.9 Feasibility and Student Benefit of Lesson One



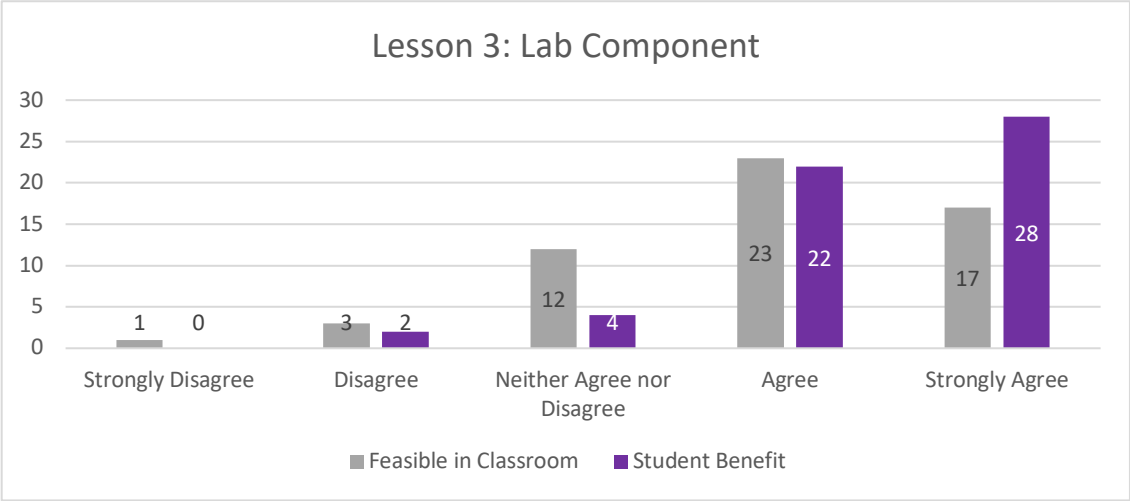
Lesson 2 survey questions questioned the impact of the lessons provided in the application portion of the curriculum. This lesson used principles taught in Lesson 1 and provided students with an opportunity to apply their learning to a specific situation. Table 4.10 describes participants' assessment of the feasibility of teaching Lesson 2 within their own classroom and their students benefit from this lesson as a piece of the curriculum.

Table 4.10 Feasibility and Student Benefit of Lesson Two



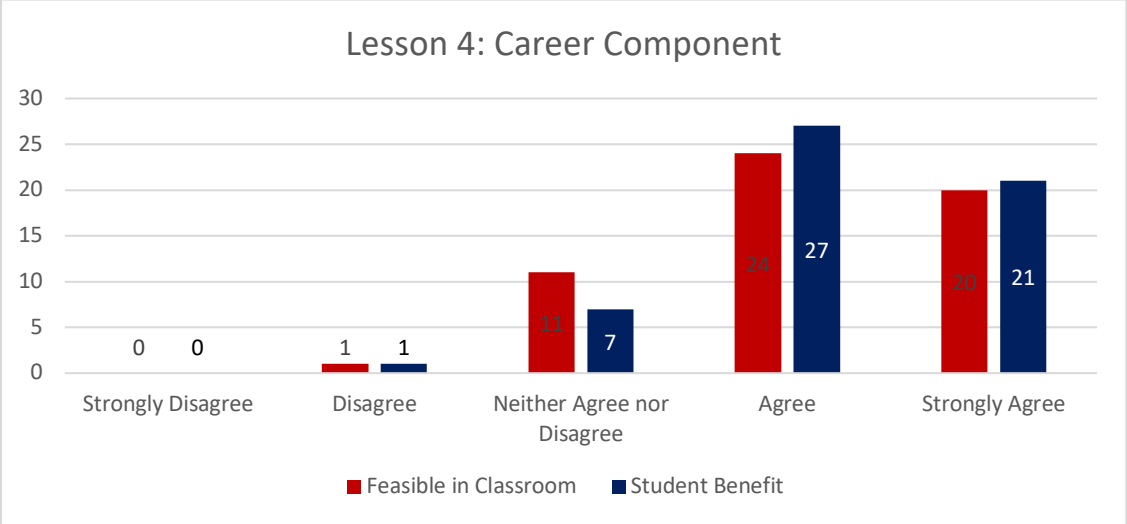
Lesson 3 survey questions examined the participants' opinion of the lab component of the sample curriculum unit. The lab component provided a hands-on experience that applied lesson philosophies taught earlier in the unit. Table 4.11 describes participants' assessment of the feasibility of teaching Lesson 3 within their own classroom and their students benefit from this lesson as a piece of the curriculum.

Table 4.11 Feasibility and Student Benefit of Lesson Three



Lesson 4 survey questions asked the participants' perception of the career component of the sample unit. A lesson utilizing the topic area presented within the curriculum was linked to a career exploration. Table 4.12 describes participants' assessment of the feasibility of teaching Lesson 4 within their own classroom and their students benefit from this lesson as a piece of the curriculum.

Table 4.12 Feasibility and Student Benefit of Lesson Four



Short Answer Questionnaire Responses

The final section of the survey encouraged open-ended short answers. Participants were asked to give professional opinions regarding their assessment of the curriculum. Short answer question #1 asked participants: Do you feel that there is a need to deepen science learning within your classroom? Table 4.13 presents a thematic organization of responses which all relate to a specific need for change.

Table 4.13 Short Answer Responses for Deepening Science Learning

To Deepen Science Learning, there is a Need for:	Participant Response
Additional Resources	- Yes and no. Sometimes the curriculum available for ag educators does not come with great resources. You find yourself always putting your own together to amp-up the science and content in general. - Yes, I think there is definitely a need but it is hard to find time to develop those resources. I am not an expert in it either so we need people that understand the science component AND how to teach it to high school students. The biggest

	problem I have found with this is that professionals have a hard time understanding that we need to make it simple enough to continue other topics in our classrooms too.
Additional Science and Agriculture Connections	- Yes, I feel agriculture provides an opportunity for students to apply science principles in realistic ways. - Yes, it would probably help tie science to ag. - I find that there is a fine line. While I understand that agriculture is science based, most students in my situation don't come to the ag program to have more science concepts thrown their way. Therefore, I try to find the relevant connections for them to make or real world applications. I also don't feel confident enough in my science background to teach some of the very scientific concepts. - There is always room for applying more science. So, yes. - Yes, the more science and hands-on learning will help to keep students engaged - agriculture is the application of science
Specific Relations to Agriculture	- I am always looking for new ways to bring in science learning into my classroom. I think it is important that students can see the connection of science principles and how they relate to agriculture. - Absolutely. The more I can connect my lessons to science concepts and standards, the more my students will be able to make connections and truly grasp scientific concepts. - Yes and no. Yes, because it's heavily tied to agriculture, no because many of the concepts are taught in the science curriculum already. - Yes, as students enjoy learning the animal components of the science learning.
Improve Current Existing Connections Between Agriculture and Science	- Yes, science is integrated but not as strongly as it should/could. - I do. I, unfortunately, take for granted that a lot of my students come in with basic scientific knowledge. However, some do not. Any time that

	we can add to those basic science skills, we want to take advantage of that. - Yes - We can always look for more ways to deepen science learning in the classroom! - Yes, I am always looking to add more science into every lesson. - Deepening the science learning within my classroom is a key aspect I want to improve in my classroom as I continue teaching. - I feel that students do need a deeper understanding of science. From what I have observed, students try to just get the basic understanding so they can do okay on tests and other assessments, but getting deeper can be a struggle for them because they don't always see the point of it. - Yes. I think that any time that science can be connect with agriculture, there is a benefit for students because they can understand the connection and realize its importance. - It would be beneficial to continue science practices within my classroom! - I have a heavy emphasis on science but like to find ways to do even more. - Yes! I love using scientific principles and applications and feel that it is important to do so. - Yes, I would love to offer some ag classes for science credit but could use help structuring it! - Yes, I think we need to do a better job of connecting and communicating with students and adults on how much science there is in agriculture.
Miscellaneous Responses	- Always! Research scientists lay the foundations for advancements in agriculture. - Yes...the world of agriculture is more technical every year. - Yes, many students view science as an isolated content - Yes, but it must not sacrifice the agricultural learning base of the topic. - I feel like we do a good job with this but I do appreciate learning and adding new things - I feel that if you don't cooperate with your science department then yes there may be a need to deepen science learning in the Ag classroom.

Yes, Only Answers	Eight responses
No Only Answers	Two responses

Open-ended short answer question #2 asked participants: What would the curriculum be able to provide in your high school? Table 4.13 presents a thematic organization of responses which all relate to a specific need for change.

Table 4.14 Curriculum Provisions Within Participant Schools

Provision in High School	Participant Response
Current Lesson Enhancement	- I have made Google Slides for most of these parasites plus I have purchased specimens. But, I don't really have structured lesson plans or accompanying worksheets and assessments. - The curriculum would be able to provide more substance to my Vet Science class. - It would provide me with ways to teach students about parasites in my animal science course and in preparing for the vet science contest. - This would get students to understand how parasites interact with animals but also humans. I think it would open their eyes to a bigger part of the animal science work. - This curriculum would be able to provide more hands on laboratory instruction, that is supported by great lecture based background materials to introduce those concepts to students. - It would just provide another outlet to students who want to gain more understanding in this area.

	- (This is) a stronger more comprehensive Companion Animal curriculum than what I currently use. - As this time, we use a standardized Vet Science curriculum from Cornell, but this looks like it fits the objectives of our Vet Science contest much better. - This is one area that my current animal science curriculum is lacking. I think it would be a good addition. - The curriculum would provide more up to date/current lessons pertaining to small animal care. - This unit ties science to agriculture in a more organized way than I do now. - I currently teach an animal anatomy and physiology course for science credit. This curriculum would help diversify that course and give more hands on learning activities. - I think it would be great supplementation to my animal science class because right now I do not hit on small animals at all. - supplemental to Zoology curriculum.
Connections to Science	- (This offers) a science connection to my companion animal class. - I think this curriculum would help to connect principles that they are learning in biology and apply them to vet science. It would be especially beneficial for the students who are interested in becoming a vet so that they can apply the principles. - This would be a great model to follow through our vet science/companion animal classes. It would focus on more of the science learning (relating to their science classes and state testing). It would also benefit students participating in the vet science CDE contest. - A new aspect of science within agriculture. - I better connection between ag & science / a stronger curriculum. - The curriculum would show how science is easily tied to agriculture. - Another way to look at things that come from biology/ life sciences.

	- A deeper understanding of science, and show students different career options - It would be able to provide consistency across different discipline areas. If I can teach scientific concepts in my classroom, chances are students will become more engaged in their core classes. - I think it could connect more concepts between Ag and science - Another quality way of instructing a deeper science knowledge. - More science based instruction to help prepare Vet science team. I do something similar to this unit on a lower level in my intro to ag class where our animal unit in that class is about animal health. - It would give an option for students to apply their small animal care knowledge with science standards and boost their knowledge of health. - a deep understanding of the science in companion animal care and the connection to human health too. - This would implement more of a science background that students can utilize the knowledge from in other courses. - An application of basic biological principles that students would have an immediate connection to - they love companion animals! - A better understanding of the link between agriculture and science. - Students would benefit from learning science concepts in the ag department where they may be more interested and comfortable than in the science class. This is in addition to the extra understanding of agriculture. - An application of science to agriculture for students that may struggle with science but excel in ag. - A quality vet science curriculum with a heavy emphasis in science.
Dual Credit Option	- This curriculum would provide my high school the opportunity for dual credit science

	and agriculture courses that are designed to meet both standards. - Science credit
New Course Offering	- A backbone for my NEW veterinary science course. - A different way to teach at Animal science that would reach more students. Almost everyone has a companion animal. - This would give my students another option for agriculture classes if their interest takes them there. - This curriculum would bring a much closer and more relatable look into animal agriculture and management. As not all students will have an ag background but most or many may have a pet they care for. - A different way to learn and retain knowledge. - A new way of learning this topic
Resource for Teaching	- Hands on activities, more up to date resources - Helps provide me with better knowledge to share with my students - also has great detail and incorporates more science - Additional resources to be used by myself and science teacher mainly.
Real World Application	- A better connection to agriculture by all students, ones that are interested in ag and ones that are not. - I believe that with this curriculum, I would be able to add a deeper, real-life science understanding for my health unit in animal science. - real world connections and applications - career exploration and life science standards - A better understanding of science and how to use it in the "real" world. - It would be able to provide that connection and real world application of content that students learn in science but don't understand how it is useful to them.

Miscellaneous Responses	- Vet science for Companion Animals - I don't use premade curriculums; I use books and design my classes to look similar to college courses. - Some yes and some maybe - (This is) a course I do not have time to teach

Open-ended, short answer question #3 asked participants: Would you be able to provide this curriculum in your high school? Why or why not? Table 4.15 presents a thematic organization of responses which all relate to a need for change.

Table 4.15 Curriculum Feasibility in Participant High School

Feasibility in Participant High School	Participant Responses
Yes, Without Doubt.	- Yes - Definitely! As mentioned above, I have bits and pieces but not a cohesive curriculum. - Yes, in the vet science class and probably some of the parasite identification in my Intro to Ag or Animal Science classes. - Yes, we've just adopted it as a new course offering. - Based on what I have seen yes. I would be able to add a Vet Science class to my rotation of classes in order to provide the opportunity for my students. - Yes. We are 1 to 1 and it looks feasible. - Yes, I could implement this into our animal science course. The standards align and create better learning subject to catch the attention of many students.

	- yes-it can allow students to transfer this knowledge to other animals' species - Yes. As long as we have lesson plans turned in, there is no question as to what's being taught in the class. (as long as it fits within the class being taught) - Yes - I have access to provide this curriculum - Yes, being a second year teacher, I am always looking for new curriculum. This curriculum would definitely benefit my class. - Yes - this is a good fit to follow the small animal care class - Yes, I could use the curriculum in my Vet Science class. This class is taught once every third year. - Yes, our administration is always wanting teachers to utilize the best curriculum available - Most of it. I don't have science equipment (microscopes), so I may not do the lab. - Yes. I am biology endorsed and teach a similar course. - Yes, presuming I could acquire all of the necessary supplies. - Yes! I could implement this into my courses! - Yes, courses are determined based on student interest and there are several that have been interested in vet science. - Yes. Easy to introduce and teach - Yes, I can work small animal into some veterinary science days. I would love to see other classes made like this. - Yes, the curriculum is well laid out and I have a majority of the resources available to use at my school. - yes, I determine my curriculum - yes- I would incorporate it into my companion animal and vet science

	classes as well as utilize it in our live animal laboratory. - Yes, our current administration allows teachers to make most of these calls. - Yes, because we do not talk about companion animals now.
Yes, With Concern.	- I believe so. As a small school we are very dependent upon interest and enrollment to offerings. - I think - we are a pretty new program with little money so getting some of the lab supplies might be tricky, however I really appreciate that there was links for where to find the materials - Yes, it seems easy to follow. I would need to get some supplies for the lab but I think I could find them. - I think I could make it fit, or add a whole other semester Veterinary Science/Companion Animal class that would maybe work in a rotation. - I believe that I could implement this curriculum in my animal science class since I do talk about health and diseases in my health unit anyway, but was having a hard time thinking how I could bring in parasites. Just based on this curriculum here, this would allow me to take a deep dive into parasites with the students which would benefit them. - Yes. It would depend on the number of interested students and the ability to schedule the period to offer it. - Yes, however the lab is something I would probably never do but would consider bringing in a certified vet to demonstrate the process. - No because I don't use premade curriculums. - Yes - this is a good fit to follow the small animal care class

	- Yes, I could use the curriculum in my Vet Science class. This class is taught once every third year. - Yes, our administration is always wanting teachers to utilize the best curriculum available - Yes... if I can drop some items I currently teach - Not currently, but possibly in the future. Currently in a 3 year contract with my current curriculum. - If I had access to the whole curriculum I would be able to use it in my vet science course. - Yes, for the most part. I do not currently have any science lab equipment but it may be able to be borrowed
Yes, Already Offering.	- Yes, because I currently offer a companion animal course - Yes - Our curriculum currently for our vet science/companion animal class is patched together from many resources and isn't very structured. - yes, I teach a vet sci class that this could easily be incorporated into. - Yes, I am teaching this course this year.
Maybe, With Question.	- As a first year teacher, I am not sure if I would be able to implement it at this time, but I think I would be able to utilize some of the resources provided if I don't follow the lessons exactly. - It depends mostly on the makeup of the class that I get in animal science
No, Could Not Offer.	- Not sure that I have the time to fit something new added into my current practices. - No because I don't use premade curriculums.

Miscellaneous Responses	- I would use parts of it in places like Animal Science and Animal Science II - Yes, but not all as I only teach a semester of vet science. - I believe that I could integrate it into my Plant & Animal Science class which is a yearlong course. - Yes(ish), I want to teach the fecal float, but don't know if I will teach to the depth of the other material.

Open-ended short answer question #4 asked participants: How would offering this integrated science/agricultural education curriculum effect your student enrollment? Table 4.16 presents a thematic organization of responses which all relate to a specific need for change.

Table 4.16 Possible Curriculum Effect in Student Enrollment

Effect in Student Enrollment	Participant Responses
Positive Effect	- I believe this would impact enrollment positively if added as a dual credit course - I think there will be lots of interest. Much of the information doesn't only apply to veterinary science, but also human health career options too. - I love how hands on the material is, I think it would get students talking to their friends and get more students interested in taking ag classes - I think adding this curriculum would increase student enrollment in the Ag Department at my school. - Students tend to engage more with hands on laboratory based learning, if this curriculum was implemented, I believe students may find my courses more attractive when selecting elective courses, or deciding which classes they would like to take to finish their required high school science credits.

	- I think it would catch a few more students than I would normally get. - Likely - I think it could spike more interest in my class because of the real world application that it provides - Students love this class, so it is always a popular choice. - The more engagement I can have, the more students will be interested in my courses. Especially in getting those non-traditional students enrolled in ag. I struggle with "I'm not going into ag after high school." If students can see that what I am teaching is relevant in their other courses, chances are enrollment will increase. - More students may feel that this subject is more relevant to what they want to learn and thus more students may want to enroll in the class. - I think if we would incorporate this curriculum, there would definitely be more students that want to take animal science class. Many students take the class because they think of cute animals, but if they would see some of the deeper science concepts in a vet science-based unit, then there should be more students for the next years to come. - I may gain students who thought ag wasn't for them - It would be appealing to them and probably increase the enrollment. - I believe that after the first year students that had taken the course would talk to other students and tell them about the curriculum. I think it would increase enrollment. - Provide opportunity to increase student enrollment but likely no change. - It would increase. - It helps the students relate what is happening in their lives (their pets) to what is taught in school. - increase possibly

	- It would make it easier for students to learn cross curricular standards. - Slight increase - I think it would grab some of those 'non-ag kids' and bring them into the classroom. - I think it would be challenging for students, but I think if the expectation for higher learning was established right away, they would step up to the challenge. - I think it may draw students in. - increase, but something else will have to be cut out. - I think it would increase it I think it would be popular
Negative Effect	- A change in my curriculum would decrease the number of special needs students in this class. Typically, they are enrolled in this course because it is viewed as "easy". - No effect.
No Effect	- Probably not going to do dual credit, need smaller classes not bigger for me. I'm looking for students to do the entire Ag Education program, not 1 class. - Probably none. - In my case, very little. I am the only Career & Tech Ed program at my school so I already see 100% of the students and retain 95% of them throughout their four years. - I think it wouldn't affect my enrollment - With so many elective courses for our size of school, I don't believe it would alter my enrollment. - Same - I think it would stay the same. - Not much. Students that take vet science have a specific interest in the area. - I would say no change - I don't think that it would affect my enrollment - Not sure how it would affect my enrollment being from a school with small class sizes. Students that start in the Animal Sciences pathway should naturally fill into this class as a capstone course.

Unsure of the Effect	- I am not sure. Students who enroll in Animal Science or Vet Sci or Companion Animals enroll because they are interested in the topics and associated CDE contests. - I would hope that the students like the hands on aspect of the curriculum that they would like to continue taking ag classes. - Not sure if it would make a change - I don't believe it would have any affect. - I'm not sure. - I don't think it will affect my enrollment much. - Not sure - I don't think it would change anything. - I have the majority of students in agricultural education, so it wouldn't make much change. - I don't think it would. - We are in a school where Ag courses are always filled completely, so I am unsure if this would affect the enrollment numbers. - I don't know how enrollment would be impacted. - not sure - I don't know that it would affect the enrollment overall, but it might attract more students to take this course if they could receive science credit for it. - I'm not sure it would affect my student enrollment. Most of the students in our school (95%) of them take every ag class throughout their high school career.
Miscellaneous Responses	- Companion to animals - N/A - I have fairly good enrollment right now based on the size of my school, I may get a few more kids with this but the way their schedules are set up it would really depend on when in the schedule it was taught.

Open-ended, short answer question #5 asked participants: Please describe the impact of this curriculum if it was to be added to your agricultural education program. Table 4.13 presents a thematic organization of responses which all relate to a specific need for change.

Table 4.17 Possible Curriculum Impact on Agricultural Education Program

Impact on Agricultural Education Program	Participant Responses
Benefit to Students	- I thought your choice of videos was excellent! The videos and assessments will have a positive impact on my students. - It would have a positive impact because it would challenge my students, and it is set-up very thoroughly. - Kids don't like learning from books! If we brought live animals into the classroom on a regular basis I think would be the talk of the school - I think it would definitely be a positive for our curriculum in our vet science/companion animal class. It would challenge students more and relate items to their knowledge learned in the science classroom! - I think it would help with the content and the Vet Science CDE. - It would definitely broaden the students' exposure to what I introduce them to in animal science classes. This would greatly help those students who participate in the vet science and livestock management contests. - The impact that the curriculum could have on the students would be large because the students could get a deeper look at real-life health problems that could possibly hurt their animals. - I hope that the student sees the value and usability of what he learns immediately in the care of his pet.

	- I feel it might make the vet science class more interesting. - Overall, students would benefit from being more proficient at science skills and see the connections between science and agriculture. - I really believe it would help students that have never had an experience with farm animals to relate more to what we are discussing and how it impacts them more directly - I think it would be an enhancement to my current curriculum and may touch those students interested in animals other than the traditional livestock emphasis. - It would be appealing to them and probably increase the enrollment.
Science Connection	- This would allow students to take more agriculture classes as they would count for science credits as well - Huge benefit! This is well thought out material that has a clear purpose and engaging activities. - It would be beneficial to have a class that connects science and agriculture specifically. It would also act as a way for students interested in a career in vet science an opportunity to study it specifically instead of as just a single until in a general animal science class. - it would increase the biology science side more in my class. - By using animals that students are familiar with, allows them to be more open to harder scientific concepts. - It would help bridge the gap between agriculture education, biology and the real world! Student engagement would improve greatly! - Provides another opportunity for students to learn and understand the science in agriculture. - I think my science teachers would love the cross curriculum approach

	- This would provide students with a connection between science and agriculture. It would also provide exposure to career opportunities for students.
Learning Changes	- More hands on and deeper learning - This curriculum would add a lot of purposeful substance to the program and allow us to "work smarter, not harder" by incorporating CDE into the classroom curriculum. - I love the hands on component, it's something that is lacking in our school as a whole. So, I think students would hear/see that, and it would be attractive. - Students may make better connections & see a different side of agriculture - positively, gives them one level of what I teach - It is lined up specifically with our live animal lab, and would greatly benefit our school in a cross-curricular standard goal. - A good consistent way of learning - I think students would have to do more critical thinking. - It would have a positive impact as students would be more engaged in an active learning environment. - Students in animal science would welcome the discussion focused on small animals rather than livestock. - Students get a well-made hands-on activity. - I think it will enhance the curriculum already offered - It would add an engaging way to teach about parasites. - This would give students extra knowledge in the classroom that they could later bring into their FFA contests!
Teacher Effect	- I believe it would boost my own knowledge of this curricula area and is set up in a tangible manner to teach to students. - This curriculum would enhance my desire to implement as much hands on laboratory

	learning as possible into my classroom while still centering my instruction on the introduction of concepts and terms through traditional lecture instruction. This curriculum is very well designed to meet both of those needs, while also providing numerous opportunities for assessment of student learning at multiple different points during each unit. - I am currently teaching this course, but this would definitely allow for better integration of the contest so that students could better prepare to participate in the contest. It would also allow for more thorough understanding of the content. - Increased enrollment, decreased stress (prepared curriculum would be awesome!), - As a beginning teacher I feel the inclusion of curriculum like this would only strengthen my teachings in the classroom. - This curriculum would not only benefit the student, but it would benefit me. I gained new knowledge from looking over this curriculum, and I really like how it ties science to agriculture. - It would help me as a teacher be more organized, and give me new content to teach students - I think this curriculum would help me feel more comfortable with companion animal units and that we could help connect small animals into large animals. - It would be more engaging. I've taught this subject before but don't always find labs that work well and miss some topics or content. But this is laid out very nicely. - Would definitely add to our program, and help me feel more confident in teaching the real scientific ideas and terminology. - It would allow more students to take my class and be in FFA> - I think that it would enhance my teaching.
Miscellaneous Responses	- I would have fewer special needs students as this is the class that counselors typically enroll them into. I have had to severely simplify the curriculum.

	- See answers above. - It looks good, beneficial, and easy to follow. - I'm not sure what you mean by this question. - None - I may strengthen some areas. - It would bring more interest in careers related to this - not sure

Lastly, participants were given opportunity to provide additional comments at the conclusion of the survey to provide supplementary feedback, critiques or suggestions. Table 4.18 presents additional comments according to four themes: curriculum comments, accolades, clarifications, and general remarks.

Table 4.18 Additional Participant Comments

Additional Comments	Participant Responses
Curriculum Comments	- I love that you offered multiple options within the curriculum! Directions are easy to follow! - May be a start to offering science credit - Looks like a well thought out unit. - I appreciate all of the pictures and real examples that are included in the unit. Makes it easier for students to learn. - I would love to have a unit like this on just a general health exam on a Small Animal like a dog or cat. - I really enjoyed this sample and I think it would be wonderful to be able to integrate into my classroom at some point! - I like the format of the lessons and the follow up evaluation tools.

	- I would like to see the entire companion animal biology curriculum. - I thought this lesson was well thought out and put together. It really ties everything together from the beginning to the end of the lesson. - This seems like a great curriculum I would like to try! - I could definitely see myself using these lessons in an animal science class that I will be teaching next semester. - It should prove useful. - This looked like a very complete curriculum as it has both bell ringers and exit tickets for the beginning and end of class which really impressed me. Along with providing a realistic plan of days needed to complete each lesson. - I know I'm late submitting my survey, but I am really interested to see what this curriculum would look like once brought into the curriculum! - This is awesome. I would love to see an entire course in this. Way to go! - Outstanding quality resource, and curriculum that helps bridge the gap between agriculture and science with students. Thank you for allowing me to evaluate!! - I love that this also correlates to the very complicated vet science CDE - Great set up - I really liked what I was able to view and am curious about the future of this work and if it's something I will be able to tap into beyond what I took a look at. - I love how detailed and organized this curriculum is! Most pre made curriculum that I've seen or tried to use is complicated and hard to follow, this was not
Accolades	- Great job! - Good information

	- Thank you for putting this together for instructors who like to use these premade curriculums. - Great job! Awesome work! - Looks like a great resource to use! - Thank you this looks great! - Good work, Nicole!!
Clarifications	- Overall, I like the curriculum and how it is laid out. However, I'm a bit confused on what task students would perform to go along with the rubric in lesson 4. - Lectures need to have time for photos and stories within. Some photos need to accompany early terms. I think teach the term then give example (photo). I believe it would take twice as long to allow for stories and photos, otherwise it would suck to be the student in the lecture. - I'm not sure if I missed it but I wasn't sure about what you were using for assessment other than the exit tickets. Is the idea that all student worksheets, notes, lab sheets will be graded? Or is the only assessment feedback the exit tickets? I know you also integrated use of Kahoot which is good. I just wasn't clear about the overall - In Lesson #2 the ppt and reference documents were not able to be opened. All the other pdf's in this lesson were accessible. - I counted up the allotted hours for each lesson plan and I do not believe I could get this done in 4 hours. And, I have done fecal flotations and two class periods is realistic; however, parasite identification of eggs through adults and associated life cycles is a lot to process. I would probably double or triple the time as I have worked with students trying to ID eggs, ID larvae, and ID adults plus figure the associated life cycles. - assessment for each lesson when reviewing the material.

General Remarks	- Looking forward to seeing the finished results! - Thank You - I am always looking for ways to benefit my program and district. - I look forward to using this curriculum! - Thank you for doing this! - I have never concentrated on companion animals before

CHAPTER V.

CONCLUSIONS AND RECCOMENDATIONS

Introduction

Chapter five presents the findings of this exploratory survey research study. The previous chapter presented the feedback data from Nebraska agricultural education instructors on a curriculum sample unit that proposed lessons which addressed both core science and agricultural education standards. This exploratory survey research was conducted to answer the central research questions:

> Research Question 1: What is the feasibility of a publicly available, science-integrated agriculture curriculum within Nebraska agricultural education programs?
>
> Research Question 2: What are the benefits of a science-integrated agriculture curriculum within Nebraska agricultural education programs?

This chapter will present the research conclusions and recommendations as guided by Nebraska agriculture educators' responses to questions regarding the feasibility, viability and teachability of integrated science within their own classrooms, agricultural education programs and science learning. Conclusions and further recommendations will also be offered.

Conclusions

Participants were surveyed via Google Forms upon review of a sample unit of a Companion Animal-Biology curriculum. Both Likert Scale and open-ended responses provide opinions and suggestions regarding the sample unit. As explained to participants,

feedback provided will be used to improve the provided unit, provide direction for future units and give insight regarding Nebraska agricultural education instructors' viewpoints of science learning within the agricultural education classroom.

Overall Curriculum Interpretations

Agricultural education instructors were asked to assess the viability of the proposed curriculum lessons within their own programs and school systems. Survey questions were directed towards determining whether or not all Nebraska agricultural education instructors would be able to use the proposed curriculum to integrate science within their classroom. In terms of feasibility, the researcher learned that the overall curriculum design and implementation of the curriculum was considered a realistic option within their classroom. This inferred that the overall unit topics, as well as the proposed entire Companion Animal-Biology course, seemed to be a reasonable fit within participants' programs and can be seen as one that would fit into courses state-wide.

The majority of survey respondents (98%) supported the integration of this curriculum and determined that the curriculum content provided a large amount of science instruction incorporated within the proposed curriculum. Additionally, 94.5% of instructors agreed that the curriculum would provide deeper science learning for their students. As one participant explained that this curriculum model would be ideal to follow throughout both companion animal management and veterinary science classes, as it follows more seine learning, therefore better preparing them for core science courses and standardized testing. Teacher respondents determined the proposed curriculum provided a new aspect of science learning, with better connections between science and agricultural concepts, using a new style of curriculum. These data points echoed the

viability of curriculum as a model of integrated science and agriculture, as well as multiple teachers' perspectives of the curriculum. In sum, respondents determined the proposed curricula showed promise of successful incorporation of science into the Nebraska agricultural education classroom.

As expected, teacher participants were concerned that their current course scheduling or program sizes would be an issue when considering offering the course in its entirety. Since Nebraska agricultural education programs vary greatly in size (as shown in Figure 4.4), participants voiced apprehension regarding the practicality of the curriculum if the instructor does not have the scheduled time or if school did not have enough resources or funding to do so. While the curriculum was considered to have potentially positive impact upon their agricultural education programs, participant teachers voiced worries over some of the materials required, material costs and student enrollment in small schools. This is a practical concern, as many science-based courses require multiple supplies, those specifically for lab practicals. The curriculum is designed to utilize materials commonly found in the agricultural education classroom, or those in a typical core science classroom. The materials found in this course are also easily purchased at local supply stores, or easily attainable online. Labs also can be altered to use different supplies, or focus on different lessons, to make modules more feasible in the agricultural education classroom.

Additional considerations of this concern would include the feasibility of this course within a curriculum pathway, depending on the course offerings currently being offered at the school. Despite the aforementioned concerns, the Companion Animal-

Biology curriculum could fit in alongside small animal management or veterinary science courses. Both courses are capstone courses, which are a semester long.

Overall, teacher respondents found the sample unit curriculum to be a positive addition to their programs, despite the above concerns that come alongside a smaller school size and program. With the positive response regarding the program addition, the researcher can conclude that there is a strong possibility that this curriculum could fit into a variety of agricultural education programs throughout the state, based upon student interests and the fit into their current curriculum mapping.

Understanding of the Curriculum

This curriculum was highly-rated by Nebraska Agricultural Education instructors as one that they will choose to use within their classrooms. Teacher respondents communicated that the layout of the curriculum was one that was easy to follow (Table 4.15). Further, participant teachers appreciated the curriculum provision of directions, worksheets, and lab activities for each lesson. The majority of responses showed that the curriculum's easily attainable components provided material backing (as well as general context and lesson support) to instructors. These teacher respondents expected they would use these resources as support and that this what an important reason why they would use such curriculum within their classroom (Table 4.15)

A majority (94%) of agricultural education teacher respondents felt that the curriculum design was easy to follow, material needs were minimal (and easily attainable through a local retailer or their school science instructor). This was a strong desire of teachers across Nebraska, as agricultural education curriculum resources, and funding,

are scare. Regarding course fit for agricultural education, (Table 4.1), most teacher respondents (85.7%) of surveyed teachers found that the course could a plausible fit for their agricultural education program. They highly rated the flow and lesson alignment when discussing the connections between lessons and concept development. These high ratings demonstrate that participating Nebraska agriculture educators determined the sample curriculum to be a viable curriculum that could be implemented within their courses (either in its entirety or portions of it).

Lesson Effectiveness

When asked of the efficacy of the lessons, instructors described the curriculum sample unit as one that gives deeper insight to current lessons that are already being taught. Teacher respondents appreciated that the curriculum not only gave a more in-depth look at the veterinary science principles, it also provided real-life connections that students could apply to the FFA Veterinary Science contest and other FFA contests. With these state-level implications, those which could influence state-level FFA contests, the research data collected supports the creation of similar curriculums to implement within Nebraska agricultural education.

Teacher respondents rated this curriculum as one that is needed in Nebraska agricultural education. Survey results determined that the curriculum would provide a strong content foundation prior to giving students the opportunity to using the concepts in a laboratory setting. By utilizing lessons that provide an instructional component, one that teaches the foundation content, and moving into application, lab and career-based lessons, survey respondents determined that this curriculum would facilitate learning of both science and agriculture throughout the use of this integrated curriculum. These

ratings led the researcher to believe that the offerings of a dual-aligned curriculum, between life sciences and agriculture, would give students better preparation for higher-level science courses, as they would use the concepts learned in this course in a future setting. Over 78% of teacher responses showed that a course such as the Companion Animal-Biology would be a feasible dual-credit option. Survey results showed that ninety-eight percent of Nebraska agricultural education instructors agreed that the curriculum provided a foundation of science-based curriculum and instruction. In sum, teacher respondents justified the feasibility of the curriculum structure, standards met through the lessons presented, and expressed overall interest in the content by their student population.

High School Enhancement

Teacher respondents expected the sample curriculum will provide Nebraska high school agricultural education programs with a complete lesson planning resource (see Figure 3.1*)*. Participants spoke highly of the overall curriculum plan and development (which seemed to solidify their ideas of implementing this curriculum within their own classrooms. Survey data showed that instructors felt that the curriculum would make them more comfortable with companion animal units and provide connections between small animals into large animals. Additionally, these data showed that the curriculum provided more hands on laboratory instruction, which is supported by a lecture-based background material to introduce those concepts to students. These responses (Table 4.14) expressed that participating Nebraska agricultural education instructors found this curriculum to be a viable option within their schools and agricultural education programs.

The sample curriculum unit included multiple course standard alignments. For this reason, teacher respondents determined this curriculum was both a course that could stand solid as a companion animal course and one that could provide supplemental lessons for preexisting courses. Teacher respondents supported this idea through free response data that explained how the curriculum would introduce students to a bigger part of the animal science work, as it is another way to look at things that come from biology and life sciences. Additionally, teacher respondents explained that the lesson content provided a deeper understanding of science, and also gave students insight into different career options.

Nebraska agricultural education instructors described the sample curriculum unit as one that offers real world application of content that students learn in science—especially since they don't always understand how it could be useful to them. Additionally, participant teachers determined this curriculum provides opportunities for students to become more engaged with the material (due to both the lesson design and the nature of the topic). This gave the researcher confidence that this curriculum is one that could be implemented into a typical animal science course. More specifically, this relation was because of the standards alignment and the creation of a better learning subject to catch the attention of many students. Teachers who completed the survey also revealed that they might not be able to implement the exact curriculum, but incorporate specific units and lessons to enhance the curriculum that they are currently offering (*Table 4.15*).

Curriculum Design

Teacher respondents indicated the overall design of the sample curriculum unit (which includes an instructional, application, laboratory and career component) would be well-received and easily incorporated into an agricultural education classroom. Each of the aforementioned lesson areas were determined to be feasible to implement within a Nebraska agricultural education classroom. Ninety-five percent of participants also determined that the sample curriculum unit included higher order thinking, problem solving and reasoning. Teacher respondents reported students will be able to easily follow and comprehend each lesson, specifically the directions, design and teaching models that are included within each instructional set. As intended, participants deemed this curriculum to provide a foundation of science-based curriculum and instruction. Ninety-eight percent of agricultural education instructors answered with agreeance or strong agreeance that the curriculum provided a foundation of science-based curriculum and instruction. This provided assurance to the researcher that this resource would provide benefit to Nebraska agricultural education instructors and students within the program.

Standards Assessment

Teacher respondents were asked to rate the curriculum based upon the correlation and teachings of agricultural and science standards. Ninety-two percent of participants agreed or strongly agreed that the curriculum aligned with the NCCRS-S Life Science standards. Ninety-one percent of participants agreed or strongly agreed that the curriculum aligned with the Nebraska Agricultural Education Small Animal Management standards. Ninety-eight percent of participants agreed or strongly agreed that the

curriculum aligned with the Nebraska Agricultural Education Veterinary Science standards. In sum, teacher respondents determined the proposed curriculum could provide a way to include both subject standards without the time and resources to create lessons of their own.

Science Instruction

Teacher respondents determined that this unit would be likely to enhance science learning within agricultural education programs. Participant data revealed this sample unit provides context for learning scientific principles, specifically within companion animal science. As referenced in chapter three, Thompson and Balschweid (1999) explained that a common issue that agricultural education instructors have is the STEM integration process. Teachers' Likert scale-based and open ended responses deemed this sample unit curriculum as a possible solution to the common integration process, as aforementioned by Thompson and Balschweid (1999). Popular teacher response contributed data to confirm that the curriculum is both a resource and solution to concerns about science integration. Practicality of use and implementation of the integrated curriculum was confirmed through the positive responses regarding the teacher's guides, included in the curriculum as a resource for each lesson that provides a foundation for their teaching and student learning.

Although survey data determined that many agricultural education instructors already incorporate science into their current curriculum, responses revealed that this curriculum sample unit made it possible to incorporate more concrete connections that would align standards within their lessons. Additionally, teacher responses regarded this curriculum sample unit and complete course as one that could be used as supplementary

units to bring additional science standards and connections to an existing animal science or companion animal course. Through the utilization of companion animals as models for learning science, teacher respondents determined that this curriculum provides similar context-based learning that is asked within the new NCCRS-S standards and the standardized state testing models. The researcher concluded that this curriculum unit makes science concepts easier for students to understand when integrated into the agricultural education lessons.

Deepening Science Learning

The sample unit provided aspects of core science standards that will allow students to deepen their learning of principles within science subjects. By using companion animals as models, participants deemed this curriculum to take NCCRS-S science standards one step further and provide students with the opportunity to draw connections between core science and agriculture. By incorporating animals that students are familiar with, survey data showed that participant teachers believed that the curriculum would allow students to be more open to learning harder scientific concepts. Participants agreed that, often times, it is taken for granted that students are well-equipped with basic scientific knowledge. Short answer data explained teachers expected this curriculum would add to basic science skills. Teachers want to take advantage of that, as it provides context for students who are working towards a veterinary or health care areas careers. This validation of the curriculum was a common theme shown in Table 4.13.

Survey results determined this curriculum as one that would provide confidence in science for students who have taken both science and agriculture courses. The

researcher concluded that the sample unit, and ultimately the entire curriculum, could provide consistency across different discipline areas as it teaches scientific concepts in an agricultural education classroom. Teacher respondents agreed that there is always more room in agricultural education for science, that students need additional ties between science and agriculture, and that agriculture is application of science. Survey short answer responses supported the idea of consistently tying science and agriculture to provide students with more opportunities to become engaged in their science core classes.

State-Wide Impact

The impact upon agricultural education programs was the primary motivation for creating the curriculum and for seeking agriculture education teachers' assessment. As shown by survey response data, the large variation of location, size, and number of students enrolled in programs provided a challenge for complete curriculum sets. Importantly, fifty percent of teacher respondents included those that teach in a Class D (or class D6) schools which are among the smallest of those in the state of Nebraska. These teacher respondents particularly voiced apprehensions related to course offerings, material use, and the curriculum's teachability in schools that cannot provide flexible course offerings.

Despite these concerns, teacher respondents reported this sample unit of Companion Animal-Biology curriculum was one that provides flexible lesson plans for any size and location (so teachers could tailor lessons to fit their course needs). The researcher concluded that flexibility, as well as provision of multiple lesson options are a key component in implementation and feasibility within agricultural education. In the survey section *Curriculum Provisions Within Participant Schools*, participants suggested

that this curriculum would be particularly welcome in schools lacking veterinary and small animal science (see Table 4.14). This particular context proves to be feasible due to the high availability of agricultural education programs currently present within Nebraska schools.

Feasibility within High Schools

In terms of feasibility for high school programs, survey response data determined that this curriculum was a much-needed resource for the small animal content area. A small/companion animal course was seen to be one that teachers would like to offer, but often do not have the resources and materials to adequately teach the content material. Data analysis helped to define three benefits the sample curriculum could provide Nebraska agricultural educators. These included:

- Providing a strong, comprehensive curriculum beyond what is currently being used in classrooms.
- Incorporating small animal agricultural curriculum, a little-known subject area in the state of Nebraska
- Connecting principles of life science principles (that students are learning in biology) and applying them to animal and veterinary science

For those who already offer the course, the researcher determined that, based upon short answer survey questions, the flexible curriculum could be implemented in either small or large animal science courses. By offering multiple standards alignment, this subject matter can create a better learning model to catch the attention of the varied needs within diverse student populations.

Overall Agricultural Education Enrollment and Program Effects

This integrated curriculum has the potential to increase enrollment within agricultural education courses. By suggesting a subject that is not traditional production agriculture, this course provides opportunity for students who have interests in small animal and smaller-scale agriculture. Offering this course as a dual credit science option is an additional benefit to increasing enrollment, due to the applicable nature of the integrated approach. Survey data supports this theory as 93% of Nebraska agricultural education instructors who completed this survey rated this curriculum as one that they expect would help their students feel better prepared in science. In this, teachers expected students would find this course to be more relevant to what they want to learn, and thereby increase student enrollment in agricultural education courses. This could be due to the almost full support of survey respondents who believed that their students will see more connections between science and agriculture after taking this course. Agricultural education teachers relayed that many students already take a small or companion animal class because of their interest in the animals themselves. This curriculum builds upon student interest and provides deeper science learning in a vet science based unit.

Research and Survey Data Alignment

These survey results support multiple conclusions that align with literature previously cited in Chapter II. As Balschweid and Thompson suggested in their 2002 study, survey participants concluded that this curriculum provides an optimal agricultural-based vehicle for learning and teaching core science subjects. As the data in Table 4.2 show, survey participants expect this curriculum will create awareness and

connections to science through agricultural lessons, as promoted by Balschweid and Thompson's study of holistic learning (2002).

These research conclusions align with Warnick, Thompson and Gummer's (2004) expectation that students will be more aware of science when it is integrated within agriculture. In this study, 90% of surveyed agriculture educators (see Tables 4.7 and 4.8) agreed that the sample Companion Animal-Bio curriculum would make science concepts easier for students and over 80% thought that it connected specifically small animal concepts to science. These findings indicate survey participants align with Stephenson, et al. (2008) conclusions regarding the value of integrated academics, explicitly science, into vocational courses.

As Thompson and Balschweid (1999) suggested, survey participants confirmed that incorporating science into Agricultural Education allows students to create connections between various disciplines, in this instance; companion animals and life sciences. Drew (2011) found that while a large percentage of students who had an interest in STEM subjects they considered the content too difficult. These survey data, however, showed that that over 94% of Nebraska agricultural educators expect students will be better prepared for science learning (and deepen their science learning) via integrated science and agriculture curricula similar to the unit they reviewed for this study.

Discussion

Based upon survey results, Nebraska agricultural education instructors deemed this sample unit of a Companion Animal-Biology course as a successful implementation of both science and agricultural education standards. With this support, the presentation

of this material to the population resulted in a warm response to implementing the curriculum into their classrooms. In relation to the central research questions, Nebraska agriculture education instructors are supportive of this curriculum and believe that, using this curriculum as a vehicle, science learning can be incorporated into the classroom. While this idea is not novel, this research suggests that it can be more attainable through the implementation of the proposed curriculum. Nebraska agriculture education instructors saw this sample unit as a viable option for integrating core science principles, specifically those outlined in the NCCRS-S standards, into a small animal science classroom setting.

Through the inclusion of this curriculum into their classrooms, it was determined that this small animal science unit will better prepare students for science learning. Literature supports the need for scientific learning within agricultural education (Roberts & Ball, 2009; Thompson & Balschweid, 1999; Warnick & Thompson, 2007; Meyers & Washburn, 2008; Warnick et al., 2004) . Dual enrollment in both a science and agricultural education course has been deemed to be successful in higher-order thinking and accelerated learning for students (Thompson & Balschweid, 1999). It was determined that integrating science into agriculture curricula provided opportunity for higher academic achievement, as well as preparation for future career aspirations (Warnick & Thompson, 2007). Survey participants' evaluation of an integrated science and agriculture curriculum in this study echoed these ideas. Survey responders stressed that there was a need for both science and agricultural curriculum within the state of Nebraska, as well for the overall academic advantage of their students. Given these results, it seems this sample curriculum unit will support Nebraska agricultural education

instructors' opportunities to teach an integrated science and agricultural education curriculum.

Additional survey results explained that the implementation of the Companion Animal-Biology curriculum would provide a challenge for students who have current small animal and veterinary science knowledge. By relating core science concepts, survey participants expected this curriculum would give students the opportunity for higher order science learning. More importantly, survey participants expected this curriculum will provide context and content preparation for those students participating and competing in the Veterinary Science FFA Career Development Event (CDE). Participants noted the unique inclusion of the CDE preparation within the curriculum. Survey participants remarked that the lab lesson, lesson three, would provide student benefit due to the inclusion of the CDE practicum and lab activity.

The large-scale benefit of this curriculum is the effect that it has on their daily caretaking of their own companion animals, as students would be given a deeper look at real-life health problems that could possibly impact their pets and animals that they come into contact with. As survey respondents noted, not only will these curriculum unit lessons help those who have an interest in small animals, but it will also help those who also tend to have a stronger emphasis on raising and caring for livestock, as most principles carry over from species to species.

Limitations of the Study

Limitations of this study were primarily defined by the number of survey responses received. Fifty-six participants completed the survey, of a possible 189

Nebraska agricultural educational instructors. This limits the study to 30% of the possible population of Nebraska agricultural educational instructors and may limit the generalizability of the results. The original study design included personal interviews with participants, but the researcher was unable to complete the second part of the curriculum analysis due to time constraints. This would have provided additional qualitative data to draw conclusions upon.

Additional limitations included the student-dependent factors that may not have been included in the participants' evaluation of the sample curriculum. By way of example, students' outside and previous agricultural experience prior to taking the proposed agricultural education course may have altered the effectiveness of the proposed curriculum being taught. A students' previous science competency may also have altered the effectiveness of the integrated companion animal unit. Finally, the additional involvement and overall commitment to their FFA chapter may have enhanced their achievement of the teachings within the research curriculum.

This sample unit was limited to NCCRS-S Life Science standards that could be seamlessly connected to animal science. NCCRS-S Life Science standards also include topics of plant science, were not addressed within this curriculum. Therefore, additional curriculum units will need to be created and assessed to fully understand additional integration opportunities with NCCRS-S.

Recommendations

Recommendations related to this study are primarily drawn from the data determining the need and importance of science inclusion within agricultural education.

Participants strongly remarked on the apparent need for more science integration within agricultural education curriculum, as well as the importance for doing so. Since there is no formal curriculum for agricultural education in the state of Nebraska, further recommendations include continuing to address the need for curriculum development that is state and state standards supported. This could also include teacher professional development from state staff, rather than those provided solely from independent pre-made curriculum companies that provide curricula nation-wide.

Additional recommendations related to this study include sending out an additional survey to Nebraska agricultural education instructors to receive more feedback. Although every class size of Nebraska schools was represented in the survey participants, additional feedback would determine whether or not this curriculum is feasible in a larger number of the Nebraska agricultural education programs. Future research might be conducted as Nebraska agricultural education instructors have taught this curriculum and implemented it within their classrooms.

Furthermore, another curriculum or teaching plan might address the plant-based standards of the NCCRS-S Life Science course. While there is a seamless fit between the companion animal management, veterinary science and the NCCRS-S Life Science standards, the complete NCCRS-S Life Science course requires more standards than can be addressed using animals as a model alone. A recommendation for continued development and study would be to address the remaining standards by using plants as models, rather than companion animals. This would provide a comprehensive, agricultural education-based curriculum that meets all NCCRS-S Life Science standards.

With such a strong positive reaction to the aligned curriculum, the researcher is expecting that this curriculum can be utilized as a possible alternative science course for students who benefit from hands-on learning, rather than the typical learning styles found within a core science course. As previously mentioned, literature has confirmed that agriculture is a valid context for employing the content learned in core science courses. Roberts and Ball (2009), as well as Thompson & Balschweid (2002), both confirm that agriculture is the ideal vehicle for science learning due to the compatible nature of the subjects, as well as the constant advancements in both topics. This allows the researcher to conclude that the curriculum provided within the proposed lessons will reach both of these topics and provide benefit to students who learn best through a context-based teaching style.

Further Actions

Next steps for this study include completing revisions to the sample unit, and subsequent units, based upon on recommendations from the survey results. Due to the support from Nebraska agricultural educators, the Companion Animal-Biology course will be completed and offered for instructors throughout the state of Nebraska. Based upon the survey data received, the curriculum will be able to be implemented in any agricultural education program within Nebraska, regardless of the size of program. Since there were no concerns regarding curriculum and lesson design, the same lesson and instructional format will be continued throughout the remaining units of instruction.

The Companion Animal-Biology course will be distributed electronically. Instructors will be able to access online versions of the curriculum, similar to those offered within the survey. Possibilities of professional development trainings and supply kits will be considered at the time of the complete course release. These possibilities can

include in-person trainings, or Zoom/video conference trainings. Science incorporation into agriculture is not a new concept, but this curriculum is unique by providing concrete and complete lessons that instructors can tailor to fit their course and student needs.

Survey data supports the idea that Nebraska agricultural education will continue to grow, specifically in regards to the inclusion of science. Participant responses regarding the need to improve current existing connections between agriculture and science (see Table 4.13) support the need for connecting and communicating the importance of foundational science within agriculture and agricultural practices. Through the growth and enhancements of technology, science is always and will continue to present within agriculture. As career industries continue to shift, and more positions are created within agriculture, there will always be a need for science learning. This curriculum will provide students, and teachers, with foundational knowledge of science that is given in the applicable context of agriculture.

Conclusion

The conclusions presented in this chapter align with prior research on the need for holistic learning within educational systems. Agricultural education is a key facilitator of holistic and integrated learning, as supported by Balschweid and Thompson (2000 and 2002) through their studies and follow-up studies, which include higher scholastic achievement and better career preparation. As solidified by participant data, the literature-backed ideals of an agricultural education curriculum allow students to feel more confident in STEM-based courses, therefore furthering their exploration of those subjects and considering more career opportunities and future endeavors. The researcher expects these results point to feasibility and benefits of a publicly available curricula to

assist Nebraska agricultural educators with preparation and standard alignment through integrated science and agriculture curriculum.

REFERENCES

2019-2020 CTE Course standards and programs of study. (2019). Retrieved from https://cestandards.education.ne.gov/Subject_Link.aspx?Sub=Ag

AAAS. (1993). Benchmarks for science literacy. New York, NY: Oxford University Press.

Accreditation Board for Engineering and Technology. (2007-2008). Engineering accreditation criteria. Baltimore, MD: Author.

Ag Daily (2019). National FFA Organization hits a record 700,000 student members. (2019, September 12). Retrieved from https://www.agdaily.com/ffa/national-ffa-record-700k-student-membership/

Agricultural Education. (2019, January 14). Retrieved from https://www.ffa.org/agricultural-education/

American association for the advancement of science. (1989). *Science for All Americans.* New York, NY: Oxford University Press.

Anderson, G. (2019, July 30). The Value of voc ed. Retrieved from http://www.insidehighered.com/news/2019/07/30/career-and-technology-education-effective-pathway-earning-money

Apel, H. (2017). Notable events throughout CASNR's 145 year history. Growing Magazine. doi:https://ianr.unl.edu/growing/notable-events-throughout-casnrs-145-year-history

Balschweid, M. A. (2002). Teaching biology using agriculture as the context: Perceptions of high school students. *Journal of Agricultural Education*, *43*(2), 56-67.

Barrick, R. K. (1989). Agricultural education: Building upon our roots. *Journal of Agricultural Education*, *30*(4), 24-29.

Bartlett, J. E., Kotrlik, J. W. K. J. W., & Higgins, C. C. H. C. C. (2001). Organizational research: Determining appropriate sample size in survey research appropriate sample size in survey research. *Information Technology, Learning, and Performance Journal*, *19*(1), 43.

Boehm, J. (2019, January 24). Retrieved from https://www.ffa.org/diversity-inclusion/__ffa/

Boone, H. N. (1990). Effect of level of problem solving approach to teaching on student achievement and retention. *Journal of Agricultural Education*, 31(1), 18-26.

Brown, B. B., & Theobald, W. (1998). Learning context beyond the classroom: Extracurricular activities, community organizations, and peer groups. In K. Borman & B. Schneider (Eds.), The adolescent years: Social influences and educational challenges (pp. 109-141). Chicago: The National Society for the Study of Education.

Caine, R. N., & Caine, G. (1990). Understanding a brain-based approach to learning and teaching. *Educational leadership*, *48*(2), 66-70.

CASE Curriculum. (2019). Retrieved from https://www.case4learning.org/curriculum/case-courses

Cheek, J. G., Arrington, L. R., Carter, S., & Randell, R. S. (1994). Relationship of supervised agricultural experience program participation and student achievement in agricultural education. *Journal of agricultural education*, *35*(2), 1-5.

Companion animal; Animal science extension. (2019). Retrieved from https://animalscience.unl.edu/companion-animal.

Connors, J., Moore, E., & Elliot, J. (1990). Factors influencing secondary Michigan agricultural students' decisions not to join the FFA. The 17th Annual Proceedings of the National Agricultural Education Research Meeting, 16, 19-26.

Creswell, J. W. (2013). Qualitative inquiry and research design: Choosing among five approaches (3rd ed.). Thousand Oaks, CA: SAGE.

Croom, D. B. (2008). The Development of the integrated three-component model of agricultural education. *Journal of Agricultural education*, *49*(1), 110-120.

Dormody, T. J. (1993). Science credentialing and science credit in secondary school agricultural education. *Journal of Agricultural Education*, *34*(2), 63-70.

Drew, C. (2011, November 4). Why science majors change their minds (It's just so darn hard). *New York Times*. Retrieved from http://www.nytimes.com/2011/11/06/education/edlife/why-science-majors-change-their-mind-its-just-so-darn-hard.html

Dreyfus, A. (1986). The potential role of agriculture in science teaching. *Research in Rural Education*, *4*(1), 23-27.

Dugger Jr., W. E. (2010). Evolution of STEM in the United States. Retrieved from http://www.iteaconnect.org/Resources/PressRoom/AustraliaPaper.pdf

Fritsch, J. (2013). Learning to learn: Why the supervised ag experience Is key to agricultural education. *ACTE Online,* 30-33.

Hamlin, H. M. (1962). Public school education in agriculture. Danville, IL: Interstate.

Hoover, T. S., & Scanlon, D. C. (1991). Enrollment issues in agricultural education programs and FFA membership. *Journal of Agricultural Education*, *32*(4), 2-10.

ITEA. (2000). *Standards for technological literacy: Content for the study of technology*. Reston, VA: Author.

Johnson, D. M. (1996). Science credit for agriculture: Perceived support, preferred implementation methods, and teacher science course work. *Journal of Agricultural Education*, *37*, 22-30.

Johnson, R. B. (1997). Examining the validity structure of qualitative research. *Education*, *118*(2), 282.

Kelley, K., Clark, B., Brown, V., & Sitzia, J. (2003). Good practice in the conduct and reporting of survey research. *International Journal for Quality in health care*, *15*(3), 261-266.

Kreifels, M. (2019). *Nebraska Department of education- Agricultural education update* (pp. 1–72). Lincoln, NE.

Marshall, T., Herring, D., & Briers, G. (1992). Factors associated with enrollment in agricultural science and membership in the FFA in Texas. Journal of Agricultural Education, 33 (4), 17-23.

Mays, N., & Pope, C. (2000). Assessing quality in qualitative research. *Bmj*, *320*(7226), 50-52.

McCreight, M. G. (1973). History of vocational agriculture in Nebraska.

Meyers, B. E., & Washburn, S. G. (2008). Integrating science in the agriculture curriculum: Agriculture Teacher Perceptions of the Opportunities, Barriers, and Impact on Student Enrollment. *Journal of Agricultural Education*, *49*(2), 27-37.

Nardi, P. M. (2018). *Doing survey research: A Guide to quantitative methods*. Routledge.

National Council for Agricultural Education. (2015). *Philosophy and Guiding Principles for Execution of the Supervised Agricultural Experience Component of the total school based agricultural education program* (pp. 1–5). Indianapolis, IN.

National FFA Organization. (2006b). Public Law 105-225. Retrieved Nov. 22, 2006, from http://www.ffa.org/about_ffa/ html/ffa_publaw225.htm

National Research Council. (1996). *The National science education standards*. Washington, DC: National Academy Press.

N. D. of E. (2019, January 23). About agricultural education. Retrieved from https://www.education.ne.gov/nce/about-agricultural-education/

N. D. of E. (2019, September). Nebraska career academy programs. Retrieved from https://www.education.ne.gov/nce/nebraska-career-academy-programs/

N. D. of E. (2017). *Nebraska Department of Education 2016-17 annual report* (pp. 1–6). Lincoln, NE.

Parr, B. A., Edwards, M. C., & Leising, J. G. (2006). Effects of a math-enhanced curriculum and instructional approach on the mathematics achievement of agricultural power and technology students: An experimental study. *Journal of Agricultural Education*, *47*(3), 81.

Patton, M. Q. (1999). Enhancing the quality and credibility of qualitative analysis. *Health services research*, *34*(5 Pt 2), 1189.

Radhakrishna, R., & Doamekpor, P. (2008). Strategies for generalizing findings in survey research. *Journal of Extension*, *46*(2), 1-4.

Reis, R., & Kahler, A. A. (1997). Factors influencing enrollment in agricultural education programs as expressed by Iowa secondary agricultural education students. Journal of Agricultural Education, 38 (2), 38-48.

Ricketts, J. C., Duncan, D. W., & Peake, J. B. (2006). Science achievement of high school students in complete programs of agriscience education. *Journal of Agricultural Education*, *47*(2), 48.

Roberts, T. G., & Ball, A. L. (2009). Secondary agricultural science as content and context for teaching. *Journal of Agricultural Education*, *50*(1), 81-91.

Roegge, C. A., & Russell, E. B. (1990). Teaching applied biology in secondary agriculture: Effects on student achievement and attitudes. Journal of Agricultural Education, 31(1), 27-31.

Rubenstein, E. D., & Thorn, A. C. (2014). Successful supervised agricultural experience programs as defined by American FFA degree star finalists. *Journal of Agricultural Education*, *55*(3), 162-174.

Science education: HS Life science (revised 2/11/18). (2019, September 5). Retrieved from https://www.education.ne.gov/science/.

Smith, K. L., Rayfield, J., & McKim, B. R. (2015). Effective practices in STEM integration: describing teacher perceptions and instructional method use. *Journal of Agricultural Education*, *56*(4), 183-203.

Stephenson, Lee G., Brian K. Warnick, and Rudy S. Tarpley. (2008). "Collaboration between science and agriculture teachers." *Journal of Agricultural Education* 49.4 (2008): 106-119.

Stevens, G.Z. (1967). Agricultural education. New York: Center for Applied Research in Education.

Stimson, R. W. (1919). Vocational agricultural education by home projects. Macmillan.

Talbert, B. A., & Balschweid, M. A. (2004). Engaging students in the agricultural education model: Factors affecting student participation in the National FFA Organization. *Journal of Agricultural Education*, *45*(1), 29-41.

Thompson, G. W., & Balschweid, M. M. (1999). Attitudes of Oregon agricultural science and technology teachers toward integrating science. *Journal of Agricultural Education*, *40*, 21-29.

Thoron, A. C., & Myers, B. E. (2010). Perceptions of preservice teachers toward integrating science into school-based agricultural education curriculum. *Journal of Agricultural Education*, *51*(2), 70.

Turner III, D. W. (2010). Qualitative interview design: A practical guide for novice investigators. *The qualitative report*, *15*(3), 754-760.

Ulmer, J. D., Velez, J. J., Lambert, M. D., Thompson, G. W., Burris, S., & Witt, P. A. (2013). Exploring science teaching efficacy of CASE curriculum teachers: A Post-then-pre assessment. *Journal of Agricultural Education*, *54*(4), 121-133.

Warnick, B. K., & Thompson, G. W. (2007). Barriers, Support, and Collaboration: A Comparison of science and agriculture teachers' perceptions regarding integration of science into the agricultural education curriculum. *Journal of Agricultural Education*, *48*(1), 75-85.

Warnick, B. K., Thompson, G. W., & Gummer, E. S. (2004). Perceptions of science teachers regarding the integration of science into the agricultural education curriculum. *Journal of Agricultural Education*, *45*(1), 62-73.

Wilson, E. B., & Moore, G. E. (2007). Exploring the Paradox of Supervised Agricultural Experience Programs in Agricultural Education. *Journal of Agricultural Education*, *48*(4), 82-92.

Thompson, G. W., & Warnick, B. K. (2007). Integrating science into the agricultural education curriculum: Do science and agriculture teachers agree?. *Journal of Agricultural Education*, *48*(3), 1-12.

Whent, L. S., & Leising, J. (1988). A Descriptive study of the basic core curriculum for agricultural students in California. Paper presented at the 66th Annual Western Region Agricultural Education Research Seminar, Fort Collins, CO.

Wilson, E. B., & Moore, G. E. (2007). Exploring the paradox of supervised agricultural experience programs in agricultural education. *Journal of Agricultural Education*, *48*(4), 82-92.

White, D. W. (2014). What is STEM education and why is it important. *Florida Association of Teacher Educators Journal*, *1*(14), 1-9.

APPENDIX A. IRB APPROVAL LETTER

University of Nebraska Lincoln

Official Approval Letter for IRB project #19592 - New Project Form

July 10, 2019

Nicole Sorensen
Teaching, Learning and Teacher Education
CREC 55 UNL NE 685880232

Julie Thomas
Teaching, Learning and Teacher Education
HENZ 215A UNL NE 685880355

IRB Number: 20190719592EX
Project ID: 19592
Project Title: Agriculture and Science Standard Alignment in Curriculum

Dear Nicole:

This letter is to officially notify you of the certification of exemption of your project for the Protection of Human Subjects. Your proposal is in compliance with this institution's Federal Wide Assurance 00002258 and the DHHS Regulations for the Protection of Human Subjects at 45 CFR 46 2018 Requirements and has been classified as exempt. Exempt categories are listed within HRPP Policy #4.001: Exempt Research available at: http://research.unl.edu/researchcompliance/policies-procedures/.

o Date of Final Exemption: 07/10/2019
o Review conducted using exempt category 2a at 45 CFR 46.104
o Funding (Grant congruency, OSP Project/Form ID and Funding Sponsor Award Number, if applicable): N/A

We wish to remind you that the principal investigator is responsible for reporting to this Board any of the following events within 48 hours of the event:
* Any serious event (including on-site and off-site adverse events, injuries, side effects, deaths, or other problems) which in the opinion of the local investigator was unanticipated, involved risk to subjects or others, and was possibly related to the research procedures;
* Any serious accidental or unintentional change to the IRB-approved protocol that involves risk or has the potential to recur;
* Any protocol violation or protocol deviation
* An incarceration of a research participant in a protocol that was not approved to include prisoners
* Any knowledge of adverse audits or enforcement actions required by Sponsors
* Any publication in the literature, safety monitoring report, interim result or other finding that indicates an unexpected change to the risk/benefit ratio of the research;
* Any breach in confidentiality or compromise in data privacy related to the subject or others; or
* Any complaint of a subject that indicates an unanticipated risk or that cannot be resolved by the research staff.

This project should be conducted in full accordance with all applicable sections of the IRB Guidelines and you should notify the IRB immediately of any proposed changes that may affect the exempt status of your research project. You should report any unanticipated problems involving risks to the participants or others to the Board.

If you have any questions, please contact the IRB office at 402-472-6965.

Sincerely,

Becky R. Freeman

Becky R. Freeman, CIP
for the IRB

Full Accreditation

APPENDIX B. INTERVIEW INVITATION EMAIL

July 24, 2019

Dear Nebraska Agricultural Education Instructors,

I hope to find your summer going well so far. I am writing to request your participation in my Agriculture and Science Standard Alignment in Curriculum survey. This survey is being sent and asked to be completed by agricultural education instructors within Nebraska

You will be asked to review a sample unit of the proposed curriculum. This unit is portion of an entire Companion Animal Biology curriculum that will align with both the Nebraska College and Career Ready Standards for Science (NCCRSS) and the Nebraska Agricultural Education Veterinary Science and Companion Animal Management standards. Upon completion of the review, you will be asked to complete a short survey to rate the effectiveness of the curriculum. Participation will take place where you choose to review and complete the survey and is at your discretion.

Your participation in this survey is completely voluntary and all of your responses are anonymous. None of the responses will be connected to identifying information.

The survey will take 15-30 minutes to complete. Upon completion of the survey, you will receive the entire Health Care Module as a thank you for your time. This comprehensive module includes core veterinary science health content, FFA Veterinary Science contest preparation, practicum involvement and hands-on, leaner-based activities. The survey will close on Friday, August 16, 2019 at 11:59pm.

To participate, please click on the following link: https://forms.gle/ma59MzXis6Gr6b867

Complete Lesson Plan/Files for Sample Unit
https://drive.google.com/file/d/1ahd_h-qbb__MsHAmJR9HxnYy390AwPDO/view?usp=sharing

Individual Lesson Files for Sample Unit:
https://drive.google.com/drive/folders/1Y7S4fYFOvx1DHK4SSX2eaDhdXT7UHW2w?usp=sharing

If you have any questions about this survey, or difficulty in accessing the site or completing the survey, please contact Nicole Sorensen at nicole.dangelo@huskers.unl.edu or nicole.sorensen@minatareschools.org.

Thank you in advance for providing this important feedback and supporting my dissertation research!

Nicole Sorensen
nicole.dangelo@huskers.unl.edu

Dr. Julie Thomas
julie.thomas@unl.edu

APPENDIX C. INFORMED CONSENT LETTER

University of Nebraska Lincoln

IRB Number # 19592

Study Title: ***Agriculture and Science Standard Alignment in Curriculum***

Invitation

Dear Nebraska Agricultural Education Instructor,

My name is Nicole Sorensen. I am conducting a study on the viability of an agricultural education and science standard aligned curriculum within Nebraska agricultural education courses. If you are 19 years of age or older and hold a current Nebraska teaching certificate with an endorsement in agricultural education, you may participate in this research.

What is the reason for doing this research study?

This is a research project that focuses on the alignment of Nebraska science and agriculture standard within a sample curriculum. The purpose of this study is to determine the usefulness of the proposed curriculum unit and inform Nebraska Agricultural Education leaders about teachers' interest and readiness to plan instruction matched with Nebraska's state agricultural education and science standards.

What will be done during this research study?

Participation in this study will require approximately 15-30 minutes. You will be asked to review a sample unit of the proposed curriculum. Upon completion of the review, you will be asked to complete a short survey to rate the effectiveness of the curriculum. Participation will take place where you choose to review and complete the survey and is at your discretion.

What are the possible risks of being in this research study?

There are no known risks or discomforts associated with this research.

What are the possible benefits to you?

These survey data will advise the usefulness of the proposed curriculum unit and inform Nebraska Agricultural Education leaders about teachers' interest and readiness to plan instruction matched with Nebraska state agricultural education and science standards. The current curriculum trainings are comprehensive and effective within the classroom, but the training costs, time commitment to the five to ten-day training often turns instructors away. Additionally, these curriculums ask for high-cost implementation materials that are mostly consumable.

How will information about you be protected?

Your responses to this survey will be kept anonymous. Data will be kept confidential through the use of a survey form that does not require specific details about your program, your name or your students' data. Responses will not require you to identify your name, school or any other identifying information.

What are your rights as a research subject?

You may ask any questions concerning this research and have those questions answered before agreeing to participate in or during the study.

What will happen if you decide not to be in this research study or decide to stop participating once you start?

You can choose not to be in this research study, or you can stop participation in this research study ("withdraw') at any time before, during, or after the research begins for any reason. Deciding not to be in this research study or deciding to withdraw will not affect your relationship with the investigator or with the University of Nebraska-Lincoln.

You will not lose any benefits to which you are otherwise entitled.

For study related questions, please contact the investigator(s):

Nicole Sorensen
nicole.dangelo@huskers.unl.edu

Dr. Julie Thomas
Julie.thomas@unl.edu

For questions concerning your rights or complaints about the research contact the Institutional Review Board (IRB):

- Phone: 1(402)472-6965
- Email: irb@unl.edu

Documentation of Informed Consent

You are voluntarily making a decision whether or not to participate in this research study. By completing and submitting your survey responses, you have given your consent to participate in this research. You should print a copy of this page for your records.

APPENDIX D. SURVEY

Agriculture and Science Standard Alignment in Curriculum

Thank you for participating in my Agriculture and Science Standard Alignment in Curriculum survey!

You will be asked to review a sample unit of the proposed curriculum. This unit is portion of an entire Companion Animal Biology curriculum that will align with both the Nebraska College and Career Ready Standards for Science (NCCRSS) and the Nebraska Agricultural Education Veterinary Science and Companion Animal Management standards. Below are two options to evaluate the curriculum.

Complete Lesson Plan/Files for Sample Unit (1 PDF):
https://drive.google.com/file/d/1lZ9nqACGDr_DO5efOzrTDThUTEZYcDqr/view?usp=sharing

Individual Lesson Folders for Sample Unit:
https://drive.google.com/drive/folders/1Y7S4fYFOvx1DHK4SSX2eaDhdXT7UHW2w?usp=sharing

Your participation in this survey is completely voluntary and all of your responses are anonymous. None of the responses will be connected to identifying information.

The survey will take 15-30 minutes to complete. Upon completion of the survey, you will receive the entire Health Care Module as a thank you for your time. This comprehensive module includes core veterinary science health content, FFA Veterinary Science contest preparation, practicum involvement and hands-on, leaner-based activities. The survey will close on Friday, August 2, 2019 at 11:59pm.

If you have any questions about this survey, or difficulty in accessing the site or completing the survey, please contact me at any time.

Thank you in advance for providing this important feedback and supporting my dissertation research!

Nicole Sorensen
nicole.sorensen@minatareschools.org

Dr. Julie Thomas
julie.thomas@unl.edu

* Required

SECTION 1: PARTICIPANT AND SCHOOL INFORMATION

1. **Are you an agricultural education educator in Nebraska?** *
   Mark only one oval.
   - ◯ Yes
   - ◯ No

2. **Which of the following most closely describes your job title?** *
   Mark only one oval.
   - ◯ Agricultural Education Instructor
   - ◯ Agricultural Education and Biology Instructor
   - ◯ Agricultural Education and Science (Other than solely biology) Instructor
   - ◯ Other: _____

3. **Including the 2019-2020 school year, how many years have you been in agricultural education?** *
Mark only one oval.

- 1-5 years
- 6-10 years
- 11-15 years
- More than 15 years

4. **What class is your school considered, as based on the Nebraska Department of Education?** *
Mark only one oval.

- Class A
- Class B
- Class C1
- Class C2
- Class D
- Class D6

5. **Is your school considered to be in a rural location?** *
Mark only one oval.

- Yes
- No

SECTION 2: PROGRAM COMPONENTS

6. **As of June 1, 2019, about how many students in your school were enrolled in agricultural education courses?** *
Mark only one oval.

- 0-10
- 11-20
- 21-30
- 31-40
- 41-50
- 51-60
- 61-70
- 71-80
- 81-90
- 91-100
- 100+

7. **Which of the following courses do you offer? (Check all that apply)** *
Check all that apply.

- [ ] Introduction to Agriculture and Natural Resources
- [ ] Plant Science
- [ ] Horticulture
- [ ] Floriculture
- [ ] Nursery Landscape
- [ ] Animal Science
- [ ] Livestock Management
- [ ] Companion Animal Science
- [ ] Veterinary Science
- [ ] Equine Science
- [ ] Food Science
- [ ] Natural Resources
- [ ] Agronomy
- [ ] Biotechnology
- [ ] Welding/Metals
- [ ] Woods/Structures
- [ ] Small Engines
- [ ] Ag Power
- [ ] Other: _____

8. **Do you use pre-made or pre-packaged agricultural education curriculum?** *
Mark only one oval.

- ◯ Yes
- ◯ No

SECTION 3: CURRICULUM DESIGN ASSESSMENT

Rate the following questions using a Likert scale of 1 to 5, with 1 = Strongly Disagree (SD), 2 = Disagree (D), 3 = Neither Agree or Disagree (N), 4 = Agree (A), 5 = Strongly Agree (SA)

9. **The curriculum timeline is realistic to complete the unit.** *
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

10. **The provided assessments accurately measure student learning.** *
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

11. **The instructional strategies and activities include higher order thinking, problem solving, and reasoning.** *
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

12. **This sample unit of the curriculum is presented in such a way that students will be able to actively participate in each lesson.** *
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

13. **As an instructor, I think that this curriculum provides a foundation of science-based curriculum and instruction.** *
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

14. **This course would be an appropriate fit for my current agricultural education program.** *
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

15. **I would consider adding this course, which included similar units to the one reviewed, to my program as a dual credit option in my agricultural education program.** *
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

SECTION 4: STANDARDS ASSESSMENT

Rate the following questions using a Likert scale of 1 to 5, with 1 = Strongly Disagree (SD), 2 = Disagree (D), 3 = Neither Agree or Disagree (N), 4 = Agree (A), 5 = Strongly Agree (SA)

Incorporation of Science Standards Within Curriculum

16. **I think that my students will be better prepared in science after they complete this unit.** *
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

17. **I think that this curriculum would provide deeper science learning for my students.** *
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

18. **Upon completion of this unit, I think that my students will be more aware of the connection between scientific principles and agriculture.** *
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

19. **Objectives in this module would allow my students to properly process and comprehend life science standards as laid out in the Nebraska's College and Career Ready Standards for Science (NCCRS-S) standards. Link: https://cdn.education.ne.gov/wp-content/uploads/2017/10/Nebraska_Science_Standards_Final_10_23.pdf (page 34-37).** *
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

20. **Objectives in this module would allow my students to properly process and comprehend small animal management standards as laid out in the NE Ag Ed standards. Link: https://cestandards.education.ne.gov/Courses/011015%20-%20Vet%20Science.pdf** *
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

21. **Objectives in this module would allow my students to properly process and comprehend vet science standards as laid out in the NE Ag Ed standards. Link: https://cestandards.education.ne.gov/Courses/011015%20-%20Vet%20Science.pdf** *
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

22. **This curriculum would make science concepts easier for students to understand when integrated into the agricultural education lessons.** *
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

23. **My students would be more motivated to learn when science is integrated into the small animal lessons.** *
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

SECTION 5: OVERALL CURRICULUM INTERPRETATIONS

Rate the following questions using a Likert scale of 1 to 5, with 1 = Strongly Disagree (SD), 2 = Disagree (D), 3 = Neither Agree or Disagree (N), 4 = Agree (A), 5 = Strongly Agree (SA)

Interpretation of Curriculum Specific Lessons

24. **The instructional component of the curriculum (Lesson 1) appeared to be feasible to implement in my classroom.** *
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

25. **I feel that my students would benefit from the instructional component of the curriculum.** *
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

26. **The application component of the curriculum (Lesson 2) appeared to be feasible to implement in my classroom.** *
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

27. **I feel that my students would benefit from the application component of the curriculum.** *
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

28. **The lab component of the curriculum (Lesson 3) appeared to be feasible to implement in my classroom.** *
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

29. **I feel that my students would benefit from the lab component of the curriculum.** *
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

30. **The career/practicum component of the curriculum (Lesson 4) appeared to be feasible to implement in my classroom.** *
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

31. **I feel that my students would benefit from the career component of the curriculum.** *
Mark only one oval.

	1	2	3	4	5	
Strongly Disagree	◯	◯	◯	◯	◯	Strongly Agree

Please answer the following questions to the best of your ability.

32. **Do you feel that there is a need to deepen science learning within your classroom?** *

33. **What would the curriculum be able to provide in your high school?** *

34. **Would you be able to provide this curriculum in your high school? Why or why not?** *

35. **How would offering this integrated science/agricultural education curriculum effect your student enrollment?** *

36. **Please describe the impact of this curriculum if it was to be added to your agricultural education program.** *

37. **Additional comments:** *

Thank you!

Thank you for your time and input! If you would like the entire Companion Animal Health Care Module, approximately 24 days of instruction, please enter your email below.

38. **Email for Shared File**

APPENDIX E. NEBRASKA VETERINARY SCIENCE STANDARDS

Veterinary Science

Course Description:
Introduces students to the basics of animal medical care. Topics covered include disease, parasites, feeding, shelter, grooming, and general animal care. Classroom and laboratory activities are supplemented through supervised agricultural experiences and leadership programs and activities.

Course Code: 011015

Endoresements to teach: AFNR

Programs of Study to which this Course applies:
Animal Systems
Animal Systems Plus

AFNR.HS.2.2	
Utilize best-practice protocols based upon animal behaviors for animal husbandry and welfare.	
AFNR.HS.2.2.a	Demonstrate management techniques that ensure animal welfare.
AFNR.HS.2.2.b	Analyze procedures to ensure that animal products are safe for consumption.
AFNR.HS.2.4	
Apply principles of animal reproduction to achieve desired outcomes for performance, development and/or economic production.	
AFNR.HS.2.4.a	Evaluate animals for breeding soundness and readiness.
AFNR.HS.2.4.b	Apply scientific principles to select and care for breeding animals.
AFNR.HS.2.4.c	Apply scientific principles to breed animals.
AFNR.HS.2.7	
Apply principles of effective animal health care.	
AFNR.HS.2.7.a	Design programs to prevent animal diseases, parasites, and other disorders and ensure animal welfare.
AFNR.HS.2.7.b	Develop a biosecurity plan and procedures to prevent the spread of disease.
AFNR.HS.CR.1	
Describe career opportunities and means to achieve those opportunities in each of the AFNR career pathways.	
AFNR.HS.CR.1.a	Evaluate and implement the steps and requirements to pursue a career opportunity in an AFNR career pathway.
AFNR.HS.CR.1.b	Examine and choose career opportunities that are matched to personal life skills, talents, and career goals in an AFNR pathway of interest.
AFNR.HS.CR.2	
Demonstrate employability skills for college and career readiness.	
AFNR.HS.CR.2.a	Model personal responsibility in the workplace and community.
AFNR.HS.CR.2.d	Synthesize information, knowledge and experience to generate original ideal and challenge assumptions in the workplace and community.
AFNR.HS.CR.2.e	Apply reason and logic to evaluate workplace and community situations from multiple perspectives.
AFNR.HS.CR.2.f	Investigate, prioritize and select solutions to solve problems in the workplace community.
AFNR.HS.CR.2.g	Contribute to team-oriented projects and builds consensus to accomplish results using cultural global competence in the workplace and community.
AFNR.HS.CR.3	
Identify and demonstrate personal financial management and planning.	
AFNR.HS.CR.3.a	Design and implement a personal financial management plan.
AFNR.HS.CR.4	
Identify and demonstrate workplace safety.	
AFNR.HS.CR.4.a	Identify and explain the implication of required regulations to maintain and improve safety, health and environments management systems.
AFNR.HS.CR.4.b	Apply health and safety practices to AFNR workplaces.
AFNR.HS.CR.4.c	Use appropriate protective equipment and demonstrate safe and proper use of AFNR tools and equipment.
AFNR.HS.CR.5	
Evaluate the nature and scope of the AFNR Career Cluster and the role of agriculture, food and natural resources (AFNR) in society and the economy.	
AFNR.HS.CR.5.b	Identify public policies and examine their impact on AFNR systems.
AFNR.HS.CR.5.c	Examine the components of the AFNR systems and assess their impact on the local, state, national and global society and economy.
AFNR.HS.CR.6	
Identify and demonstrate leadership skills and traits in demand of leadership roles in the agriculture industry.	
AFNR.HS.CR.6.b	Craft SMART goals to achieve by the end of a specific agricultural education course.
AFNR.HS.CR.6.c	Write a career objective.
AFNR.HS.CR.6.f	Write and deliver a speech focused on a currently controversial topic within the agricultural industry while arguing both points of view.

APPENDIX F. NEBRASKA SMALL ANIMAL MANAGEMENT STANDARDS

Small Animal Management

Course Description:
veterinarian. This course includes breeding, grooming, care and marketing of companion animals. Classroom and laboratory activities are supplemented through supervised agricultural experiences and leadership programs and activities.

Course Code: 011006

Endoresements to teach: AFNR

Programs of Study to which this Course applies:
Animal Systems
Animal Systems Plus

AFNR.HS.2.3	
Design and provide proper animal nutrition to achieve desired outcomes for performance, development, reproduction and/or economic production.	
AFNR.HS.2.3.a	Analyze nutritional needs of animals.
AFNR.HS.2.3.b	Analyze feed rations to examine if they meet the nutritional requirements of animals.
AFNR.HS.2.3.c	Utilize industry tools to make animal nutrition decisions.
AFNR.HS.2.7	
Apply principles of effective animal health care.	
AFNR.HS.2.7.a	Design programs to prevent animal diseases, parasites, and other disorders and ensure animal welfare.
AFNR.HS.2.7.b	Develop a biosecurity plan and procedures to prevent the spread of disease.
AFNR.HS.CR.1	
Describe career opportunities and means to achieve those opportunities in each of the AFNR career pathways.	
AFNR.HS.CR.1.a	Evaluate and implement the steps and requirements to pursue a career opportunity in an AFNR career pathway.
AFNR.HS.CR.1.b	Examine and choose career opportunities that are matched to personal life skills, talents, and career goals in an AFNR pathway of interest.
AFNR.HS.CR.2	
Demonstrate employability skills for college and career readiness.	
AFNR.HS.CR.2.a	Model personal responsibility in the workplace and community.
AFNR.HS.CR.2.d	Synthesize information, knowledge and experience to generate original ideal and challenge assumptions in the workplace and community.
AFNR.HS.CR.2.e	Apply reason and logic to evaluate workplace and community situations from multiple perspectives.
AFNR.HS.CR.2.f	Investigate, prioritize and select solutions to solve problems in the workplace community.
AFNR.HS.CR.2.g	Contribute to team-oriented projects and builds consensus to accomplish results using cultural global competence in the workplace and community.
AFNR.HS.CR.3	
Identify and demonstrate personal financial management and planning.	
AFNR.HS.CR.3.a	Design and implement a personal financial management plan.
AFNR.HS.CR.4	
Identify and demonstrate workplace safety.	
AFNR.HS.CR.4.a	Identify and explain the implication of required regulations to maintain and improve safety, health and environments management systems.
AFNR.HS.CR.4.b	Apply health and safety practices to AFNR workplaces.
AFNR.HS.CR.4.c	Use appropriate protective equipment and demonstrate safe and proper use of AFNR tools and equipment.
AFNR.HS.CR.5	
Evaluate the nature and scope of the AFNR Career Cluster and the role of agriculture, food and natural resources (AFNR) in society and the economy.	
AFNR.HS.CR.5.b	Identify public policies and examine their impact on AFNR systems.
AFNR.HS.CR.5.c	Examine the components of the AFNR systems and assess their impact on the local, state, national and global society and economy.

AFNR.HS.CR.6	
Identify and demonstrate leadership skills and traits in demand of leadership roles in the agriculture industry.	
AFNR.HS.CR.6.b	Craft SMART goals to achieve by the end of a specific agricultural education course.
AFNR.HS.CR.6.c	Write a career objective.
AFNR.HS.CR.6.f	Write and deliver a speech focused on a currently controversial topic within the agricultural industry while arguing both points of view.

APPENDIX G. NEBRASKA LIFE SCIENCE STANDARDS

HS Life Sciences

The life science standards and indicators help students gather, analyze, and communicate evidence as they formulate answers to questions tailored to student interest and current topics that may include but are not limited to:

How do the structures of organisms enable life's functions?
Students are expected to investigate explanations for the structure and function of cells as the basic units of life, the hierarchical systems of organisms, and the role of specialized cells for maintenance and growth. Students will demonstrate understanding of how systems of cells function together to support the life processes.

How are the characteristics from one generation related to the previous generation?
High school students demonstrate understanding of the relationship of DNA and chromosomes in the processes of cellular division that pass traits from one generation to the next. Students can determine why individuals of the same species vary in how they look, function, and behave. Ethical issues related to genetic modification of organisms and the nature of science can be described.

How do organisms obtain and use energy they need to live and grow? How do matter and energy move through ecosystems?
Students will be expected to develop understanding of organisms' interactions with each other and their physical environment, how organisms obtain resources, change the environment, and how these changes affect both organisms and ecosystems. Students will use mathematical concepts to construct explanations for the role of energy in the cycling of matter in organisms and ecosystems.

How do organisms interact with the living and non-living environment to obtain matter and energy?

Students will be expected to investigate the role of biodiversity in ecosystems and the role of animal behavior on survival of individuals and species. Students will develop increased understanding of interactions among organisms and how those interactions influence the dynamics of ecosystems.

How can there be so many similarities among organisms yet so many different plants, animals, and microorganisms? How does biodiversity affect humans?
Students will be expected to demonstrate understanding of the factors causing natural selection and the process of evolution of species over time. They demonstrate understanding of how multiple lines of evidence contribute to the strength of scientific theories of natural selection and evolution

****

SC.HS.6 Structure and Function

SC.HS.6.1 Gather, analyze, and communicate evidence of the relationship between structure and function in living things.

SC.HS.6.1.A **Construct an explanation** based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells. Assessment does not include identification of specific cell or tissue types, whole body systems, specific protein structures and functions, or the biochemistry of protein synthesis.

NE agricultural practices

Approved by the Nebraska State Board of Education on September 8, 2017

SC.HS.6.1.B **Develop and use a model** to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms. Assessment does not include interactions and functions at the molecular or chemical reaction level.

SC.HS.6.1.C **Plan and conduct an investigation** to provide evidence that feedback mechanisms maintain homeostasis. Assessment does not include the cellular processes involved in the feedback mechanism.

NE agricultural practices

SC.HS.6.1.D **Use a model** to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms. Assessment does not include specific gene control mechanisms or rote memorization of the steps of mitosis.

SC.HS.7 Interdependent Relationships in Ecosystems

SC.HS.7.2 Gather, analyze, and communicate evidence of interdependent relationships in ecosystems.

SC.HS.7.2.A **Use mathematical and/or computational representations to support explanations** of factors that affect carrying capacity of ecosystems at different scales. Assessment does not include deriving mathematical equations to make comparisons.

SC.HS.7.2.B **Use mathematical representations** to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales. Assessment is limited to provided data.

SC.HS.7.2.C **Evaluate the claims, evidence, and reasoning** that the interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.

NE river systems and ecosystems

SC.HS.7.2.D **Evaluate the evidence** for the role of group behavior on individual and species' chances to survive and reproduce.

SC.HS.7.2.E **Design, evaluate, and refine a solution** for increasing the positive impacts of human activities on the environment and biodiversity.

NE native species, conservation organizations, agriculture practices

SC.HS.7.2.F **Use a computer simulation** to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem. Assessment is limited to testing solutions for a proposed problem related to threatened or endangered species, or to genetic variation of organisms for multiple species.

SC.HS.8 Matter and Energy in Organisms and Ecosystems

SC.HS.8.3 Gather, analyze, and communicate evidence of the flow of energy and cycling of matter in organisms and ecosystems.

SC.HS.8.3.A **Use a model** to illustrate how photosynthesis transforms light energy into stored chemical energy. Assessment does not include specific biochemical steps.

SC.HS.8.3.B **Construct and revise an explanation** based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other molecules to form the four basic macromolecules. Assessment does not include the details of the specific chemical reactions or identification of macromolecules.

SC.HS.8.3.C **Use a model** to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules are broken and bonds in new compounds are formed resulting in a net transfer of energy. Assessment should not include identification of the steps or specific processes involved in cellular respiration.

SC.HS.8.3.D **Construct and revise an explanation** based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions. Assessment does not include the specific chemical processes of either aerobic or anaerobic respiration.

NE ethanol production

SC.HS.8.3.E **Use mathematical representations** to support claims for the cycling of matter and flow of energy among organisms in an ecosystem. Assessment is limited to proportional reasoning to describe the cycling of matter and flow of energy.

NE agricultural practices

SC.HS.8.3.F **Develop a model** to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere. Assessment does not include the specific chemical steps of photosynthesis and respiration.

SC.HS.9 Heredity: Inheritance and Variation of Traits

SC.HS.9.4 Gather, analyze, and communicate evidence of the inheritance and variation of traits.

SC.HS.9.4.A. **Develop and use a model** to explain the relationships between the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring. Assessment does not include the phases of meiosis or the molecular mechanism of specific steps in the process.

NE agricultural practices

SC.HS.9.4.B **Make and defend a claim** based on evidence that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors. Assessment does not include the phases of meiosis or the molecular mechanism of specific steps in the process.

NE plants and animals

SC.HS.9.4.C **Apply concepts of statistics and probability** to explain the variation and distribution of expressed traits in a population. Assessment does not include Hardy-Weinberg calculations.

NE plants and animals

SC.HS.10 Biological Evolution

SC.HS.10.5 Gather, analyze, and communicate evidence of biological evolution.

SC.HS.10.5.A **Communicate scientific** information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.

NE fossil record

SC.HS.10.5.B **Construct an explanation** based on evidence that natural selection primarily results from four factors: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment. Assessment does not include other mechanisms of evolution, such as genetic drift, gene flow through migration, and co-evolution.

NE plants and animals

SC.HS.10.5.C **Apply concepts of statistics and probability** to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait. Assessment is limited to basic statistical and graphical analysis. Assessment does not include allele frequency calculations.

NE plants and animals

SC.HS.10.5.D **Construct an explanation** based on evidence for how natural selection leads to adaptation of populations.

SC.HS.10.5.E **Evaluate the evidence** supporting claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species.

NE plants and animals

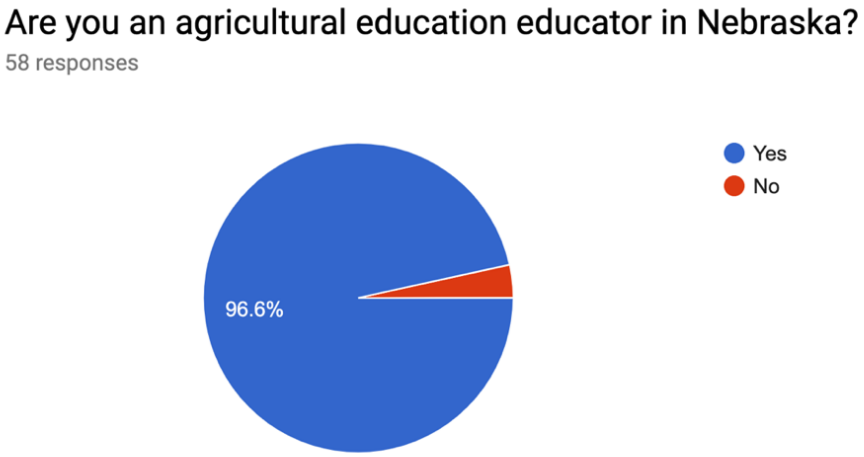
Appendix A: Topic Progression

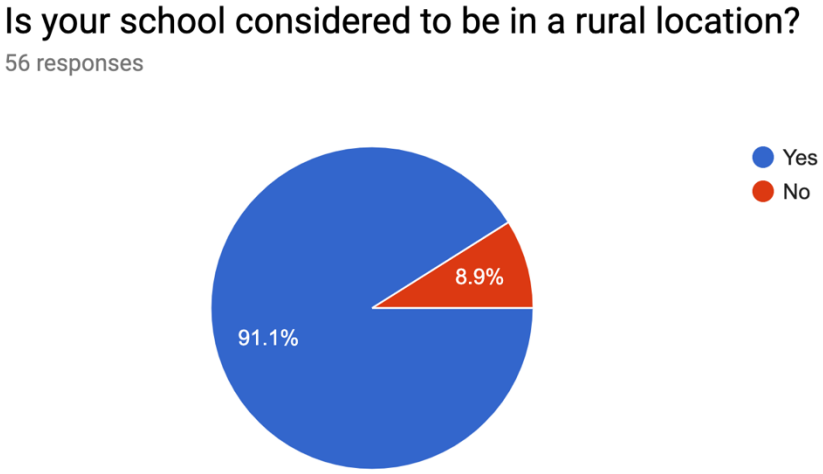
Topic \ Grade	K	1	2	3	4	5	6	7	8	HS
1 Forces & Interactions	**SC.K.1**			**SC.3.1**					**SC.8.1**	**SC.HS.1**
2 Waves & Electro-magnetic Radiation		**SC.1.2**			**SC.4.2**				**SC.8.2**	**SC.HS.2**
3 Structure & Properties of Matter			**SC.2.3**			**SC.5.3**		**SC.7.3**		**SC.HS.3**
4 Energy					**SC.4.4**		**SC.6.4**		**SC.8.4**	**SC.HS.4**
5 Chemical Reactions								**SC.7.5**		**SC.HS.5**
6 Structure & Function		**SC.1.6**			**SC.4.6**		**SC.6.6**			**SC.HS.6**
7 Inter-dependent Relationships in Ecosystems	**SC.K.7**		**SC.2.7**	**SC.3.7**				**SC.7.7**		**SC.HS.7**
8 Matter & Energy in Organisms & Ecosystems						**SC.5.8**		**SC.7.8**		**SC.HS.8**
9 Heredity: Inheritance & Variation of Traits				**SC.3.9**			**SC.6.9**		**SC.8.9**	**SC.HS.9**
10 Biological Evolution									**SC.8.10**	**SC.HS.10**
11 Space Systems		**SC.1.11**				**SC.5.11**			**SC.8.11**	**SC.HS.11**
12 Weather & Climate	**SC.K.12**			**SC.3.12**			**SC.6.12**			**SC.HS.12**
13 Earth's Systems			**SC.2.13**		**SC.4.13**	**SC.5.13**	**SC.6.13**	**SC.7.13**		**SC.HS.13**
14 History of Earth								**SC.7.14**	**SC.8.14**	**SC.HS.14**
15 Sustainability										**SC.HS.15**

APPENDIX H. SURVEY RESULTS: LIKERT SCALE QUESTIONS

Agriculture and Science Standard Alignment in Curriculum Teacher Survey Responses

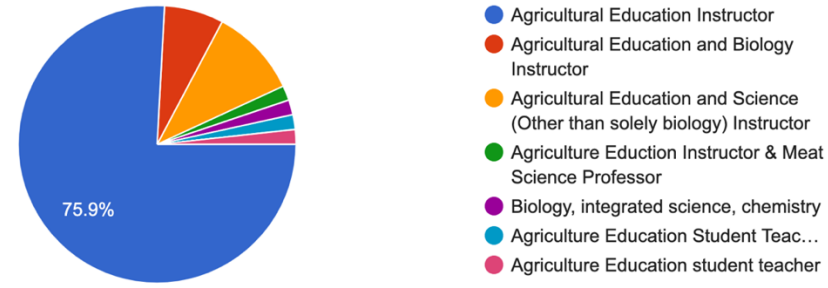
SECTION 1: PARTICIPANT AND SCHOOL INFORMATION





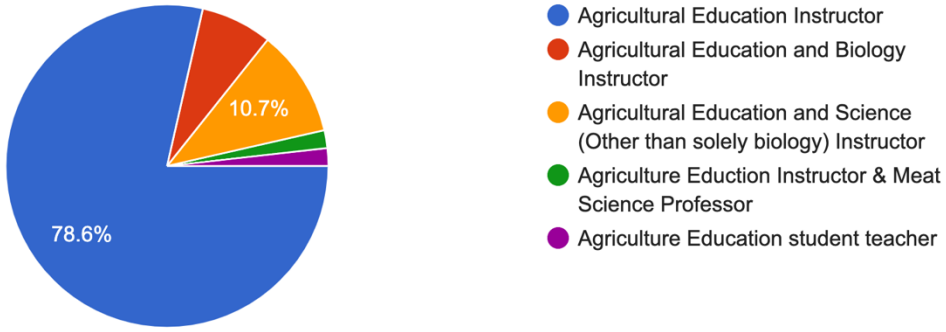
Which of the following most closely describes your job title?

58 responses



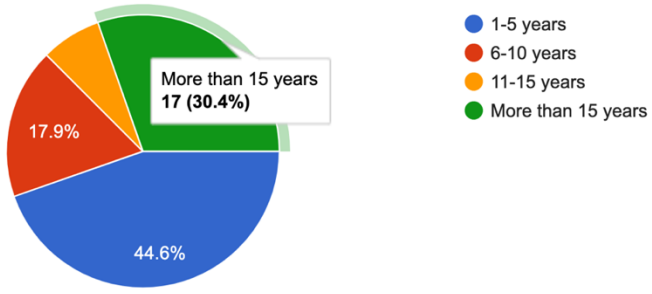
Which of the following most closely describes your job title?

56 responses



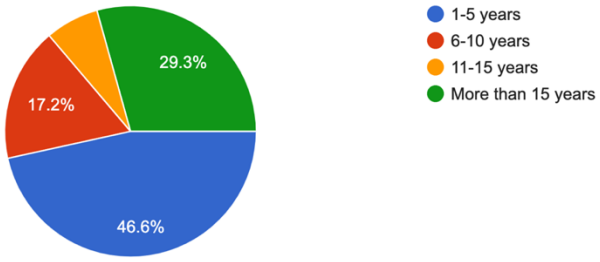
Including the 2019-2020 school year, how many years have you been in agricultural education?

56 responses



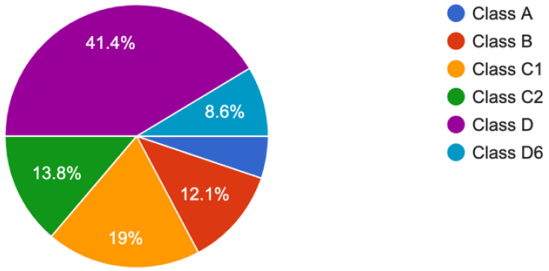
Including the 2019-2020 school year, how many years have you been in agricultural education?

58 responses



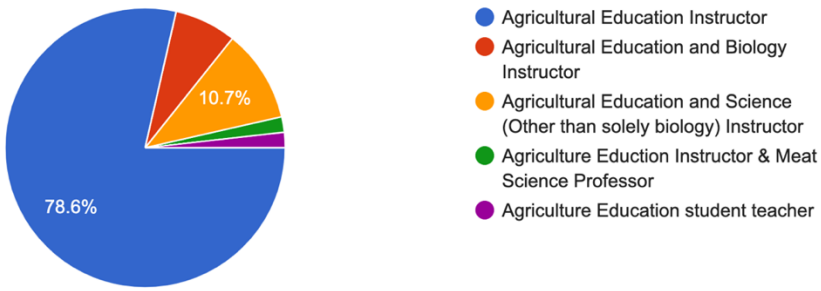
What class is your school considered, as based on the Nebraska Department of Education?

58 responses

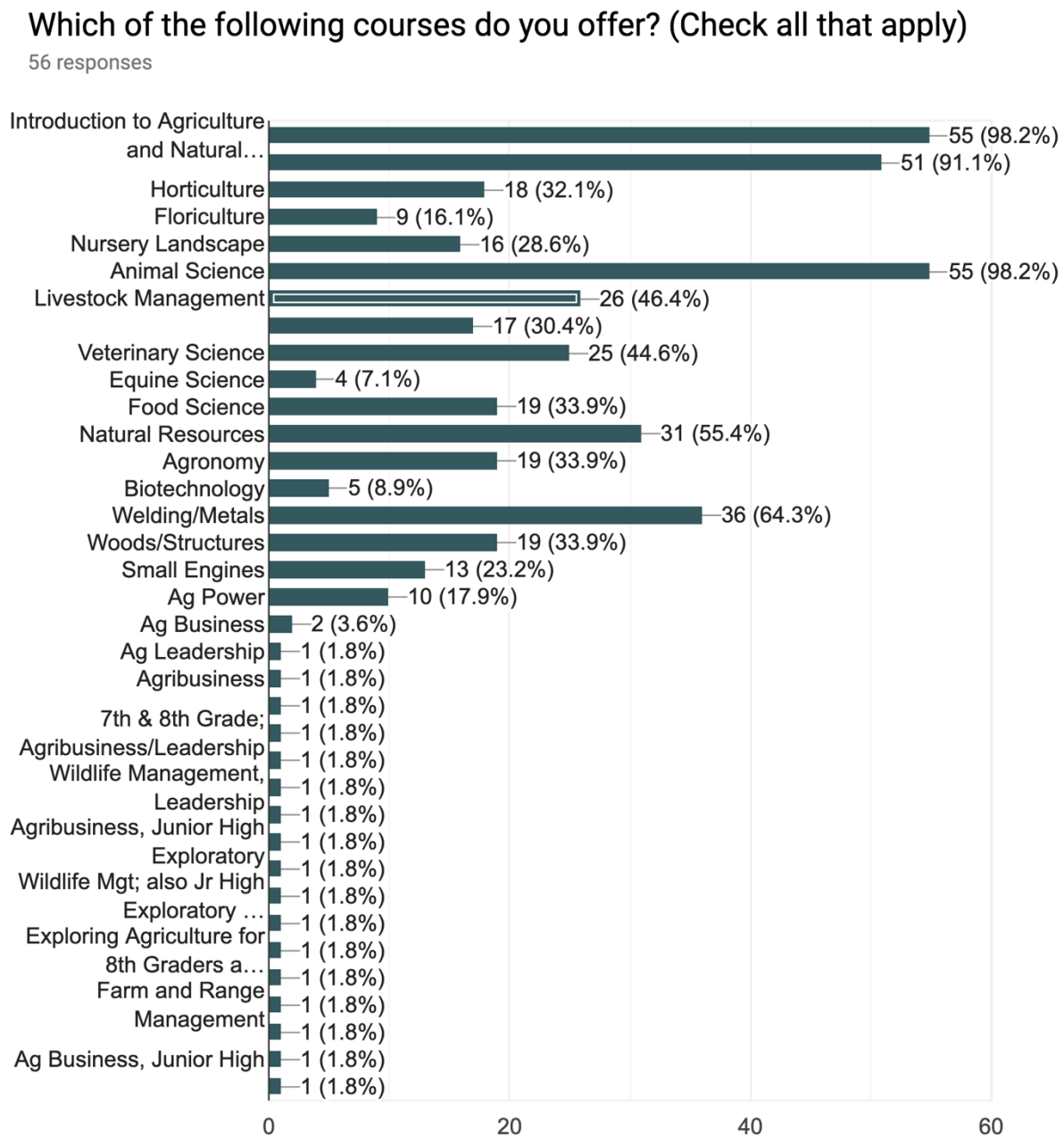


Which of the following most closely describes your job title?

56 responses

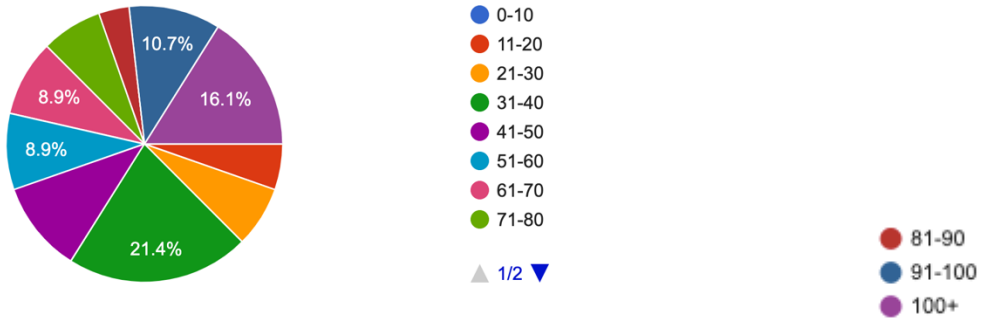


SECTION 2: PROGRAM COMPONENTS



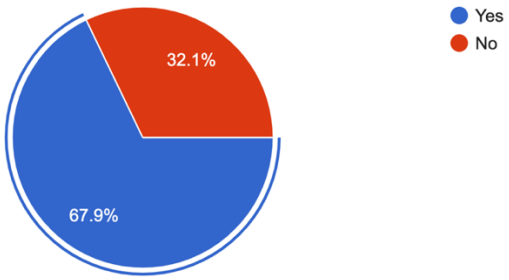
As of June 1, 2019, about how many students in your school were enrolled in agricultural education courses?

56 responses



Do you use pre-made or pre-packaged agricultural education curriculum?

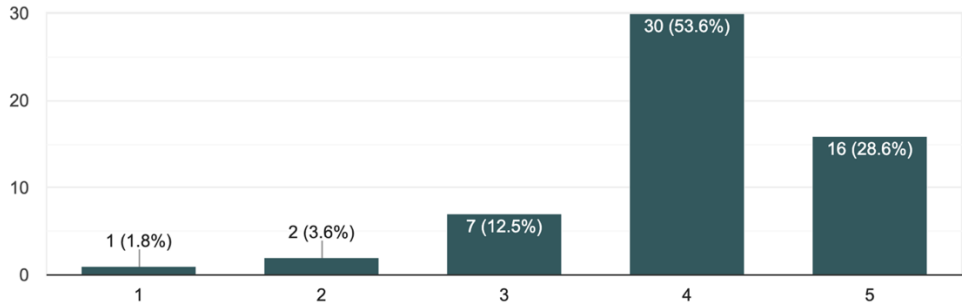
56 responses



SECTION 3: CURRICULUM DESIGN ASSESSMENT

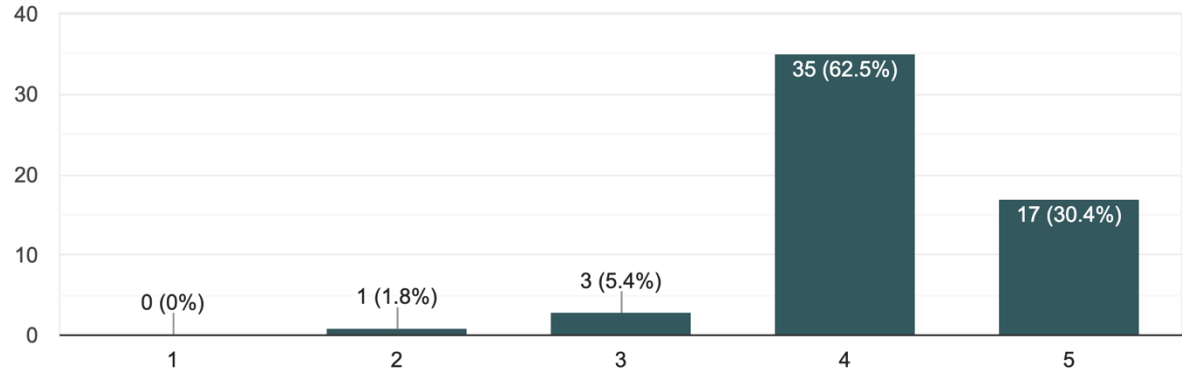
The curriculum timeline is realistic to complete the unit.

56 responses



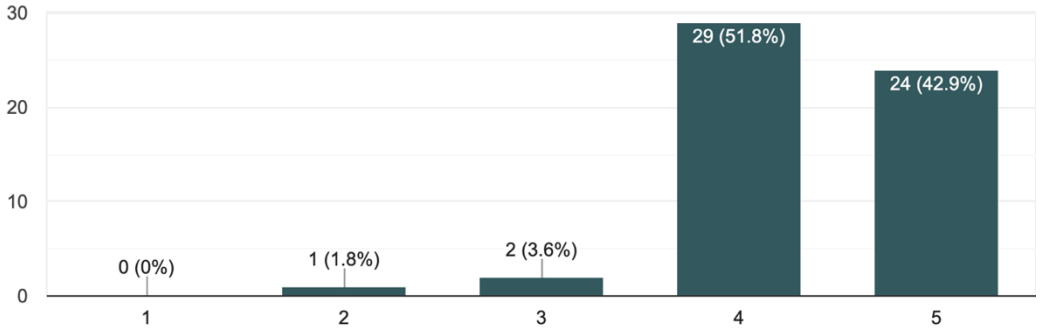
The provided assessments accurately measure student learning.

56 responses



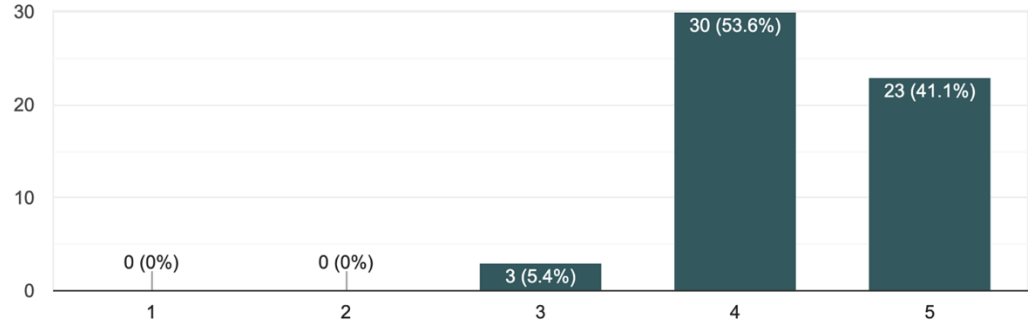
The instructional strategies and activities include higher order thinking, problem solving, and reasoning.

56 responses



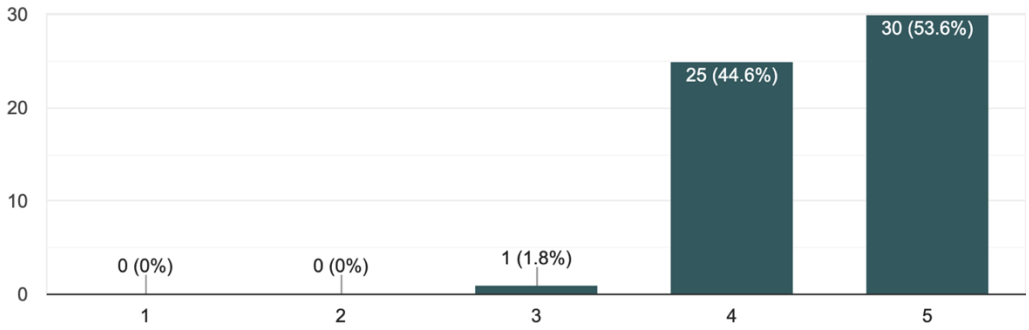
This sample unit of the curriculum is presented in such a way that students will be able to actively participate in each lesson.

56 responses



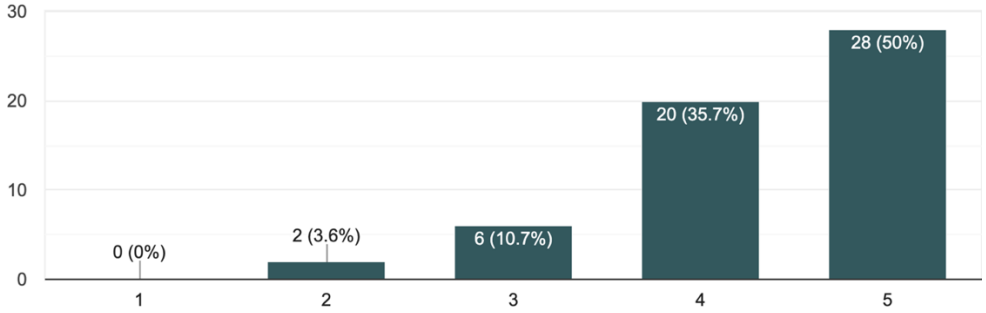
As an instructor, I think that this curriculum provides a foundation of science-based curriculum and instruction.

56 responses



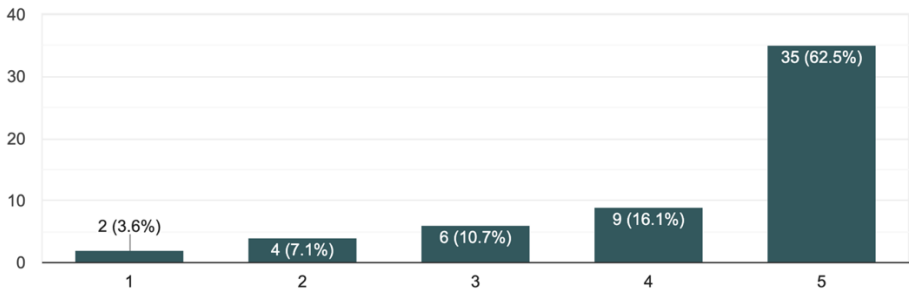
This course would be an appropriate fit for my current agricultural education program.

56 responses



I would consider adding this course, which included similar units to the one reviewed, to my program as a dual cred...in my agricultural education program.

56 responses

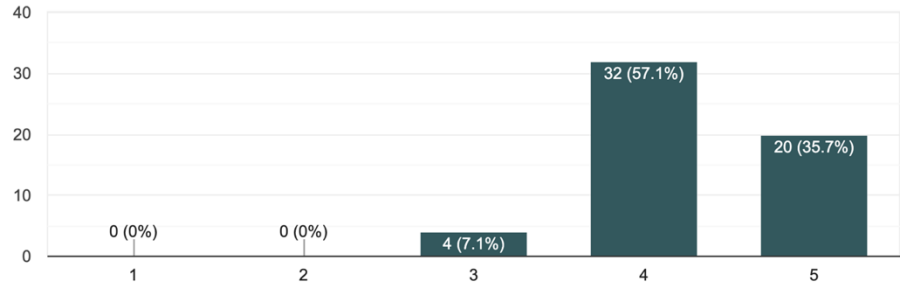


SECTION 4: STANDARDS ASSESSMENT

Incorporation of Science Standards Within Curriculum

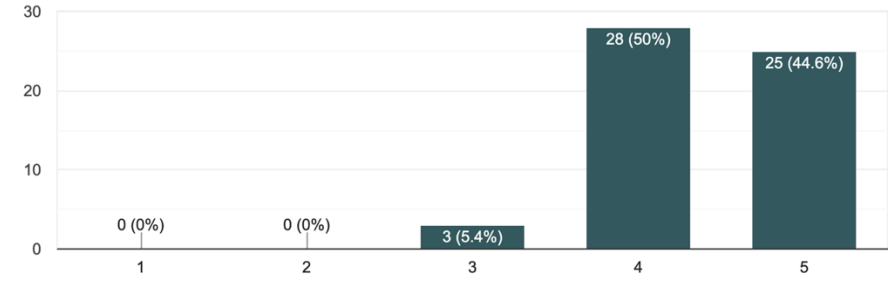
I think that my students will be better prepared in science after they complete this unit.

56 responses



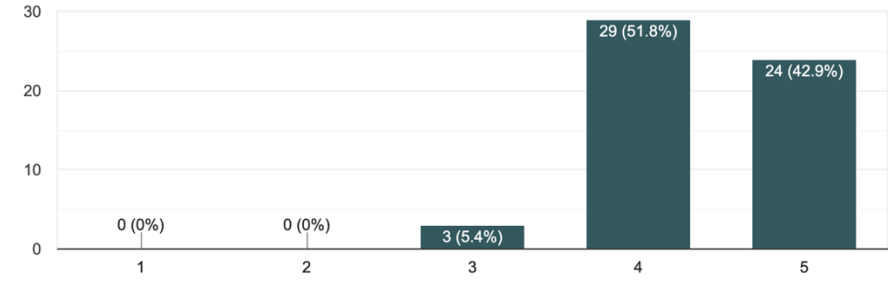
I think that this curriculum would provide deeper science learning for my students.

56 responses



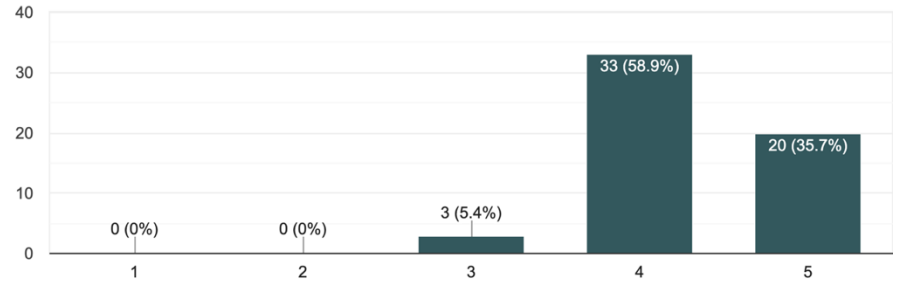
Upon completion of this unit, I think that my students will be more aware of the connection between scientific principles and agriculture.

56 responses



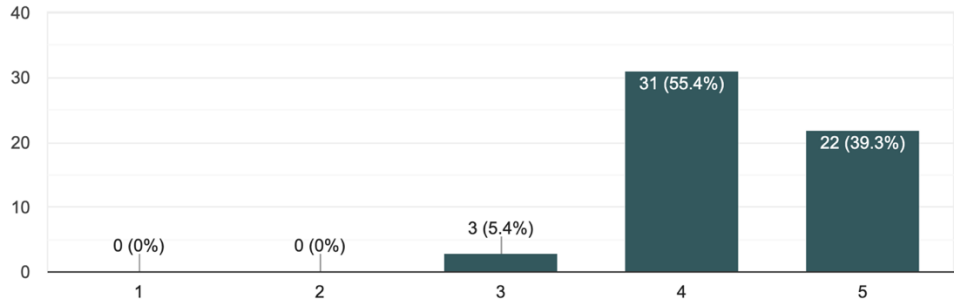
Objectives in this module would allow my students to properly process and comprehend life science standards as l...ards_Final_10_23.pdf (page 34-37).

56 responses



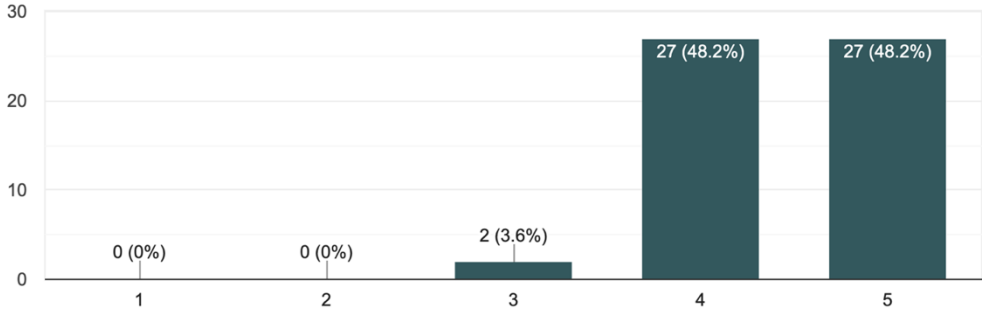
Objectives in this module would allow my students to properly process and comprehend small animal managemen.../011015%20-%20Vet%20Science.pdf

56 responses



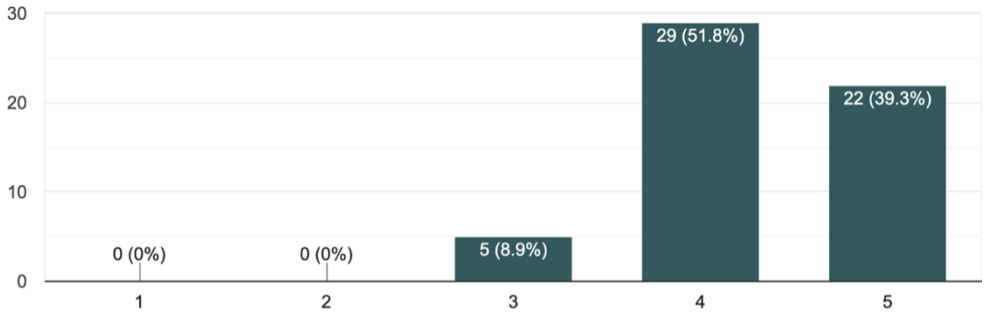
Objectives in this module would allow my students to properly process and comprehend vet science standards a...es/011015%20-%20Vet%20Science.pdf

56 responses



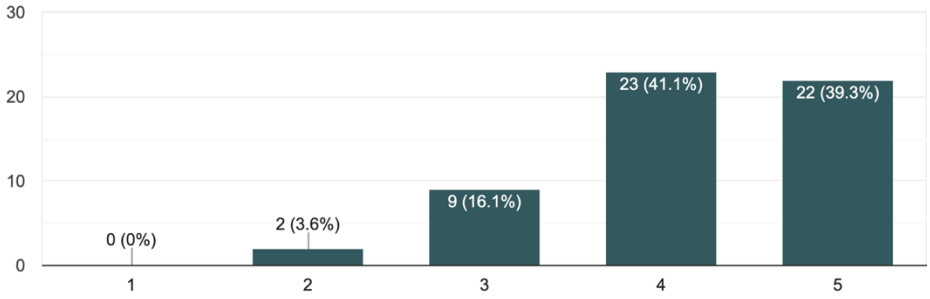
This curriculum would make science concepts easier for students to understand when integrated into the agricultural education lessons.

56 responses



My students would be more motivated to learn when science is integrated into the small animal lessons.

56 responses

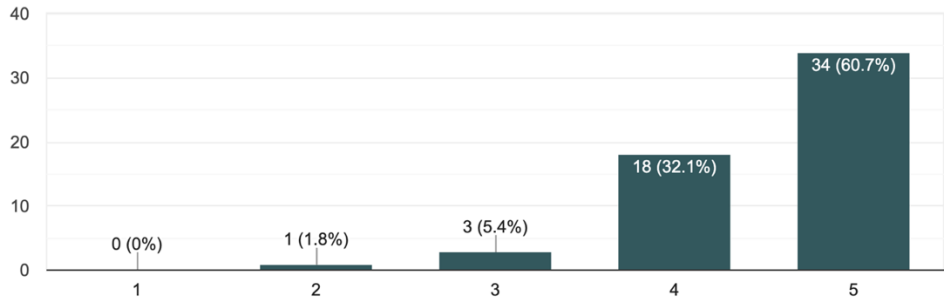


SECTION 5: OVERALL CURRICULUM INTERPRETATIONS

Interpretation of Curriculum Specific Lessons

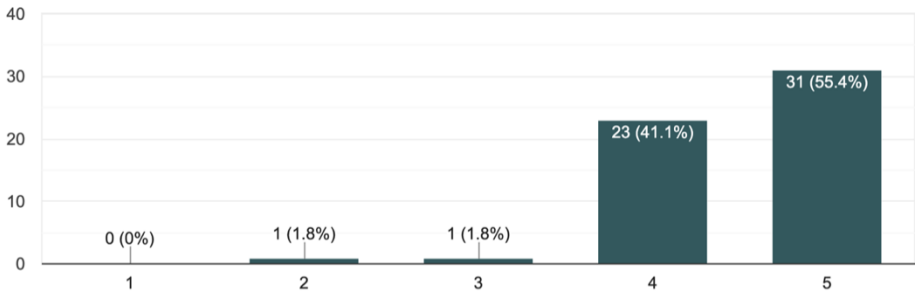
The instructional component of the curriculum (Lesson 1) appeared to be feasible to implement in my classroom.

56 responses



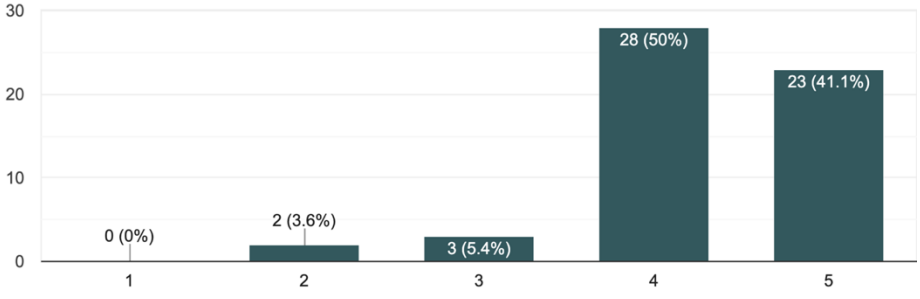
I feel that my students would benefit from the instructional component of the curriculum.

56 responses



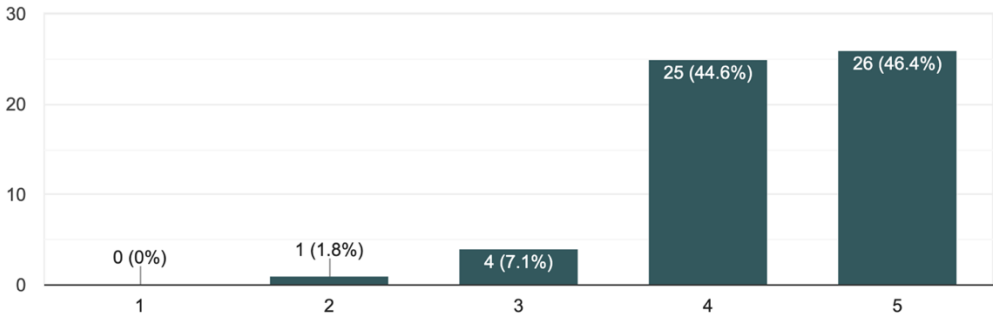
The application component of the curriculum (Lesson 2) appeared to be feasible to implement in my classroom.

56 responses



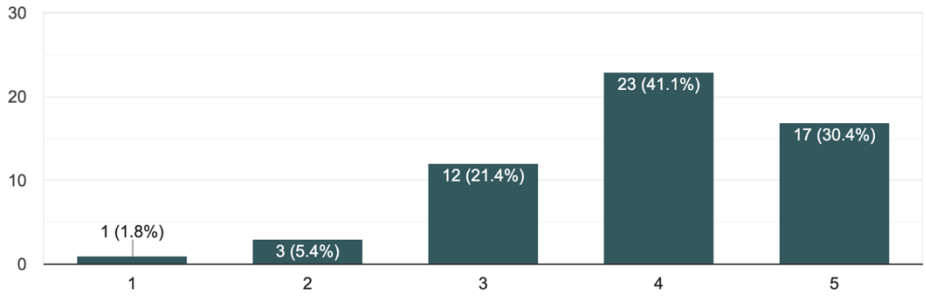
I feel that my students would benefit from the application component of the curriculum.

56 responses



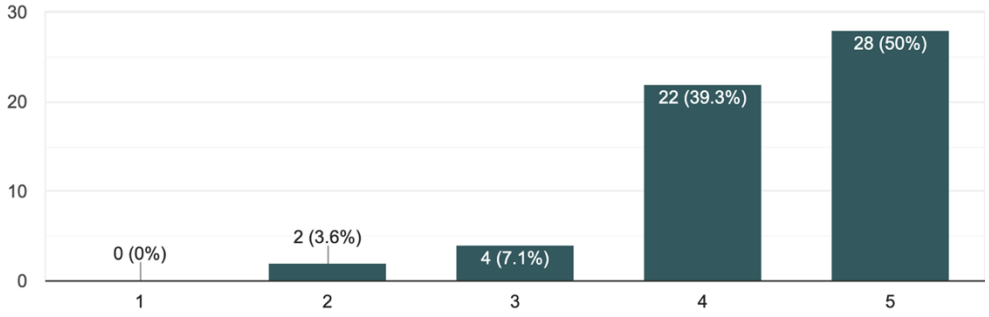
The lab component of the curriculum (Lesson 3) appeared to be feasible to implement in my classroom.

56 responses



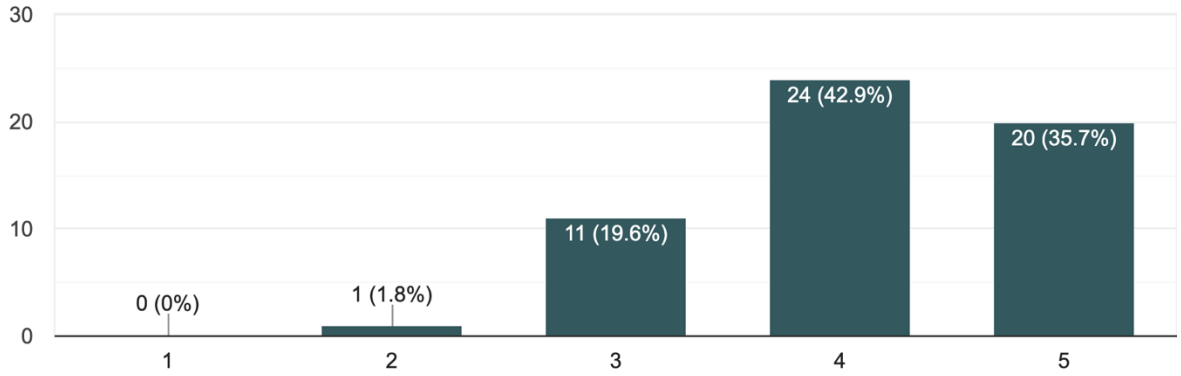
I feel that my students would benefit from the lab component of the curriculum.

56 responses



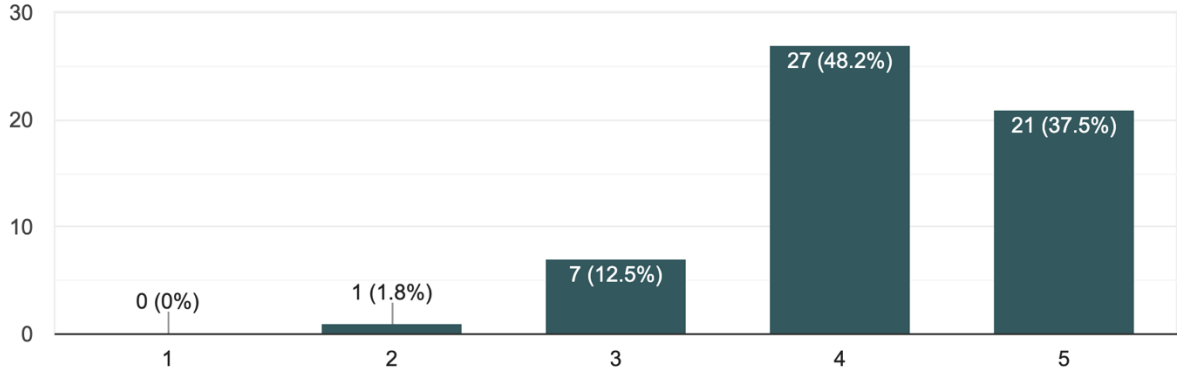
The career/practicum component of the curriculum (Lesson 4) appeared to be feasible to implement in my classroom.

56 responses



I feel that my students would benefit from the career component of the curriculum.

56 responses



APPENDIX I. COMPLETE SAMPLE UNIT CURRICULUM LINK

Companion Animal-Biology Module 4, Unit 3 Sample Unit Used for Research and Data Collection

https://drive.google.com/drive/folders/1Y7S4fYFOvx1DHK4SSX2eaDhdXT7UHW2w?usp=sharing