INVESTIGATING THE ANIMAL SCIENCE DISCIPLINE'S EPISTEMIC FRAME AT THREE LEVELS

A Dissertation

by

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ABSTRACT

Tightened operating budgets, growing class sizes, and changing student demographic challenge the instructional function of many animal science departments. A focus on effective teaching and industry-relevant learning is essential to the utility of the discipline, its scholars and the communities they serve. Therefore, three connected studies were conducted to develop a holistic view of the animal science discipline at a land-grant, research institution.

Students' (n = 559) global self-worth and self-perceptions in 14 domains were measured using an adapted Self-Perception Profile for College Students (SPPCS). The same students' sense of belonging in the animal science (ANSC) department at Texas A&M University (TAMU) was measured using an adapted Psychological Sense of School Membership (PSSM) scale. Of the 14 domains measured, animal science competence had the strongest correlations with belonging (r = .41, P < .001) and was shown to be predictive of students' total sense of belonging (b = .38, $t(258) = 5.66$, = p < .001).

To define animal science competence, or the knowledge, skills, and values expected of today's animal science graduates, the TAMU ANSC department completed the Program (Re)Design Model for a Learner-Centered Curriculum process. Survey responses (n = 289), gathered from department stakeholders during the process emphasized the importance of students' animal science knowledge and written communication skills. Consequently, effects of writing practice and peer feedback on

students' animal science knowledge and writing abilities was investigated. Students in the treatment semester (TR) practiced writing and giving and receiving peer feedback prior to responding to a short-essay question on their final exam; while students in the control semester (CON) did not engage in writing practice or peer feedback before responding to the same question. Students in the TRT group tended (p = 0.08) to receive greater total scores on the rubric used to grade all essays and received significantly (p = .04) greater scores on the section of the rubric regarding their development of claims. Results suggest writing practice and peer review is a suitable approach for instructors of large, mandatory courses within a department of animal science to teach written communication skills and animal science knowledge.

DEDICATION

To the community makers. The “hey!” sayers. The warm hug givers. The “welcome sign” wearers. Thanks for making our world better, smaller, kinder. Thanks for helping us belong.

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Morgan,

We're a good pair, you and me, me and you. Angus and I were pretty set on being life partners till you came along. He protested a bit, but we've warmed up to you. It's hard not to, with your relentless positivity, effortless confidence, consistent encouragement, and boundless ideas for adventure. You assume good like no one I know and though it might have been risky that one time on the Panamanian border, I love it, and so much more about you. Thank you! Also for Tally, she's the best there ever was.

Angus,

You silly, squishy, cuddly little beast. I love you so much that it's kinda embarrassing. Here's to making cat enthusiasts far and wide.

Mom,

You know me better than I know myself – it's annoying. Thanks for knowing just what to say to walk me off the cliffs I make for myself. I love you and admire the strength you've shown in what hasn't been an easy life.

Alisa,

Thanks for being the reliable one. I look up to you in so many ways. Particularly in how you know what you want and resolutely pursue it. I'm so happy for you, your fam, and

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Kala,

You can do anything. It's fun to see so much of myself in you, and so much of what I couldn't do. Keep your chin up, I love you.

Dad,

Thanks for the financial advice and trips to the mountains. Knowing that you're proud of me is immensely gratifying.

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Thanks for believing in me, thanks for the warm meals as I traveled through, and for the phone calls when I couldn't.

To my few but cherished BCS friends Fred, Elizabeth, Katie, Ryan, Scott, and Matt,

For reals, I would have fully lost my (expletive) without you. Thanks for making me food, smile, and occasionally get out of the house.

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Thank you. You have a difficult job, balancing so many varied demands and guiding so many young minds. As an over-thinking, self-doubting, restless achiever, I didn't make it any easier. As I reflect (go Kolb's! Reflect on things! Deep learning, yay!), I think it is

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To BCS,

It's weird to write to "you" (less so than writing to a cat?), but it's cathartic so I will. A lot of College Station became hard for me, especially later in the 8.5 years (wild). I missed consistently nice weather and outdoor access. I missed family. I missed friends. I missed the West Coast ~vibe~. But it's also where I pushed my mental and emotional strengths, beyond what I'd believed to be their bounds. Where I was when my mom was diagnosed with and defeated cancer. Where I was when others did not. Where I stayed when so many friends left. It's where I rescued #AngusFerguson (or did he rescue me?). Where I learned proper college football (thanks for making me relevant). Where I met and fell in love with a partner who melted my defenses. Where I stayed put longer than I ever have before. Where I bought and paid off a truck. From where I'll finish three (expletive) degrees because I grew up in a time and place in which I could. Where I got paid to think and learn. Where I spent months in cow placenta and hugging calves. Where I side hustled like a boss. Where, in some of the messiest ways yet, I fought for

me. For years, no lie, I've longingly pictured the closing of this chapter. But, in reflection, I wouldn't have wanted it written any other way.

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TABLE OF CONTENTS

Page

CHAPTER I

INTRODUCTION

Communities of practice are groups of people who work in the same profession, and improve it through their professional interactions (Wenger, 2011). For example, engineers work in and improve the outcomes of engineering communities of practice (Shaffer et al., 2009). Epistemic frames are the combined knowledge, skills, values, identity (way of seeing themselves) and epistemology (knowledge acquisition) that members must embody to successfully contribute to their corresponding communities of practice (Shaffer et al., 2009). Because of their engineering epistemic frame, engineers are able to work as accountants in their community of practice (Shaffer et al., 2009).

Academic disciplines in higher education teach epistemic frames. Epistemic frames are unique to each discipline, (Becher,1981) and academic disciplines prepare people to engage in communities of practice. Academic disciplines also advance their own epistemic frames, or the knowledge, skills, values, identity, and epistemology that scholars of the frame must apply in the community of practice (Krishnan, 2009) – an added role originating from the Land Grant principle of the early 20th century (McDowell, 2003). The aim of this research (Table 1) is to define the epistemic frame necessary for current animal scientists (at the curriculum level), how students may acquire it (at the course level), and self-perceptions that may contribute to an individuals' embodiment of it (at the individual level).

Table 1. Research hypotheses, instruments and analysis.

Study	Null Hypotheses	Instrument	Analysis
(student level) **Animal science students' perception of self and of belonging**	The duration of a student's enrollment in the department of Animal Science at Texas A&M University will have no significant effect on their response to measurements of their sense of belonging or self in the department. A student's sense of self will not significantly correlate with their sense of belonging in the department of Animal Science at Texas A&M University.	1. Self-perception Profile for College Students (Neemann and Harter, 2012) 2. The Psychological Sense of School Membership (Goodenow, 1993)	1. Exploratory factor analysis, separately analyzed for each instrument 2. Correlations between the two instrument's factors 3. Regression analysis to determine predictors of belonging
(course level) **Writing and peer review in a core animal science class**	Writing practice and peer-feedback, in a core undergraduate course within the Animal Science Curriculum at Texas A&M University will have no significant effect on students' course content mastery and writing ability.	Rubric adapted from Texas A&M Writing Center (2018) and Rezaei and Lovorn (2010)	Pre and post difference test
(program level) **Animal science undergraduate curriculum redesign**	Outcomes such as knowledge, skills, and values achieved from undergraduate course instruction in the department of Animal Science at Texas A&M University are in alignment with departmental stakeholders' expectations.	5 stakeholder surveys (Fowler et al., 2015); Program (Re)Design Modul for Learner-Centered Curriculum	Descriptive analysis

CHAPTER II

LITERATURE REVIEW

"Balance" is a pervasive word in research across disciplines such as ecology (Hovardas and Korfiatis, 2011) energetics (Russell and Cook, 1995), human health (Pollock et al., 2000; Hill et al., 2012), geophysics (Lucarini and Ragone, 2011) and agriculture (Baker and Griffis, 2005) – with efforts primarily focused on describing and achieving the phenomenon. In agriculture, perhaps the most imperative balance is between tradition and modernization (Meyer, 1993). Agricultural curricula are supported by leaders, scholars, and colleges that value the curricula's traditional origins, while at the same time the curricula must be relevant and enticing to modern and primarily urban students – presenting a challenge for higher education programs (Meyer, 1993). Factors that have impacted and are impacted by this challenge, as well as options for addressing the challenge will be discussed in this literature review.

Origins of Animal Science as a Discipline

Animal science, as a formal academic discipline, began with the land grant universities. The Morrill Act, signed into law by President Abraham Lincoln in 1862, allocated federal land to each eligible state for its use in establishing a land grant institution. Since that time, 76 colleges and universities have resulted from the Morrill Acts of 1862 and 1890, the Hatch Act of 1887 and the Smith-Lever Act of 1914 (National Association of State Universities and Land-Grant Colleges, 2008). Formation of land grant institutions brought new students, including farmers, and new studies,

including agriculture, to the university classroom (Meyer, 1993). Additionally, the land grant principle – a means of encouraging development and dissemination of scholarly information from the university to the public via research, extension and teaching efforts – was initiated. This principle is heralded as one of the most meaningful societal achievements contributing to the productivity of U.S. agriculture (McDowell, 2003), as improving productivity was the focus of the early agricultural disciplines in higher education.

Persistence in a Modern World: Early animal science students *entered* the discipline either closely tied to or as direct members of the animal science community of practice (Meyer, 1993; McDowell, 2003). Thus, the discipline did not need to focus on developing these student's foundational animal science knowledge, skills, and values. As a result of unattractive farming incomes and capital requirements (Meyer, 1993; McDowell, 2003) between 1920 and 1970 farmers became a minority of the American population (Meyer, 1993). Today there is an increasing number of students entering agricultural colleges that lack previous agricultural experience (Parrish et al., 2015). In fact, currently less than one percent of U.S. households are involved in production agriculture (Bobeck et al., 2014), whereas, when the Morrill Act was written in 1862, 60% of Americans were involved in farming (McDowell, 2003).

Since the U.S. population's transition away from production agriculture, the impacts of students' exposure to the agriculture community of practice prior to their enrollment in an agriculture degree have been extensively researched. Dyer et al. (2002) investigated the similarities and differences between college of agriculture freshmen

from urban backgrounds (UB) and rural backgrounds (RB). They also identified variables to predict whether or not members of these student groups would remain in a college of agriculture beyond their freshmen year. The study participants were freshmen students at two Land Grant universities in the Midwest between 1995 and 1997 (n =725). The two student groups differed in their indication of likelihood to leave their college of agriculture, with 39.4% likelihood for the UB group and 5.9% for the RB students. Both groups indicated most liking the "friendly atmosphere" followed by the "faculty" in their college of agriculture. The study identified "prior experience in agriculture," as the most significant predictor of a students' intention to remain in the college of agriculture.

In addition to impacting students' intention to remain enrolled in a college of agriculture, exposure to agriculture has been shown to impact individuals' agreement with animal agriculture practices. Prior to the start of their instruction in a university's introductory-level animal science course, student's attitudes towards animal agriculture issues were collected via survey by Bobeck, Combs and Cook (2014; n = 224). Student responses were separated into those from students whom self-identified as being from UB and those from students whom self-identified as being from RB. When compared to the attitudes of students from RB, students from UB were significantly less agreeable with the following concepts: farming being moral and humane, that farmers are concerned about animal welfare, and that livestock are of value. However, attitudes from the two different student groups regarding the aforementioned concepts became more similar after 15 weeks of a shared experience in the course. Similar findings of student's

perceptions being significantly influenced by their backgrounds prior to instruction were discussed by Adams, Holub and Ramsey (2015).

Prior to agricultural instruction students from UB believed that agriculture careers were only for those with agricultural backgrounds (Fraze et al., 2011). If urban students in colleges of agriculture hold this belief, and their future career opportunities are not made clear and relevant to them early in their program of study they may not desire to complete the program. In one example, the University of Missouri's overall graduation rate was 67%, however, out of a class of 457 students initially enrolled as animal science majors, only 35% of students graduated from the degree program (Jesse and Ellersieck, 2009); another 15% of the cohort completed a degree in a different major in the College of Agriculture, Food and Natural Resources, 15% obtained a degree outside of the college, and 4% completed a degree in veterinary medicine. While attrition from the animal science major was greater than expected by study personnel, graduation rates of these students (68%) closely represented the university's' overall graduation rate (Jesse and Ellersieck, 2009). The 35% graduation rate from an animal science degree, though from a single university, is lower than the 40-60% graduation rate from an engineering degree as reported by the National Academy of Engineering (Peuker, 2017). Valuable financial resources, missed opportunities for students and much-needed potential qualified personnel (Dyer et al., 2002; Bobeck et al., 2014) are lost if recruited students exit their program of study. Therefore, means to support students' clarity of choice of major prior to enrollment, followed with measures to retain

students once enrolled, should be a top priority for faculty and universities alike (Scott and Lavergne, 2004).

Lack of personal engagement with curriculum content is one reason agriculture students reported leaving their degree programs (Dyer et al., 2002). Student engagement is defined by Axelson and Flick (2010) as, "how involved or interested students appear to be in their learning and how connected they are to their classes, their institutions, and each other." Lack of curricular engagement could be because, unlike students with existing agricultural background and context, those entering agriculture programs of study without previous experience may not know if they are truly interested in the program until after they have already enrolled (Kauffman, 1992). Estepp and Roberts (2013) showed that students are more likely to engage in their curricular content when their educators utilize language familiar to the student. Therefore, engagement of students without previous agriculture experiences, and thus less agricultural vocabulary at the start of their program of study, may hindered by instructors' use of agricultural jargon and terminology.

Perceptions of agriculture differ between UB and RB students, especially prior to these students' exposure to agriculturally-related higher education (Bobeck et al., 2014; Adams et al., 2015). When facilitating in-class discussions, for example those regarding controversial topics in agriculture, instructor's awareness of different backgrounds and perceptions held by students and the impact those perceptions may have on discussion may promote student learning (Weinstein et al., 2003). One way awareness might promote student learning is because it can help instructors address any in-class

microaggressions that might occur between the two groups of students (Boysen, 2012) due to different backgrounds and their associated perceptions. Failing to do so might polarize students and create a chilly classroom like those described by Shulze and Tomal (2006), which fail to foster a positive learning environment.

Positive learning environments facilitate 'significant' learning. Fink (2013) describes significant learning experiences as those that create lasting change that is important in terms of the life of the learner and as the key to quality in educational programs. Lack of prior agricultural context and experience characteristic of UB students in colleges of agricultures (Martin J. Frick, 1995; Parrish et al., 2015) may imply that significant learning experiences for them differ from those appropriate for students from agriculture backgrounds. Regardless of student's background, employers of graduates from agriculture programs expect their hires to have agriculture-related knowledge and skills. Therefore, the need for students from UB seeking careers in agriculture to obtain the necessary knowledge and skills through their university experience(s) is very high.

The level of agricultural knowledge among rural versus urban, inner-city high school students in the Midwest was assessed by Frick, Birkenholz, Gardner and Machtmes (1995). Student knowledge was assessed in seven different agricultural topic areas including: significance of agriculture, agriculture policy, natural resources, plants, animals, agriculture product processing and marketing. The overall mean for "knowledge of agriculture," was 22.77 for RB students, which was greater than the mean score for UB students (16.95). However, if instructors and fellow students create an

inclusive environment for students from differing backgrounds, in which all students feel empowered and willing to engage in their educational experiences, the students could learn from one another and their unique perspectives (Chickering and Gamson, 1987; Ottenritter, 2012; Block et al., 2014). Additionally, instructors awareness of any personal bias towards teaching students from either background may help them avoid favoring one group over another (Buchanan, 1994b). If instructors have high "teacher immediacy", described by Estepp and Roberts (Estepp and Roberts, 2013) as being caring, enthusiastic, and approachable, and show effort and personal connection with students, students are more likely to engage a diverse classroom setting.

Expectations of animal science graduates

Researchers (Slusher et al., 2011; Robinson and Mulvaney, 2018) describe animal science graduates as needing to have animal science knowledge to be successfully hired in the community of practice. Robinson and Mulvaney (Robinson and Mulvaney, 2018) also reported that employers in the animal science community of practice expect graduates to have relevant animal science work experience prior to their graduation and employability.

Further, though society is less engaged in agriculture production, the need for agriculture products such as food and fiber is increasing with an expanding global population. With human population estimated to reach nine billion by 2050 (United Nations, 2012), the need for agriculture-related communities of practice, including animal science, which produce food and fiber, becomes increasingly important (Coulter et al., 1990). The responsibility to provide the context and epistemic frame necessary for

agricultural students from urban or suburban backgrounds to be successful in agricultural careers and ultimately preserve the agriculture industry falls on higher education (Esters, 2007).

The concern, shared among faculty, staff and external stakeholders, is that agriculture curricula at post-secondary institutions have not evolved to meet the needs of students without agricultural backgrounds (Buchanan, 1994b). In other words, the discipline may not be effectively teaching its students to enter the community of practice. Less than 25% of human resource professionals representing agricultural firms report that college graduates they employ are well-prepared for the workforce (Colleges and Council, 2007). If employers whom would otherwise hire animal science graduates are not able to identify candidates with the desired knowledge, skills, and values they may turn to graduates from allied programs such as biology (Hegerfeld-Baker et al., 2015). In essence, if animal science higher education is not able to provide the epistemic frame, including the knowledge, skills, values, and personal engagement, critical for its current student demographic, its role in academia and society could be questioned.

Developing animal science knowledge, skills, and values

In order for individuals, regardless of their background, to successfully work in the animal science community of practice they need to be engaged in a curriculum that develops their relevant animal science knowledge, skills, and values in a meaningful way (McDowell, 2003). A strictly didactic lecture approach is not an ideal format for students to develop deep understanding of foundational knowledge (Schillo, 1997) because it hinders students' relationship with the material, allowing for passivity.

Alternatively, situations in which students are required to take ownership of foundational knowledge and are assessed on their ability to do so via defense of their own judgments (through writing samples or oral presentations, for example), can be effective means for students to master foundational knowledge. Active learning opportunities support students' exploration, inquisition, and synthesis of information (Schillo, 1997) and can result in significant learning (Chickering and Gamson, 1987; Fink, 2013).

Examples of active learning educational approaches include project-based learning, peer-learning, and reflection. Project-based experiences usually engage students in start-to-finish elements such as forming the project's foundational questions, developing hypothesis, discussing and applying their ideas through activity and creating a tangible project (Krajcik and Blumenfeld, 2006). A challenge to implementing project-based learning is the interdisciplinary learning required; this means students need to pull learning from numerous courses and experiences. An example of project-based learning includes design challenges such as the Texas A&M College of Agriculture and Life Sciences (COALS) Grand Challenges, in which students design and complete an experiment, develop a scope of work proposal and then complete some or all of that work.

Peer learning requires students to work collaboratively with their peers to meet learning outcomes. In this way, students are teachers and learners co-constructing their learning. Usually, peer learning is first outlined and then monitored by the instructor of record. A challenge with peer learning can be assessment; it may be difficult to assess each student's mastery of the learning outcomes if their work was truly collaborative

(Boud et al., 1999). Examples of peer learning include buzz groups, in which four to six students discuss issues relating to a specific topic; affinity groups, in which four to six students meet outside of class to work on particular tasks; and peer feedback, such as the use of Peerceptiv Software™ a platform to aid students in providing their peers feedback on writing assignments.

Reflection has been described as a critical element following an experience for learning to occur (Kolb, 1984). Reflective practice is the act of thinking back on an experience to draw meaning from it. In this way, it helps bridge theory to practice. Structured reflection examples include the use of questioning models such as those from Gibbs (1988) and Rolfe (2002). Reflection is usually personal and formatted as questions based on experiences.

Anderson and Adams (1992) describe how reflection, as part of Kolb's experiential learning model, can establish students' deep comprehension of foundational knowledge. Kolb's cyclical model involves students in (1) a concrete experience, (2) reflection on that experience which should develop their (3) understanding of the concepts and generalizations of that experience and (4) an application of new understandings to the student's life and future learning experiences. Kolb's model of reflection aligns well with animal science education because it emphasizes learning via experience (Parrish et al., 2015). For example, students will better understand the foundational knowledge regarding animal protein production after having (1) experienced carcass fabrication, (2) reflected on the skills and food safety measures involved, (3) understood the role of food animal protein production in global food

security and (4) applied this knowledge when experiencing content related to feeding livestock to an optimized carcass endpoint. Ultimately, Kolb's model should be considered by educators as an option to grow the foundational knowledge of animal science students because it connects concrete experiences to essential knowledge within the discipline.

Developing animal science undergraduate students' industry-relevant knowledge, skills, and values while simultaneously providing them with employer-desired work experience (Woiwode, 2018), includes exposing animal science undergraduates to animals (Bureau of Labor Statistics, 2018). Those animals require appropriate facilities, land, water, feed and regular care from trained personnel. Providing animal science undergraduates with animal experience, particularly large animal experience, is therefore an expensive undertaking for a university. As an example of the magnitude of this cost, per diem research animal costs listed by the University of Michigan for cattle range from $10.49 - $20.95 per day, depending on the animal's size and facility type, for horses $22.65 - $27.46 per day, depending on the facility type and for sheep and goats $7.52 per day (2018). Prices listed by The Ohio State University are within these ranges as well. In addition are the costs of instructors to teach each lab section (if labs continue to be the mode of access for undergraduates), which realistically can't exceed 35 students for each to be provided with meaningful, hands-on experience. Two opportunities for providing students with hands-on experience with animals include undergraduate research and internships (Anderson, 2015; Sterle and Bundy, 2018).

Involving undergraduates in research is an accessible model for both students seeking animal science experience and faculty seeking researchers (Sterle and Bundy, 2018). Hodson (1993) suggested that simply learning about scientific methods and processes is not an effective means to learn in the sciences and will not yield application abilities; instead students must actually engage in scientific investigations. Undergraduate research actively engages students in science for example as they apply scientific concepts to their experiments compared to passive engagement such as memorizing scientific vocabulary (DeHaan, 2005). From active learning undergraduate research "can produce levels of understanding, retention and transfer of knowledge that are greater than those resulting from transitional lecture/lab courses" (DeHaan, 2005). For example, a study (Hake, 1998) involving 62 semester-long physics courses at universities across the country, used a pre- andpost-test scores to measure student gains in problem solving skills and knowledge of physics concepts. Physics courses that used active engagement methods, e.g. provided opportunities for students to problem solve or perform small experiments resulted in gains in students' knowledge of course concepts and problem-solving abilities that were twice that of gains shown in students from course that did not include active engagement strategies (Hake, 1998).

Definitions and practices of undergraduate research differ depending on the culture and intended research direction of each research institution (Beckman and Hensel, 2009). In fact, when attempting to provide a succinct yet encompassing definition of undergraduate research, the Carnegie Academy for the Scholarship of Teaching and Learning, in partnership with nine institutions in the US, Canada and the

UK and the Council on Undergraduate Research, determined such a task is not achievable. Even without definite definitions and standardized methods, the literature is rich with studies indicating the ability of undergraduate research to excite and professionally direct students in the general field of science. A research article by Frantz et al. (2006) articulated two different case studies, both of which indicated raised attitudes and confidence of students after their participation in undergraduate research within neuroscience. Additionally, Auchincloss et al. (2014) validate the benefit of undergraduate research in the curriculum of biology students.

In addition to attitudinal changes, the literature suggests students' involvement in undergraduate research directly corresponds to skill-based developments. Increased cognitive abilities specifically necessary for science majors and enthusiasm for research are a described result of undergraduate research projects in a study by Kardash (2000). Beyond the benefits seen during the undergraduate years, this study also indicated influence on students' future career choices. As the literature would suggest, participation in undergraduate research engages science students while in school and better prepares them for success in their community of practice upon completion of their undergraduate degree. As reported by Russell et al. (2007) "SRI International conducted a nation-wide evaluation of undergraduate research opportunities to understand who participates, what effects the experience has on them, and what factors favor positive outcomes." Their results indicated undergraduate researchers in science, technology, engineering, and math (STEM) majors were diverse in terms of their demographics. They also described increases in student knowledge and confidence in conducting

research and clarity of graduate school as a result of their involvement in undergraduate research.

VanWormer et al. (2014) provide an example outside of STEM through their investigation into the value of undergraduate research in the field of psychology. They surveyed freshmen, sophomore, junior and senior psychology students, all of which testified to being better equipped in their understanding of research and increased interest in research activities after participating in volunteer research experiences. The study indicated that psychology students would otherwise only be *introduced* to research methods in their coursework, and that these courses not only fail to increase student interest in research but reduce the perceived utility of research and statistics by students.

Another means to provide undergraduates with relevant animal science experience is for universities to outsource this experience to employers through internships (Anderson, 2015). A survey given to animal science students after their completion of an equine-related internship reported that students learned new information and methods, and believed their internship was beneficial and a provided them with exposure to a potential career of interest. A different study (Oglesbee et al., 2016) asked students (n = 115), distributed across four consecutive years of an animal science class, about their perceptions of an internship related to the topic of the course they were enrolled. Students' self-reported beliefs regarding an internship that provided relevant experience were that it was beneficial for those seeking future involvement in production agriculture, and it increased job-placement confidence and skills. Students' estimates of the number of jobs and average pay for employment in the field of the

internship were lower than actual opportunities and pay. This suggests that an internship experience provides students with more accurate and important career decision-making information about the field. In addition to valuable experience, internships provide participants with accurate industry context necessary to make informed employment decisions.

Beyond animal science-specific knowledge, skills and values, internships have been shown to develop students' critical thinking and communication skills (Duncan et al., 2017). Despite reported benefits of internships, when observing 11 different animal science undergraduate degree plans available online, only two of them included an internship requirement – a finding supported by descriptions in animal science articles (Anderson, 2015; Sterle and Bundy, 2018). Available literature did not describe why animal science departments choose not to require internships. However, the management of an internship requirement, including assisting students with placement in an internship that is both feasible and of interest and determining the suitability of variable internships to count for credit, may deter departments from mandating an internship.

As previously discussed, there is evidence indicating a variety of benefits resulting from students' participation in undergraduate research and internships. However, their thoughtful alignment within an animal science curriculum, including determination of corresponding learning outcomes, measurement of those outcomes and communication of learning outcomes to potential employers appears lacking in available literature and perhaps practice.

Educational theories that support the use of active learning strategies include the constructivist instructional theory (Brooks, 2013), and Mezirow's theory of transformational learning (Mezirow, 1978). The constructivist instructional theory describes how people learn. Originators of this theory include Jean Piaget and Giambattista Vico (Brooks, 2013). Though constructivism brings together a variety of related perspectives, its core defines learning as a process of humans making meaning from their experiences (Merriam et al., 2012). As an instructional theory, it highlights instructional practices or learning experiences that require students to actively construct their own knowledge by, "processing the information they receive and building patterns of association to existing knowledge" (Redish, 2004).

Mezirow is an influential theorist in the area of adult learning (Irby et al., 2013). His transformational learning theory draws inspiration from Dewey's and Kolb's work regarding experiential learning. Mezirow's transformational learning theory most closely aligns with the constructivist and humanist orientations of learning, suggesting that learning is drawn from experiences and is self-directed. This theory is comprised of four main components, "experience, critical reflection, rational discourse, and action (Merriam et al., 2012)." It involves the learner progressing through personal change. Mezirow says that adults learn and transform (over time) from experiences by critically reflecting on the experience (independently or with others) and then acting on that reflection.

Belonging in the discipline

In his theory of human motivation, Maslow (1943) says that people are motivated to fulfill certain human needs. He says that these needs are hierarchical, and as such his theory is often depicted with the needs listed in a five-part pyramid (needs needing to be met from bottom to top). The needs are categorized into 1) biological and physical needs (bottom of the pyramid) 2) safety needs 3) social needs 4) esteem needs and 5) self-actualization needs. Sense of belonging is included in Maslow's theory of human motivation under social needs, above esteem and self-actualization.

Belonging is a basic human need – one that is particularly important for student success in a school setting (Leary and Baumeister, 1995; Osterman, 2000; Lonczak et al., 2002; Allen and Bowles, 2012; Sari, 2012). Goodenow (1993b) describes belonging in educational environments as:

> "Students' sense of being accepted, valued, included, and encouraged by others (teacher and peers) in the academic classroom setting and of feeling oneself to be an important part of the life and activity of the class. More than simple perceived liking or warmth, it also involves support and respect for personal autonomy and for the student as an individual."

In a review of literature, Osterman (2000) found students' sense of belonging in school to be significantly associated with their academic engagement, expectancies for success, emotional functioning and maturation of psychological processes such as motivation, self-regulation and internalization as well as psychological outcomes including self-concept. Similar findings, indicating the powerfully positive impact of

students' sense of belonging on their academic motivation, persistence and success have been found by Allen et al. (2018), Tinto (1998), Goodenow (1993b), and Hurtado and Carter (1997). Alternatively, consequences of students lacking a sense of belonging in their educational environment include them searching for, "artificial belonging in negative ways" (Hensley et al., 2007), and having feelings of social isolation, alienation and loneliness (Leary and Baumeister, 1995). Though when discussing significant associations with school belonging such as academic motivation, Allen and associates (2018) caution that causal directionality of these links is difficult to determine, however, they summarize that these links, regardless of direction, make them important to consider in education.

In a meta-analysis of factors that influence students' sense of belonging in their school, involving 51 studies (n = 67,378), published between 1993 and 2013, Allen et al. (2018) found that the teacher was the strongest predictor of school belonging (r = 0.46), followed by personal characteristics (r = 0.44). The study says that personal characteristics, "refer to positive and negative aspects of a student, including their personal qualities, attributes, abilities, temperament and nature." The study states that teacher support, "refers to teachers who promote mutual respect, care, encouragement, friendliness, fairness and autonomy." After gathering international educational leaders and researchers, convened to discuss literature on the topic, the US Centers for Disease Control and Prevention's (CDC) Division of Adolescent and School Health published their report of the factors that develop belonging in a school. The factors they described as able to increase school belonging were adult support, students' belonging to a positive

peer group, commitment to education and school environment (Control and Prevention, 2009).

Research regarding sense of belonging is lacking in the animal science discipline and community of practice. However, when talking about farmers, Schein (2009) stated that belongingness is tied to resilience and Mucchielli (1980) said that it is part of individual's personal identification and social identity. Further, renowned theorist on the topic of student persistence, Vince Tinto (Christie and Dinham, 1991), describes students' background characteristics as the initial indicator for their commitment to a degree, but that after they start their degree, their experiences with the social and academic aspects of an institution define their commitment to persist (Tinto, 1975). Identification of factors contributing to and detracting from students' sense of belonging in the animal science discipline can add clarity to the design of departmental pedagogy, curriculum, and student retention strategies (Hoffman et al., 2002) – better preparing students for successful degree attainment and development of their social identity in the animal science community of practice.

Summary

This literature review describes the origins of the animal science discipline and student demographic changes since those origins. It describes downfalls of the discipline not addressing those changes such as attrition rates and unprepared graduates. Additionally, it describes strategies to support learning for animal science students', primarily based on research from other disciplines, such as expecting their active engagement throughout the curriculum and increasing their academic motivation through

a sense of belonging in the animal science community of practice. Based on this information we determined it important to study who animal science students are today, how they learn, and what they need to learn and be able to do to be successful in the animal science community of practice today. To further define who animal scientists are today, we investigated their domains of self-perception and explored if those domains are predictive of students' sense of belonging in the animal science community of practice. To investigate how they learn, we tested an approach to teach animal science knowledge and written communication in the context of a modern, core animal science course. Finally, to define the knowledge, skills, values, and attitudes expected of animal science graduates today we engaged in an evidence-based undergraduate curriculum redesign. In summary, preparing students to enter the animal science community of practice requires a curriculum and learning environment that successfully balances the discipline's rich tradition and place in modern society and research described in the following chapters aims meaningfully contribute to literature supporting those endeavors.

CHAPTER III

ANIMAL SCIENCE STUDENT'S PERCEPTION OF SELF AND OF BELONGING

Overview

There is an increasing demand for animal scientists to serve societal needs such as sustainable food production (Hurtado et al., 2007; Goecker et al., 2015). Two key prerequistes to individuals meeting this demand for animal scientists in the workforce are students' completion of an undergraduate animal science program that prepares and qualifies them for entry into the community of practice in the community of practice (Zekeri, 2004; Robinson and Garton, 2008; Goecker et al., 2015; Bureau of Labor Statistics, 2018; Robinson and Mulvaney, 2018), and graduates' choice to enage in the community of practice. The nexus between these prerequisites is students' sense of belonging in an animal science program (Tinto, 1997; Hurtado et al., 2007). An animal science undergraduate program is where the majority of individuals today are first exposed to the animal science community of practice (Bobeck et al., 2014; Parrish et al., 2015) and serves as the professional practicum (Schon, 1987) necessary for developemnt of students' animal science knowledge, skills, values, identity, and epistimology (Shaffer et al., 2009).

Sense of belonging is the interconnection between one's degree completion and pursuit of a community of practice because it indicates both academic and social integration, which are essential to either outcome (Wilson et al., 2015). In terms of academic integration, students' sense of belonging, or personal feeling of connectedness,

to their institution (Leary and Baumeister, 1995), is a positive predictor of their academic motivation (Maslow, 1943; Goodenow, 1993a; Leary and Baumeister, 1995; Allen et al., 2018). Academic motivation is the "expectancy of academic success through goal setting and future aspirations" (Allen et al., 2018), i.e. students' belief in and motivated actions towards their own academic success. Therefore, sense of belonging promotes academic success (Osterman, 2000; You et al., 2011; Allen and Bowles, 2012; Quinn and Oldmeadow, 2013; St-Amand et al., 2017). Student academic success resulting from a sense of belonging and its associated academic motivation is manifest in "persistence," or completion of an academic program (Tinto, 1987; Goodenow and Grady, 1993; Hoffman et al., 2002; Morrow and Ackermann, 2012; Simon et al., 2015; Roksa and Whitley, 2017). When students persist through an academic degree in higher education, they can subsequently be employed in the related community of practice (Robinson and Garton, 2008; Robinson and Mulvaney, 2018).

Social integration, or a sense of belonging, requires alignment of ones' perception of self (Paterson et al., 2002) with their program; or as described by Hagerty et al., (1992), "the experience of personal involvement in a system or environment so that persons feel themselves to be an integral part of that system or environment." This kind of personal integration into a larger social setting such as a university (Pittman and Richmond, 2007) has been linked with important educational outcomes (Wilson et al., 2015), such as (Hurtado et al., 2007; Ostrove and Long, 2007; Strayhorn, 2018) students' persistence (Gray et al., 2013) and engagement in educationally purposeful activities (e.g. studying, interacting with faculty members and peers in contexts related

to topics of study, and using the library) (Hu and Kuh, 2002; Kuh et al., 2008) which is a predictor of academic achievement (Zumbrunn et al., 2014).

Sense of belonging as an indicator of positive educational outcomes (Strayhorn, 2018) is well-documented at the university level (Wilson et al., 2015). However, less is known about belonging at the major or program level – though this level should be of interest as academic majors are where much of students' academic experiences are situated (Wilson et al., 2015) and belonging in them can serve as a proxy for belonging in the greater community of practice (Marzocchi, 2016). Though evidence suggests that sense of belonging affects student interest in and persistence through STEM programs, and that belonging may be reduced by stereotyping and isolation of particular groups of people (Good et al., 2012; Marra et al., 2012; Wilson et al., 2015; Marzocchi, 2016), existing data specifically describing what contributes to or detracts from students' sense of belonging in animal science has not been identified. Given evidence of the positive academic, social, and learning outcomes associated with students' sense of belonging (Leary and Baumeister, 1995; Strayhorn, 2018), this study aims to build on the standing body of research by investigating, 1) students' sense of belonging in an animal science program, 2) those students' perceptions of self, and 3) links, if any, between those students' self-perception and belonging in the animal science program.

We hypothesized that students' sense of belonging in the TAMU ANSC Department would significantly increase with duration of students' enrollment, and that students' self-perceptions, particularly those pertaining to competence in social domains, would correlate with their sense of belonging in the department. This study aims to

inform tangible departmental improvements such as teaching strategies and change projects to increase students' sense of belonging in an animal science department. Although this study took place at one large land grant, Research 1 institution in the United States, findings will be useful for other animal science departments as they prepare students for the animal science community of practice.

Methods

Participants

This study occurred at Texas A&M University (TAMU), a land grant, Research 1 institution in the United States. Study population consisted of undergraduate students enrolled in the Animal Science (ANSC) Department at TAMU during fall 2017 and spring 2018. Participants were freshmen (n= 202), sophomores (n=61), juniors (n= 90), or seniors (n= 184), with an average age of 20 years. Self-reported demographics indicated the majority of participants were female (79%) and from a self-described agricultural background (54%).

Procedure

Recruitment of participants occurred during regularly scheduled (50 min) classes within three core courses housed in the Department of ANSC at TAMU. At the start of each class, study personnel described the study, and informed potential participants that their involvement decision would not influence their standing in the university or course. Course instructors were not present during survey administration nor informed of individuals' decisions regarding participation. Consent to participate was made by

participants returning a completed paper survey to study personnel. Study personnel did not collect identifying information nor provide incentives for participation.

Measures

Belonging Instrument: The Psychological Sense of School Membership (PSSM) Scale developed by Goodenow (1993a) to measure adolescent's self-reported sense of school belonging, has been extensively utilized by researchers (Hagborg, 2003; Cheung, 2004; You et al., 2011). The instrument includes 18 questions, answered on a 5-point Likert scale. Scale choices range from "not at all true (1)" to "completely true (5)." Half of the questions are written in a positive frame, for example, "people here notice when I'm good at something" the other half of questions are negatively framed, for example, "sometimes I feel as if I don't belong here."

Most studies using the PSSM report a unidimensional score of school belonging by determining the average score across all 18-Likert questions (You et al., 2011). Cronbach alpha scores, commonly used to represent an instrument's reliability, across 27 research studies applying Goodenow's (1993b) scale as a unidimensional measure, were between 0.78 and 0.95 (You et al., 2011). However, few researchers have described the multi-factorial merits of the PSSM scale (Hagborg, 1994; Cheung and Hui, 2003; Shochet et al., 2011; You et al., 2011; Allen et al., 2018). Some studies have reported moderate to high correlations between the PSSM scale and other educational constructs such as academic success (You et al., 2011).

Goodenow and Grady's (1993) definition of students' sense of belonging in an educational setting was the most consistent definition referenced across 51 studies

included in a meta-analysis of factors influencing school belonging by Allen et al. (2018). Goodenow and Grady's (1993) definition of academic belonging is, "the extent to which students feel personally accepted, respected, included and supported by others in the school social environment." Because positive personal characteristics such as self-worth have been strongly associated with a sense of belonging (Allen et al., 2018), we wanted to be able to describe those characteristics across our study population. Therefore, an objective of this study was to examine correlations between the students' sense of belonging measured by the PSSM instrument and students' perception of self and self-worth (Boulter, 2002) as measured by the Self-perception Profile for College Students (SPPCS), the latter of which will be described in subsequent sections. The PSSM instrument has been used extensively, and has shown high reliability (St-Amand et al., 2017), and concurrent validity with other educational constructs (You et al., 2011). For these reasons, and because of the instrument's strong theoretical background (St-Amand et al., 2017), it has been adapted (Zumbrunn et al., 2014), for integration in this study.

Self-perception Instrument: Some researchers have argued that a person's overall sense of self-worth is a single-score summation of their self-worth in a variety of diverse contexts, such as in peer relationships (Neemann and Harter, 2012). Others argue that self-worth is multi-dimensional (Boulter, 2002) requiring multiple subscale-specific measurements. Addressing these varying viewpoints, Neemann and Harter (2012) suggest a combination of measuring one's self-competence in different subscale areas in addition to independently and directly measuring an individual's overall self-worth. The

authors note that their measurement of overall self-worth is meant to describe individual's overall perception of their worth as a person, which is unique from their perception of competence in specific sub-areas. The SPPCS instrument is intentionally designed for college students measuring perceptions of their own overall self-worth and competence in age-relevant, cognitive and physical subscales such as: creativity, intellectual ability, scholastic competence, job competence, appearance, social acceptance, close friendships, finding humor in one's life and morality. Cronbach alpha measures of internal reliability for the instrument's subscales area have been reported between .74 and .92 (Rinn and Cunningham, 2008; Neemann and Harter, 2012).

The question format of the SPPCS asks respondents to make two decisions for each question. First, respondents select the description, out of 2, they believe best fits themselves. The two descriptions start with either "some students" or "other students" and are separated by the word "but," suggesting that either side exists in student populations and that no one side is "correct." Secondly, respondents decide to what degree the first option they chose fits them – these degrees include either "really true for me" or "sort of true for me." The instrument's format offsets respondent's tendency to give socially desirable answers (Neemann and Harter, 2012), while allowing respondents to identify with the reference group most appropriate for them. Variability in the items and the use of the full range of responses justifies this choice of question format. A complete methodology and reasoning behind this question format is found in Harter (1985 and 2012). Once responses are collected, they are scored from 1 to 4, where a score of 1 indicates low self-competence, and a score of 4 reflects high competence. Half

of the high competence (4) phrases are matched with the "some students" statements, while the other half are matched with "other students" phrases. Based on its measurement of a college student's subscale specific and overall self-worth, its extensive use by developmental social psychologists (Granleese and Joseph, 1994), repeatability, and its clarity of methodology as described in the Self-perception Profile for College Students: Manual and Questionnaires (Neemann and Harter, 2012), the SPPCS was used in this study.

Adaptations to measures: Both the PSSM and SPPCS instruments were adapted for use in the animal science department at Texas A&M and then combined into one paper survey (Appendix E) Adaptations to the PSSM instrument ensured questions pertained to student's belonging in TAMU ANSC department. For example, a change from, "I feel like a real part (name school)" to "I feel like a real part of Texas A&M Animal Science Department" and from, "I can really be myself at this school" to, "I can really be myself in this department." Adaptations to the SPPCS scale included the addition of an animal science-specific subscale area. This addition enabled us to measure participant's perception of their competence and their perceptions regarding the importance of competence in the animal science department at Texas A&M. Prior to our recruitment of participants, one of the authors of the SPPCS instrument, Dr. Jennifer Neemann, reviewed the adapted instrument and confirmed the suitability of the added animal science subscale questions. An example question from the animal science subscale is, "Some students feel like it is important that they know just as much or more about ANSC than most students in the TAMU ANSC Department BUT others do not

feel like it is important if they know just as much or more about ANSC than most students in the TAMU ANSC Department." Sub-sections below describe question formats for each instrument in more detail. Also included in the paper survey were opportunities for participants to self-report demographic information pertaining to GPA, age, gender, grade classification, major of study (to confirm ANSC), ANSC option (science or production emphasis), if they transferred into the department, and if they came from a self-described agriculture background.

Analysis

Initial analysis of variance was computed using the one-way ANOVA test to determine any statistically significant model effects, this significance was determined at $P < 0.05$. A post-hoc Scheffe test (Scheffé, 1953) was used to compare levels within each significant effect. Factor analyses of the SPPCS instrument (Neemann and Harter, 2012) and the PSSM instrument (Goodenow, 1993) were conducted separately. First, to determine if the thirteen subscales of the SPPCS, as previously determined by Neemann and Harter (2012), constitute separate factors in our study. An exploratory factor analysis (varimax rotation) of the PSSM was completed to determine if factors emerged when the instrument was used with our study population. Factors were determined to have emerged when eigenvalues were greater than 1.00 (Gorsuch, 1983). Reliability of each instrument was assessed using Cronbach's alpha.

Correlations between the two instruments were determined and considered significant at 0.30 and greater (Cohen, 1988). Multiple regression was used to investigate whether SPPCS self-perception items were predictive of students' sense of

belonging in the TAMU ANSC department. Computations were completed for the total sample of students (Table A5) and, because we were interested in whether SPPCS scale items differently predict sense of belonging based on students' year in school, regression were computed for the following sub-samples of the population: freshmen (Table A6), sophomores and juniors (Table A7), and seniors (Table A8). Each analysis was computed by entering six demographic variables (gender, z-score of age, GPA, transfer status, agricultural background, and animal science degree option), and the 15 SPPCS scale variables as independent variables in the regression equation, with the exception of GPA which was not included in the equation for freshmen. The dependent variables were the three factors of the PSSM scale as determined by factor analysis in this study (feel involved, general belonging, treated well), and total belonging measured by the entire PSSM scale.

Results and Discussion

Descriptive statistics

Descriptive statistics for study variables are shared in table A1. Freshman student GPAs were not reported as it was their first semester at the university. Participants' competency scores, on a 1 to 4 scale, across all items in the SPPCS instrument range from an average of 2.39 (stress management, freshman) to 3.35 (work competence, sophomores), indicating that participants perceive positive self-competence in each area (Pittman and Richmond, 2007). Post hoc comparisons using the Scheffé test indicated that junior students' ($n = 90$) mean score for global self-worth ($\mu = 3.02$) was greater ($P = 0.017$) than senior students' global self-worth ($n = 184$; $\mu = 2.76$). Mean scores for

humor competency were also greater (P = 0.041) for junior students (n = 90; μ = 3.29) than senior students (n = 184; μ = 3.07), and senior students humor scores were greater than freshmen students (n = 202; μ = 3.16; P = 0.037).

Mean scores for openness competency were also greater (P = 0.001) for junior students (n = 90; μ = 3.31) than senior students (n = 184; μ = 2.96), which were less than freshmen students (n = 202; μ = 3.17) (P = 0.037). Sense of belonging as measured by the PSSM scale did not significantly differ across year in school (P value here). Contrary to our hypothesis, time in the department did not significantly affect students' sense of belonging. Except for mean scores of freshmen (μ = 2.93) and juniors (μ = 2.88) in the 'feeling involved' factor, all mean scores were above the 3.00 threshold which indicates a sense of belonging (Goodenow, 1993b). Mean scores for total belonging in this study were similar to those identified in freshmen students in business and economics programs across three universities in the UK (Kane et al., 2014).

Lower mean scores for global self-worth for senior students compared to juniors could be related to the fact that senior students are facing a life-stage transition (Schlossberg, 1981; Murphy et al., 2010); a transition that can begin as early as the fall of their senior year (McCoy, 2003). Similar findings, of decreased measures of self-worth during a transition in life-stage have been measured in students transitioning to junior high (Nottelmann, 1987; Midgley et al., 1989), and from high school to college (Harter and Whitesell, 2003). Transitioning through life-stages may disrupt an individual's sense of continuity, particularly in how they compare themselves to others

in a particular environment such as a school, which may negatively impact their sense of self-worth (Leahy and Shirk, 1985; Galambos et al., 2006).

The openness sub-scale assesses respondent's "ability to laugh at oneself and take kidding by friends," (Neemann and Harter, 2012), and the humor sub-scale assesses "whether one is comfortable with being open-minded about different ideas, such as religions, politics, cultures, ethnicities, etc." (Neemann and Harter, 2012). Seniors' lower mean scores for openness when compared to both junior and freshmen students may be because college students become more established in their personal beliefs throughout their time in college (Astin et al., 2010). Seniors' lower mean scores for humor compared to both junior and freshmen students may be related to college seniors' focus on the high-stakes expectations associated with their transition into careers (Barnett et al., 2003; Wood, 2004).

Factor analysis

The thirteen subscales of the SPPCS instrument Neemann and Harter (2012), constituted 8 factors in our study, explaining 55% of the variance in responses (Table A2). Additionally, the animal science competence subscale, developed for this study, loaded on an independent factor (α = 0.57). Factors that exactly replicated the Neeman and Harter (2012) factor structure include stress management (α = .72), appearance (α = .71), and creativity (α = .55). The work subscale, which assesses students' self-perceived competence in non-academic jobs cross-loaded with the health subscale which assess participants' lifestyle behaviors (e.g. eating, exercise, alcohol consumption) and the morality subscale which measures whether one feels that his or her behaviors are moral.

Therefore, rather than distinctly measuring one's work domain, the four items in the SPPCS scale were correlated (and cross-loaded on factors) with measures of health and morality domains. The cross-loading of work competence with two different subscales in this study could be because non-academic jobs are not pertinent to our study population, (Wichstraum, 1995; Thomson and Zand, 2002); as this is the case for most children, the work competence subscale is not included in the Self-Perception Profile for Children (Harter, 1985). An alternate hypothesis is that items measuring work, health, and morality may be tapping a broader domain of behavioral conduct (Worrell, 1997).

Cross-loading of close friendship and social competence items onto one factor in this study, meaning they do not distinctly measure their respective domains, are similar to findings by Trent et al. (1994), Thomson and Zand (Thomson and Zand, 2002), and by Wichstraum (1995) indicating that social and close friend domains are highly intercorrelated or closely aligned. Similarly, academic and intelligence items constituting one factor in this study may be a result of intercorrelation of the two domains. It is also possible that respondents in this study assume measures of academic competence indicate intelligence. Factor analysis of the SPPCS scale was only partially predictive of the independence of Neeman and Harter's (2012) original scales as some scales in this study overlap in a minor way.

Research by Hagborg (1994), Freeman et al. (2007), and You et al. (2011) suggest a multidimensional nature of the PSSM scale, meaning that items in the scale group together into observable variables called factors which describe belonging in an underlying way. Because identifying these factors allows researchers to reduce the

number of variables needed to effectively measure belonging in a data set (Hoffman et al., 2002) we performed an exploratory factor analysis, results of which are shown in table A3. During exploratory factor analysis of the PSSM scale, three factors emerged explaining a total of 55% of the variance in participant responses. While the three factors reported by Freeman et al. (Freeman et al., 2007) were described as a) a general sense of belonging, b) teacher support, and c) peer acceptance, the three factors of the PSSM scale in current data were described as a) a sense of involvement ($\alpha = .85$), b) a general sense of belonging ($\alpha = .81$), and c) being treated well ($\alpha = .83$). Unlike in a study by Pittman and Richmond (2007) in which cross-loading of items in the PSSM scale were such that it was determined best to use a single composite score for belonging, no items cross-loaded on more than one factor in this study. Additionally, Cronbach's alpha scores for factors in our study were within the range (.78 - .95) reported by numerous other studies using the PSSM scale (You et al., 2011), therefore the three factors and an overall factor of belonging were used in subsequently described analyses.

Correlational analysis

Most SPPCS items had statistically significant correlations with PSSM factors of belonging (Table A4). Global self-worth, and academic, social, close friendship, and animal science competence were correlated with each of the three PSSM factors identified in this study as well as total belonging ($P < .001$). Most identified correlations, though statistically significant, were low (< .30) except for social competence which was correlated PSSM factor of feeling ($r = .30$, $P < .0005$), and total belonging ($r = .33$, $P < .0005$). Correlations between one's perspective of their social competence and their

belonging in this study are supported by findings of Allen et al. (2018) who conducted a meta-analysis of factors that influence school belonging – they determined relationships, including those with parents, peers, and teachers are strongly linked with one's sense of school belonging. Of all SPPCS subscales, animal science competence had the highest correlations with PSSM belonging factors including feeling involved (r = .39, P < .0005), general belonging (r = .39, P < .0005), treated well (r = .26, P < .0005), and total belonging measured by the PSSM scale (r = .41, P < .0005). This finding supports the hypothesis of this study, and findings from Trede et al. (2012), and Paterson et al. (2002) that there is a relationship between one's view of their professional identity described by Cox and Ewan (1988) as a "self-image which permits feelings of personal adequacy and satisfaction in the performance of the expected role in a community of practice and their sense of belonging in that community."

Regression analyses

Regression analysis of the entire study population indicate that 31% of the variance for students sense of feeling involved was predicted by GPA (positive), social competence, and animal science competence. Students' general sense of belonging accounted for 28% of the variance and was positively predicted by social and animal science competence and negatively predicted by creative competence. Students' sense of being treated well in the department accounted for 19% of the variance and was predicted by the same variables as the aforementioned factor plus having an agriculture background. Total sense of belonging in the TAMU ANSC department, as measured by the PSSM scale, accounted for 31% of the variance and was predicted by having social

($P < .001$) and animal science competence ($P < .001$), lacking creativity competence ($P = .003$), and somewhat by GPA ($P = .081$) and intelligence competence ($P = .081$). Results from analysis by class year were not markedly different from aforementioned findings; the strongest positive predictors of belonging were social and animal science competence and creative competence was a negative predictor within each level. One difference that did emerge across year in school analyses was that GPA strongly predicted ($b = .70$, $t(132) = 3.34$, $= P < .001$) senior students' sense of feeling involved in the TAMU ANSC department. However, interpretation of this finding is limited by the fact that GPAs for freshmen students were not collected.

Regression analysis findings suggest that to feel a sense of belonging in the animal science community of practice is to feel competent in animal science, to demonstrate university-wide academic achievement (represented by GPA and academic competence in this study), to feel satisfied with one's own social skills and ability to make friends, and to not feel competent in creative and inventive abilities. Social and academic ties to belonging have been extensively reported (Freeman et al., 2007; Sari, 2012; St-Amand et al., 2017; Allen et al., 2018), and thus our results do not seem divergent from other study populations.

Educational opportunities in the department should support students' positive social relations (St-Amand et al., 2017) and highlight academic support through teaching strategies that emphasize content mastery (Osterman, 2010). Only one report of a significant relationship with the creativity domain of the SPPCS scale was identified in existing literature; a study of 263 college freshmen from a small liberal arts school in the

southeast of the U.S. reported creative competence as negatively predictive of academic adjustment (Boulter, 2002), which as previously discussed has connections with sense of belonging. Boulter et al. (2002) described the finding as unexpected and potentially due to students in the small, conservative, liberal arts institution with limited resources as unsatisfied with the number of creative outlets available. The university this study was conducted in, though large, is also conservative, emphasizes research and does not have a fine arts department, which could attract students who tend to perceive lacking self-competence in the creative domain.

CHAPTER IV

WRITING AND PEER REVIEW IN A CORE ANIMAL SCIENCE COURSE

Introduction

Writing requires students to critically engage with course material (Lu and Bol, 2007), simultaneously expanding their written communication skills and discipline-specific knowledge (Bangert-Drowns et al., 2004; Newell, 2006; Larson, 2016) — both of which are expected by employers of contemporary animal science graduates (Barry and Orth, 2013). However, writing tasks are seldom emphasized in discipline-specific courses (Vacca, 2002; Cho et al., 2006; Graham and Harris, 2013; Wright et al., 2017). This could be because of the workload, time, or substantial instructional shifts commonly associated with doing so (Akkus et al., 2007a; Bok, 2009; Cho and MacArthur, 2010).

However, Cho and Schunn (2007) describe the feasibility of implementing writing assignments in discipline-specific courses, containing 75 or more students, through the use of peer review. Peer review involves students evaluating each other's work – in doing so they improve the work, and co-construct their own learning (Lu and Bol, 2007). Further, peer review removes the task of providing timely and authentic feedback to a large number of students, from an individual instructor (Sharp et al., 1999), without sacrificing academic improvements associated with feedback (Ramsden, 2003; Plutsky and Wilson, 2004). Anonymous peer review can be facilitated through the use of Peerceptiv (www.peerceptiv.com, Pitsburg, PA), a software platform that has

been shown to positively impact student writing (Cho and Schunn, 2007). This study will investigate the effects of writing practice and peer review, facilitated by Peerceptiv, on animal science students; discipline-specific knowledge and writing abilities in a core animal science course at Texas A&M University.

Methods

Principles of Animal Nutrition (ANSC 303) is a 3-credit, lecture course, that is open to non-majors and required of all students majoring in animal science (ANSC). As a 300-level course, ANSC students are encouraged to take it during their junior year in the department, though some sophomores and seniors enroll each semester. The course is capped at 250 students and is taught by the same professor each semester, who also instructs the honors section of the course which is taught each semester and capped at 35 students per semester.

To test our hypothesis that writing practice and peer-feedback in a core undergraduate ANSC course positively affects students' course content mastery and writing ability, one semester of ANSC 303 was conventionally taught (CON; Fall 2017; n = 130), and one semester of the course was taught with the inclusion of students' writing practice and peer feedback (WPPF; Spring 2018; n = 250). Course content was consistent and similarly taught in both semesters. During the CON semester students' grades came from their performance on 4 exams, evenly dispersed throughout the semester and a cumulative final exam which contained the same short-essay question asked during the WPPF semester. During the WPPF semester, students' grades were compiled from 3 exams and 6 writing responses distributed throughout the semester and

one final exam. The first writing prompt in the WPPF semester asked students about scientific writing and plagiarizing, questions in the subsequent 4 writing prompts reflected course topics in weeks surrounding the prompts and the final prompt, delivered during the final exam, asked students to compare and contrast livestock digestive systems as discussed throughout the semester.

To facilitate disbursement of peer feedback on WPPF students' writing samples, Peerceptiv's data-driven peer assessment software was used with each writing prompt response except the one associated with the final exam. All students in the WPPF course were given the writing assignments and received peer feedback via Peerceptiv. Responses to the final writing prompt by students in the WPPF and CON semesters were assessed using a rubric adapted from Rezaei and Lovorn (2010) and the Texas A&M Writing Center's model rubric (2018). Rubric development (adaptation) was guided by work of Jonsson and Svingby (2007) and Timmerman (2011) and therefore, the final rubric used in this study (Table B1) has detailed descriptors containing examples, is analytic (has 4 levels each with scores), and raters (two) were trained to use it. The rubric used in this study had the following sections to assess student's content mastery: argument, accuracy, and development – point values for each ranged from 0 to 10 points. Point values for the writing ability sections of the rubric also ranged from 0 to 10 points for the areas of organization and clarity, spelling and language, and punctuation and grammar.

Two raters graded all (n = 380) of the written responses without knowing from which semester they came; scores from the two raters were then averaged (Ary et al.,

2018). Combined rater scores were analyzed using SPSS (IBM SPSS Statistics, Armonk, NY). We ran descriptive statistics, and because our sample sizes differed Levene's test for homogeneity was used to confirm that homogeneity of variances was met by our data (Levene, 1960). Given that homogeneity was confirmed we proceeded to analyze data using one-way ANOVA to determine if significant differences between population mean scores on final writing prompts existed.

Results and Discussion

Students written responses from the WPPF semester scored significantly better (μ = 5.09; P = 0.04) on the development section of the rubric than CON students (μ = 4.68). The development section of the rubric assesses the degree to which students' claims or points are developed and supported through explanation. Written responses from the WPPF semester tended (P = 0.06) to perform better on the punctuation portion of the rubric when compared to CON students, with mean scores of 7.60 and 7.34 respectively. Overall writing ability scores, measuring the organization, spelling, and punctuation of students' written responses tended (P = 0.06) to be different between the two groups of students – mean scores for WPPF students was 21.35 out of 30 possible points and mean scores for CON students was 20.60. Similarly, overall rubric scores tended (P = 0.08) to be different between the two groups with WPPF mean scores being 37.98 (out of 60 possible points) and CON students' means being 36.39. In each category measured, WPPF students performed better than CON students suggesting confirmationation of our hypothesis, that writing practice and peer feedback improves students' content mastery and writing abilities.

Results from our study suggest that writing skills and disciplinary knowledge can be developed in-tandem, in agreement with findings from Sherwood and Kovac (1999) and Bangert-Drowns et al. (2004),. These outcomes are particularly important to the animal science discipline as employers of animal science graduates expect individuals' mastery of animal science knowledge and written communication (Robinson and Mulvaney, 2018). Further, the significant improvement of students' development scores is encouraging, as others (Akkus et al., 2007b; Haack, 2011) have described the importance of being able to establish and justify knowledge claims in science communities of practice.

Andrade (2008) asserted that peer feedback, given prior to a final grade, is valuable because it can provide students with formative assessment throughout a learning experience. Results from our study also endorse the feasibility and value of incorporating peer-learning into courses containing more than 100 students and thus support findings from Sharp et al. (1999) declaring that peer review is a useful tool to improve student writing without drastically increasing instructor workloads. When surveying students, Liu et al. (2001) found that 70% of respondents preferred receiving peer feedback on writing assignments. In further support of peer feedback, Andrade and Boulay (2003) said that self-assessments did not improve undergraduate's writing. In summary, teaching strategies such as writing practice in combination with peer review can positively contribute to students' writing abilities and animal science content mastery.

CHAPTER V

CURRICULUM

Overview

To address tightened operating budgets, increasing enrollment, and employer expectations of graduates, the Texas A&M Animal Science Department embarked on an undergraduate curriculum redesign. Efforts were led by a curriculum committee comprised of faculty, advisors, and students from the department along with an academic developer from the university's Center for Teaching Excellence. Their objective was to align the undergraduate curriculum with the knowledge, skills, and values expected of graduates. Data regarding the knowledge, skills and values required of graduates was gathered from 5 department stakeholder groups. Stakeholders (n=289) reported graduate's proficiency in animal science knowledge and transferable skill areas to be less than the reported importance of those same knowledge and skill areas, with a discrepancy (importance minus proficiency; on a 1-4 scale) of -0.22 and -0.56, respectively. This supported the development of 3 disciplinary and 7 transferable skill-based program learning outcomes (PLO). To incorporate all PLO, four new department courses and an internship requirement were developed. Three of the new courses were freshmen-level courses, included to increase student's mastery of foundational knowledge and skills and awareness of animal science career opportunities, prior to progression to advanced courses. An internship requirement was added based on stakeholder's need for graduates to have industry-relevant experience. A senior capstone

course was added to support students' ability to solve industry-relevant problems while demonstrating curriculum content mastery. Survey data supported the incorporation of an existing university accounting course into the animal science curriculum. Upon determination of course sequencing, members of the curriculum committee facilitated incorporation of learning outcomes, and assessments into faculty member's course plan. By fall 2017, course documents were approved by the department, college and university undergraduate curriculum committees, faculty senate, provost, and university president. The redesigned curriculum was implemented in fall 2018. An implementation and assessment team will evaluate the curriculum yearly and adapt the curriculum as required. Though implementation of the process is discussed in the context of a large, research-extensive, university, the process is adaptable to a variety of programs.

Introduction

Animal scientists apply scientific principles to livestock management to produce high-quality animal products in an efficient, safe, and sustainable manner (Schillo, 1997; Powers, 2003; Bureau of Labor Statistics, 2018). Demand for animal scientists in the workforce is driven by a growing human population, increasing scarcity of water, climate change, the development of animal resistance to pests and pathogens and an overall increase in consumption of agricultural products (Bureau of Labor Statistics, 2018). In meeting this demand, individuals in animal science work in a variety of positions. Employment of animal scientists is projected to grow seven percent between 2016 and 2026 (Bureau of Labor Statistics, 2018).

Employment in an animal science profession requires discipline-specific knowledge and skills (Zekeri, 2004; Goecker et al., 2015). Employment in animal science also requires transferable skills (Fallows and Steven, 2000) such as computer fluency, communication, leadership, interpersonal, decision-making, adaptability and critical thinking. Values such as work ethic, honesty, and dependability are equally critical (Robinson and Mulvaney, 2018). It is the role of animal science departments in higher education to prepare students for a contemporary workforce by instilling the requisite knowledge, skills, and values in graduates (Robinson and Garton, 2008; Bureau of Labor Statistics, 2018; Robinson and Mulvaney, 2018). However, advancing curricula has not always been the primary focus of departments of animal science (Kauffman, 1992). Instead, there was greater emphasis on developing and applying research technologies to be used in the field (Schillo and Thompson, 2003; Britt et al., 2008; Buchanan, 2008). For example, technologies to improve farm productivity, producer incomes, and consumer prosperity (Evenson, 2001).

Since the establishment of animal science departments, much of society has changed including student demographics, career opportunities, and the global social, environmental, and economic contexts in which opportunities exist (Buchanan, 1994a; Lyvers Peffer, 2011; Robinson and Mulvaney, 2018). Elements of the contemporary animal science curriculum have yet to adapt to these changes (Meyer, 1993; Buchanan, 1994a; Parrish et al., 2015). Persistent curriculum refinement is especially important to ensure that graduates are prepared in alignment with the modern workforce. Misaligned graduates may jeopardize the long-term future of the animal agriculture industry (Dyer

et al., 2002; Bobeck et al., 2014) and the products it provides to society. Therefore, our objective was to align the undergraduate curriculum with the knowledge, skills, and values expected of graduates.

Materials and Methods

Curriculum revision occurred in the Department of Animal Science at Texas A&M University, a research 1, land grant institution with 54,000 undergraduate students. The department has 1,200 undergraduates, 130 graduate students, 35 faculty and, 38 staff. Undergraduate students may select either the business oriented "production" or science oriented "science" degree plan options.

Redesign was assisted through use of the Program (Re)Design Model (PRD) for Learner-centered Curriculum (Fowler et al., 2015) which was influenced by curriculum development work of Stark and Lattuca (1997), Wolf (2007), and Diamond (2011). The PRD is an evidence-based and learner-centered approach to department-level curriculum design or redesign. Application of the PRD is facilitated by staff at Texas A&M University's Center for Teaching Excellence (CTE). Prior to this project the CTE has more than 10 years of experience in curriculum design during which time they have developed the PRD (Center for Teaching Excellence Texas A&M University, 2019). To date, the process, and participating consultants from the CTE have assisted with curriculum development in 11 academic programs at Texas A&M University (Fowler et al., 2017).

The PRD (Figure C1) is comprised of 8 steps: 1) form and orient team, 2) gather data, 3) create program learning outcomes, 4) create competency rubrics, 5) create

curriculum map, 6) create curriculum materials, 7) implement & assess, and 8) refine (Center for Teaching Excellence Texas A&M University, 2019). Departments can elect to use or not use all PRD steps to meet curriculum evaluation needs and goals. The PRD addresses department or program-level curriculum redesign (as opposed to course or university) because that is the level at which core student learning experiences are frequently designed and implemented (Trowler et al., 2003). Department leadership supported the department's engagement with the process and appointed internal faculty, staff and students to a curriculum study group tasked to accomplish the PRD steps.

Step 1: *Form and Orient the Team*

The Animal Science curriculum committee met every other week from November 2015 to May 2017. Composition of the committee was thoughtfully considered (Brink, 1994) by the department head and included 2 senior undergraduates, 1 masters student, 1 undergraduate academic advisor, 3 assistant professors, 2 associate professors, 1 full professor, and 1 regents professor. Faculty members represented each of the major areas of study in the department, including equine, nutrition, reproduction, breeding and genetics, and meats. The graduate student member, a former undergraduate in the department, was funded by the department to support the curriculum committee's efforts in steps 1-6 of the PRD process per Fowler et at. (2015). Other members included the director of the CTE and a senior consultant from Information Technology Services (ITS). The CTE representative served as an external facilitator and educational consultant providing pedagogical expertise during the process. The ITS representative

was available to ensure curriculum materials developed could be delivered to students via the learning management system available.

During the committee's orientation meeting, members studied the redesign process and signed an IRB approved consent form. Faculty members on the committee (n = 10) investigated departmental motivations for participating in the PRD and personal readiness for change, by completing the CTE-adapted Readiness for Change (RFC) questionnaire (Table C1) (Holt et al., 2007; Jippes et al., 2013). The CTE-adapted questionnaire (Holt et al., 2007; Jippes et al., 2013), aims to determine how ready a department is to engage in the time and effort necessary to complete the redesign process. It also intends to identify gaps in study group member's and the department's buy-in to the change process.

Committee members were also given a copy and summary of "Learner-centered Teaching," by Maryellen Weimer (2002) during the orientation meeting. Learner-centered teaching is a foundational tenet for the curriculum redesign process. As such, the process focuses the curriculum on developing the knowledge, skills, and values needed by graduates of the program today, rather than only adhering to historically existing content.

Step 2: *Gather Data*

Defining the disciplinary purpose: The disciplinary perspective, theories/principles, concepts, and methods required for graduates were defined (Repko, 2008). Committee members developed lists of the scientific and applied principles central to each of the main species and topic areas of study within the department.

Committee members then collaborated with individuals from their respective areas of study to expand these lists. Following this wider discussion, the resulting lists were condensed into 31 scientific and 64 applied principles, which were arranged into 10 categories that were returned to the committee for review. The committee used the condensed list to articulate a disciplinary purpose for the department (Krishnan, 2009). Senior student focus groups: Staff from the CTE hosted 5 focus group discussions with spring 2016 graduating seniors. Instructors of the course were not present during the focus groups. Students were given the option to participate or not participate in questions of their choosing. Instructors were not informed of students' decisions regarding participation. Personal identifying information of focus group participants was not collected.

One facilitator asked the focus group questions (Appendix F) and captured brief notes while another CTE staff member captured in-depth notes. Additionally, researchers made an audio recording of the discussions to ensure that all data was captured. Aggregated focus group data was summarized and presented to curriculum committee.

Stakeholder surveys: In total, 5 surveys (Appendix G) were developed, one for each of the following stakeholder groups: internal faculty, graduating seniors, former students (2010-2015 graduates), faculty at peer departments, and individuals working in the animal science industry. Qualtrics online survey software (qualtrics.com, Seattle, WA) was used for survey distribution.

All surveys began with a description of the purpose and the participant's acknowledgement of consent to participate and allow data to be used for research. A standard participant recruitment email was sent to all stakeholder contacts. The email contained an IRB-approved information sheet explaining the study purpose, risks, costs, benefits, and privacy measures associated with participating, alternatives to participating, and study personnel's contact information. Descriptions of and links to each of the 5 Qualtrics-supported surveys were included in the email – stakeholders were encouraged to respond to the survey identifier that they believed most accurately represented their status at the time of the survey.

Survey's asked respondents to assign a score representative of their perception of the importance of certain knowledge, skills, and values for graduates of the program today as well as respondent's perception of graduate's proficiency in those same areas. Score options for importance were on a 1-4 scale, with 1 being "essential" and 4 being "do not use." Proficiency score options ranged from 1 "ideal level of preparation" to 4 "not prepared."

Peer institutions (14) were selected by the curriculum committee either because their number of undergraduates or focus on livestock production was similar to that of the department at Texas A&M or because they were determined by the curriculum committee to have an admirable reputation in the field. Data regarding peer institutions' degree plan options, and hours, number and type of core and elective courses offered, internships and other high impact opportunities was collected. Study group members analyzed data from surveys, senior student focus groups, and peer institutions, during

two meetings of 1.5 hours each. Findings were used for development of program learning outcomes.

Step 3: *Create Program Learning Outcomes*

The tools used to build the department's program learning outcomes included 1) the department's disciplinary purpose, 2) contemporary knowledge, skills and values described as necessary of graduates from the department, by the internal and external data collected, 3) the university's undergraduate student learning outcomes (Office of the Provost and Executive Vice President Texas A&M University, 2019), and 4) a revised version of Bloom's taxonomy (Anderson et al., 2001). Action verbs from Bloom's revised taxonomy (Anderson et al., 2001) were used to describe the desired levels of student's cognitive thinking for each learning outcome.

Step 4*: Create Competency Rubrics*

Program learning outcomes (PLO) were transformed into rubrics (Table C2), detailing measurement of each outcome (Brookhart and Chen, 2015). Rubrics explained specific, measurable expectations of students' knowledge, values, and skills for each performance indicator. Rubrics for each PLO contained a concise description of the PLO, performance indicators, and four developmental levels for each performance indicator which were 1) developing, 2) proficient, 3) sufficient, and 4) exemplary. Tools used to develop the animal science department's rubrics included data gathered in the process to that point, the university's student learning outcomes, and the Association of American Colleges & Universities' Valid Assessment of Learning in Undergraduate Education (VALUE) rubrics (Rhodes, 2010). Departmental faculty and staff feedback

regarding the content of the PLO rubrics was requested at multiple points throughout the process.

Step 5: *Create Curriculum Map*

A curriculum map matrix (Figure C2) served as a visual aid during the process of ensuring all PLO performance indicators were taught in appropriate courses across the curriculum. The goal was to include all developmental levels (developing, sufficient, proficient, and exemplary) of each PLO performance indicator in the core animal science curriculum. Use of the curriculum map matrix allowed for efficient identification of instances in which performance indicators were not addressed within existing curriculum courses or were misaligned with existing course flow. New courses or program elements were outlined by the committee to address any identified gaps. Department faculty were asked to review and provide feedback on map composition.

Step 6: *Create curriculum materials*

The elements of the final curriculum map provided a basis for development of curriculum materials. These materials included uniformly formatted course guides and syllabi for courses taught in the department, including the 4 new courses and internship established during the process. Course guides were designed to help individuals teaching departmental courses to incorporate the newly articulated PLO performance indicators. Course guides were also intended to support teaching and assessment strategies utilized within courses.

Step 7: *Implement and assess*

By fall 2017, course syllabi and degree plans (Figure C3) were approved by the department, college and university undergraduate curriculum committees, faculty senate, provost, and university president. Implementation of the redesigned curriculum began with (3) new freshmen courses being taught in 2018-2019 (1 in fall and 2 in spring). Elements of the redesigned curriculum, such as learning outcomes, will be assessed as courses are taught.

Step 8: *Refine*

Along with assessment, continual curriculum refinement will begin once all students in the department are experiencing the redesigned curriculum. Program assessment and refinement will be directed by a standing committtee in the department and interwoven with the University's assessment platform.

Results and Discussion

The objective, to align the undergraduate curriculum with the knowledge, skills, and values expected of graduates, was met by the department's completion of the PRD as described in subsequent sections.

Step 1: *Form and Orient the Team*

Wulf and Schave (1984) describe curriculum design as a complicated process that will fail if it does not have consistent leadership, a strong support base, realistic expectations of time and resource needs, and engagement of all faculty in the process. When implementing a curriculum redesign, the Department of Animal Science at the University of Nebraska observed similar needs for their success (Brink, 1994).

Considering these areas, maintaining committee membership and engagement, and in engaging all faculty across the department were the two greatest challenges faced within this PRD.

On average, 9 of the 13 invited and initially committed members attended each meeting between fall 2015 and fall 2016. Three faculty members left the department and study group between fall and spring 2016. The ITS consultant and one of the undergraduate students left the study group in spring of 2016. An assistant professor and a senior undergraduate student from the department joined the group in January of 2017. Of the (7) study group members who taught undergraduates in the department, only 4 remained part of group through to the assessment step.

Consistent turnover of group members required the commitee to circle back to previously addressed tasks at subsequent meetings or to move forward with input coming from a smaller cohort. Diverse travel schedules and 9-month appointments contributed to difficulties in attaining committee participation and faculty input when requested during summers. The department also hired a new head and associate head for academic programs during the redesign process.

However, expectations of time and resources needed to complete the redesign were available to the committee as it was following a process that had been implemented widely and recently across Texas A&M University (Center for Teaching Excellence Texas A&M University, 2019). The time commitment required of committee members was approximately 60 hours per semester. However, incentives and benefits to participating did not match this level of commitment – many members already fulfilled

the service component of their professional appointment through other commitments to the department.

Collaboration with the CTE provided an outside consultant and facilitator. This helped keep the study group moving forward and clarified the intentionality of each step in the process, which was particularly important when progress seemed to stall. Logistic support, including file sharing need for the committee's progress was attempted via the university online LMS (eCampus by Blackboard™). However, members primarily used email attachments and hard-copy materials brought to meetings by the graduate student member.

Like the approach of Brink (1994), the Fowler et al. (2015) process asserts the importance of investigating levels of departmental backing, and strength of the committee as a "support base" before proceeding with the redesign process. Results from the RFC survey (Table C1) suggest that committee members believed there was a need for change, and investigation of that need was worthy of their time, regardless of incentive or leave time given. However, the direction and vision for that change was not yet conceptualized when members of the committee responded to the questionnaire. At the Form and Orient the Team step, the group did not perceive their primary role to bring about a specified change, but rather to investigate the merits and direction of any necessary change. This perception was also evident in the committee's choice to refer to themselves as the "Animal Science Curriculum Study Group" rather than the "Program Redesign Committee." After looking at selected RFC results, each member of the study group was encouraged to self-reflect on their motivations and barriers to engage in a

curriculum change process (Fowler et al., 2015) and to implement any resulting program-level changes. A goal of the RFC survey, reflection exercises, and learner-centered discussions was to set the context for the remainder of the process (Fowler et al., 2015), especially as committee members envisioned creating the department learning environment (Center for Teaching Excellence Texas A&M University, 2019).

The committee struggled with identifying "theories and concepts" in the discipline, an element of defining the discipline portion of the process (Fowler et al., 2017). It is possible that some cognitive dissonance between the given definitions of theories and concepts (Repko, 2008) and the practical use of them in animal science contributed to this difficulty. Faculty and staff in the department instead identified the discipline's scientific and applied principles. From those principles, members articulated the department's purpose statement, to prepare students to "sustainably manage animals, and meat, milk, and fiber production systems for the global benefit of mankind." This purpose statement corresponds with the description of animal scientists provided by the U.S. Bureau of Labor (Bureau of Labor Statistics, 2018).

Step 2: *Gather Data*

As expected (Slusher et al., 2011; Robinson and Mulvaney, 2018), survey responses (n = 289) voiced the importance of graduate's mastery of animal science knowledge (Table C3). Knowledge areas in which each stakeholder group's mean scores for importance was less than 2, indicating an expressed importance, were: basic animal science terminology, animal health, and species-specific terminology. Mean scores of these knowledge areas averaged across all five stakeholder groups were 1.51, 1.80, and

1.87, respectively. These results concurred with Robinson and Mulvaney's study (2018) that used a modified Delphi method, and found that animal science industry experts (100%) agreed that basic animal science knowledge was necessary for students' post-college, entry-level employability.

Though some stakeholder group's mean scores for discipline specific terminology and animal nutrition were greater than 2, the overall averages for these two areas were 1.78. None of the stakeholder groups reported an average importance score for any of the 14 specific animal science knowledge areas of greater than 2.93. Of the 14 knowledge areas measured, the 3 reported by stakeholders as least important, were animal science business models (2.18), genetic selection tools (2.21), and identification of basic meat cuts and qualities (2.50). According to Robinson and Mulvaney's study (2018), the areas regarded by industry experts as least important for graduates to have prior experience were those related to production agriculture, exposure to species other than those core to animal science, and livestock handling.

In comparison, when asked about our graduate's proficiency in the same animal science knowledge areas, all areas had means from at least one stakeholder group greater than 2. Nonetheless, the animal science knowledge areas in which graduates were perceived as most prepared were, identification of different species and breeds (1.89), and basic animal science terminology (1.79). These two were the only knowledge areas out of the 14 investigated in which scores averaged across stakeholders were between "2, well prepared" and "1, ideal level of preparation."

The knowledge areas in which students demonstrated the least proficiency, based on survey results, was animal science business models, which had an average score of 2.6 across all stakeholder groups. Interestingly, findings from Robinson and Mulvaney (2018), Walker et al. (1991), and Buchanan (1994a) advised the importance of animal science graduates' growth in business-related capabilities. Further, when former students (graduation from 2010-2015) were asked, "if you were in charge, what one thing would you change about the existing animal science curriculum at Texas A&M," the most frequent response (n=7) was for the curriculum to have more animal science/general business knowledge. In this study, the knowledge area with the next highest proficiency score (higher scores representing less preparation), was animal science industry context which had an average score of 2.3 across all stakeholder groups.

The three widest discrepancy scores (Table C3), measured as importance minus proficiency; on a 1-4 scale, averaged across all stakeholder groups pertained to the animal science industry context (-0.47), animal health (-0.44), and animal science business models (-0.42) knowledge areas. The only positive, discrepancy scores were those for, identification of different species and breeds (0.02), identification of basic meat cuts and qualities (0.23), and genetics (selection tools, 0.02) knowledge areas. The overall mean discrepancy score, for all animal science knowledge areas reported by stakeholders was -0.22, indicating their perceived gap in student's animal science knowledge.

In addition to disciplinary specific knowledge, literature (Walker et al., 1991; Buchanan, 1994a; Evers et al., 1998; Robinson and Mulvaney, 2018) asserts the

importance of graduates' mastery of transferable skills (Table C4). Therefore, the 5 stakeholder groups were asked about the importance of certain transferable skills, based on the work of Robinson and Garton (2008). The three most important skills and their mean scores across all groups were, problem solving (1.25), verbal communication (1.27), and critical thinking (1.28). Correspondingly, college of agriculture graduates from the University of Missouri, indicated problem-solving skills being important in their post-graduation jobs (Robinson and Garton, 2008). In this study, the least important transferable skill was graphic communication which had a mean score of 1.84 across all stakeholder groups. In contrast to animal science knowledge, mean scores across all stakeholder groups for all transferable skills listed were scored between "essential" and "important."

Three stakeholder groups (external faculty, former students, and industry members) were asked to list skills they considered important for animal science graduates, but that were not included in the transferrable skills. Most frequent mentions across all stakeholders' responses to this question included: business and economic knowledge, curiosity for the discipline/ learning, communication skills (written and verbal), and relevant experience. Robinson and Mulvaney (2018) also reported an employer's desire for graduates to have relevant animal science work experience from internships, full, or part-time jobs before graduation/employability. They also reported the employer's desire, with 100% agreement, for their new hires to have verbal and written communication skills. Overall, they said animal science experts agreed upon 10

areas of necessary competency for entry-level employability, “two were animal science themes, one was a business theme, and seven were leadership/communication themes.” Proficiency scores of graduates’ transferable skills across all stakeholder groups were lowest (representing a greater proficiency) in the areas of computer literacy (1.80), working collaboratively (1.90), and ethical decision making (1.92). Robinson and Mulvaney (2018) stated that animal science experts considered computer skills, and honesty as essential for individuals hired into entry-level animal science positions. Stakeholders reported our students were least proficient in the areas of quantitative/analytical skills (2.32), safe animal handling (2.31), and general business skills (2.31).

The three widest mean discrepancy scores for transferable skills (Table C4), measured as importance minus proficiency, were in problem solving (-0.91), critical thinking (-0.90), and written communication (-0.79) skills. All discrepancy scores for transferable skills were negative, indicating stakeholder’s perception that the importance of these skills was greater than their perceived proficiency of our graduates. The overall mean discrepancy score for all transferable skills reported by stakeholders was -0.56.

The overall mean score for importance of measured animal science knowledge areas was 1.91, while the same score for transferable skills was 1.56. Similarly, Robinson and Mulvaney (2018) stated that animal science employers “are more concerned with students’ non-technical skill acquisition than their technical skill competence.” Overall mean scores for perceived proficiency of graduate’s animal science knowledge was 2.13, while the same score for their proficiency of transferable

skills was 2.11. In studies across numerous industries, including animal science, employers have reported graduates to be less prepared in transferable skills when compared to technical aspects of their disciplines (Evers et al., 1998; Robinson and Garton, 2008). Yet, when discussing the employability of agriculture graduates (Robinson et al., 2007), employers reported mastery of transferable skills as more important than mastery of "disciplinary knowledge and technical skills" which is in agreement with this study.

Step 3: *Create Program Learning Outcomes*

Similarly to Jarvis et al. (2012), and Fowler et al. (2016), data from the first two steps in the redesign process were used to inform the curriculum developed in the remaining steps. First, the curriculum committee created PLO (Table C5). Recognizing that graduates need to exhibit discipline-specific skills (Zekeri, 2004; Robinson and Mulvaney, 2018), and values (Schillo, 1997) to secure employment in animal-agriculture jobs, three disciplinary-specific PLO were developed. They were based on the three pillars of sustainability (economic, social, environmental) – important areas in which the discipline operates and serves society (Buchanan, 1994a; Powers, 2003). The other 7 program learning outcomes encompass Texas A&M University's learning outcomes for undergraduates (Office of the Provost and Executive Vice President Texas A&M University, 2019) and knowledge, skills and/or values consistently iterated as important in stakeholder data.

When compared to the development of the discipline-specific outcomes, the curriculum committee struggled with the development of the transferable

knowledge/skill/value outcomes. Common brainstorming statements included, “how will we teach this?” and, “how will we assess students’ learning in these areas?” Robinson and Garton (2008) and Schillo (1997) stated that incorporating non-disciplinary or transferable knowledge, skills and values is challenging and lacking in animal science departments. However, inclusion of transferable knowledge, skills, and values in animal science curricula is crucial to preparing graduates for careers (Robinson and Mulvaney, 2018; Robinson and Garton, (2008) Evers et al., (1998). Dunne and Rowlins (2000) postulated that transferable skills are weakly demonstrated by graduates because they fail to see the importance of transferrable skills, especially when in comparison to technical skills. The importance of transferable skills will be addressed via extensive incorporation of transferrable skills in PLO and future communication to students, (e.g. syllabi).

Step 4: *Create Competency Rubrics*

Program learning outcomes evolved into competency rubrics (Table C2), meaning that each PLO was broken into performance descriptors that increased in expectation across 4 developmental levels. In total, 160 unique descriptors or learning goals were developed. In comparison, a curriculum redesign in the Animal Science Department at Nebraska University described identification of 263 learning goals (Brink, 1994). Though rubrics were written such that the “sufficient” developmental level should be the minimum level acceptable for a student’s graduation eligibility, feasibility of this will need to be determined with future program assessment. Rubrics and learning outcomes will need to be regularly revised based on assessments of student performance.

Step 5: *Create Curriculum Map*

Each of the 160 learning goals were incorporated in the animal science core courses. This will enable the department to ensure all students, regardless of production or science degree plan, or of electives chosen would experience each learning goal. Another reason all learning goals were housed in the department's core courses was to allow for assessment of those learning goals. However, some learning goals, particularly those pertaining to transferable skills, are included in university core courses, but no structure for assessing those courses currently exists. To incorporate all learning goals, 4 new courses and an internship requirement were added to the animal science core curriculum. The new courses included three new freshmen courses and a senior capstone course.

Each curriculum change filled learning gaps identified during data collection (step 2) and curriculum mapping (step 5). To scaffold student's learning across the curriculum (Stark and Lattuca, 1997), lower level learning goals need to be mastered in introductory level (100) courses. Prior to the redesign process, the department only had one, 3-hour 100 level lecture/lab course. Therefore, a 1-h freshmen seminar course, "ANSC 101, Introductory Seminar for Animal Science" was added to expose students to animal science career opportunities during their first semester, and to familiarize them with university processes and career assistance resources. A 2-h 100-level anatomy and physiology course, "Farm Animal Biosystems" was added to increase student's foundational knowledge regarding the processes by which networks of cells are controlled and coordinated within the farm animal. This course was included so that

300-level courses such as reproduction and nutrition could build on this knowledge. A 3-h, 100-level lecture/lab course, “Animal Science Production Systems”, was created to increase students’ knowledge and skills related to industry context. In the redesigned curriculum, students must complete lower-level pre-requisite courses before progressing through the degree plan, the intention of this being to foster more advanced learning opportunities in higher-level courses.

Stakeholder data and other data in literature (Powers, 2003; Robinson and Garton, 2008; Goecker et al., 2015; Robinson and Mulvaney, 2018) supported the need for an internship requirement to increase a students’ relevant workplace experience prior to graduation. For students to receive credit for the requirement, internships will need to be approved by a faculty member prior to the student’s participation. Student’s will submit a report that must also be approved for credit after the completion of their internship.

To address problem-solving, communication, and critical thinking skill expectations made evident in stakeholder data, a 4 h senior capstone course was created. The capstone course will be a culmination of student’s learning in the department and as such it will require their demonstration of 7 PLO areas including animal management strategies, evaluation of socially responsible techniques to produce animal products, utilization of animal production systems to sustain economic resources, critical thinking, effective communication, lifelong learning, and integrated learning.

Stakeholder data demonstrated the need to increase a student’s business knowledge and skills. Therefore, a business course (accounting 210), taught outside of

the department to non-business majors, was added to the production focused degree plan. The added accounting course (210) is application focused and should facilitate student's mastery of applied animal science principles that were identified during steps 1 and 2 of the process.

Step 6: *Create curriculum materials*

Course guides were intended to assist instructors' incorporation of the redesigned curriculum's learning goals into their courses. However, the curriculum study group arrived at this step during the summer months, which made it difficult to meet with faculty members in person to discuss/ design their course guides. In an effort to address this, the committee chair developed an instructional video that was sent to instructors along with their customized course guides, partially completed by the graduate student member of the committee. Though many course guides were completed in this approach, instructor buy-in and clarity was increased through in-person meetings and discussions. Using completed course guides and a standard syllabus template, the graduate student member completed a syllabus for each of the core animal science courses. Learning goals were included in the syllabi as a means to increase communication of their learning expectations to students.

Step 7: *Implement and assess*

Similar to the aforementioned development steps, implementation of the redesigned curriculum, was focused on developing the evidence-based knowledge, skills, and values required of graduates. In addition to an aligned curriculum, participation in the PRD process has increased discussion of teaching and learning by

faculty. Standardized departmental syllabi containing current relevant program and course-level outcomes were available to students at or before the first meeting of each course.

The redesign required a strict adherence to the redesigned department's curriculum sequencing. However, that does not make it unlike professional degrees which our graduates may later obtain such as a DVM or MBA. Future considerations to be addressed include how and in what courses to incorporate transfer students, and efficacy of the student learning goals as they are incorporated at the course level. Fall 2018 enrollments were the first to experience the new curriculum approved by the university in 2017.

Step 8: *Refine*

Discussion regarding selection of curriculum assessment and refinement methodology has been initiated by the undergraduate curriculum assessment committee, a standing committtee in the department. The committee will apply chosen methodology when the entire redesigned curriculum is being taught in 2021.

Overall, the curriculum committee's actions and intentions while engaging in the Fowler et al. (2015) curriculum redesign process can be described by curriculum theorist Joseph Schwab (1983):

> Curriculum is "what is successfully conveyed. By committed teachers. Using appropriate materials and methods. Of legitimated matters. Which are chosen *via* serious reflection on alternatives. By those involved in the teaching of a

specifiable and known group of students. Who will differ from time to time and place to place.

CHAPTER VI

CONCLUSIONS

To achieve significant learning, animal science scholars must demonstrate in-depth, personal identification with the structure, purpose, and epistemology of their discipline (Fink, 2014). This depth requires educators who facilitate students' scientific curiosity and inquiry, information synthesis and critical thinking in the classroom (Perry et al., 2014; Goecker et al., 2015). It also requires a critical evaluation of the modern animal science discipline – one in the balance of its origins and role in modern society (Meyer, 1993). Although identifying appropriate educational goals of the animal science curriculum is challenging (Schillo, 1996), continuously studying and improving the animal science undergraduate curriculum's purpose and methodology is a worthy cause (Buchanan, 1994). Especially since not doing so jeopardizes the long-term future of the agriculture industry (Dyer, 2002) and the products it provides to society.

Motivated by the aforementioned concepts, research described in this document aimed to develop a holistic view of teaching and learning in the animal science discipline at a research 1 university in the U.S. At the student level, by looking at connections between students' sense of self and sense of belonging in the animal science department. Results described students' perceived social, academic and animal science competence and lacking creative abilities as being predictive of their sense of belonging in the animal science discipline, a proxy for the greater community of practice. Survey responses from stakeholders of the animal science department confirmed that

expectations of today's animal science graduates include their animal science knowledge, skills, values, attitudes and relevant workplace experience.

In response to these findings, the undergraduate animal science degree program was redesigned. The redesigned program incorporates discipline-specific and transferable skill-based program learning outcomes. Additionally, the redesigned curriculum includes program-level means to support students' social competence, for example through 3 additional courses being required during students' first year in the department. Trede (2012) describes how informal student cohorts develop when students' progress through courses together, which in turn supports social interactions that build students' sense of belonging.

Trede (2012) also asserted that course objectives can simultaneously teach discipline's epistemic frames and build students' sense of belonging to that disciplines' community or practice – that the two outcomes are mutually inclusive. As an initial investigation into the efficacy of this approach at a large university, in which core courses regularly enroll more that 150 students, the effects of writing practice and peer feedback on students' content mastery and writing abilities were studied. Results from this investigation suggest that it is a feasible means to teach discipline-based knowledge and skills.

Further research is needed to determine the influence of in-course peer feedback on students' sense of belonging, given that research has reported engagement with peers as contributing to individuals' sense of belonging (St-Amand et al., 2017; Allen et al., 2018). Additionally, inquiry (Morrow and Ackermann, 2012; Yeager et al., 2013; Estepp

and Roberts, 2015) suggests that teachers, and teaching strategies can positively impact student's sense of belonging which impact's students' academic motivation and persistence through a program (Hausmann et al., 2007; Osterman, 2010; Morrow and Ackermann, 2012). A study investigating the effects of sense of belonging interventions on student's academic motivation and persistence to a discipline-related community of practice would be valuable to the sustainability of the animal science discipline.

Continued discipline-based educational research can address above-mentioned unknowns (Association of American Universities, 2011). Recognition of discipline-based research began to emerge in the 1980's and 90's, beginning with the areas of physics, chemistry, engineering, biology, the geosciences, and astronomy, as seen in statements from their professional societies, journals, and in graduate and postdoctoral opportunities (National Research Council, 2012). The greatest strength of discipline-based educational research has been described as,

> "…its contribution of deep disciplinary knowledge to questions of teaching and learning. This knowledge has the potential to guide research that is focused on the most important concepts in a discipline and offers a framework for interpreting findings about students' learning and understanding in a discipline. In these ways, even as an emerging field of study [discipline-based educational research] has deepened the collective understanding of undergraduate learning in the sciences and engineering National Research Council, 2012)."

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APPENDIX A

CHAPTER III TABLES

Table A1. Descriptive statistics by year in school.

	Freshmen n = 202		Sophomore n = 61		Junior n = 90		Senior n = 184	
Variable	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
GPA	-	-	3.41	0.48	3.26 $_{a}$	0.46	3.28 $_{a}$	0.42
Age	18.26$_{a}$	0.47	19.48$_{a}$	1.91	20.32 $_{a}$	1.82	21.77 $_{a}$	1.56
SPPCS Scale								
Global Self Worth	2.86 $_{ab}$	0.64	2.98$_{ab}$	0.50	3.02$_{a}$	0.58	2.76$_{b}$	0.65
Academic	2.48 $_{a}$	0.55	2.69 $_{a}$	0.56	2.68 $_{a}$	0.58	2.54 $_{a}$	0.55
Social Competence	2.80 $_{a}$	0.71	2.95 $_{a}$	0.61	2.77 $_{a}$	0.75	2.70 $_{a}$	0.69
Creativity	2.56 $_{a}$	0.49	2.42 $_{a}$	0.71	2.51 $_{a}$	0.50	2.52 $_{a}$	0.51
Appearance	2.77 $_{a}$	0.63	2.86 $_{a}$	0.53	2.92 $_{a}$	0.68	2.74 $_{a}$	0.62
Work Competence	3.10 $_{a}$	0.58	3.35 $_{a}$	0.59	3.38 $_{a}$	0.45	3.13 $_{a}$	0.62
Close Friendship	2.92 $_{a}$	0.79	3.16 $_{a}$	0.47	2.96 $_{a}$	0.80	2.86 $_{a}$	0.79
Maturity	2.94 $_{a}$	0.65	3.02 $_{a}$	0.79	3.00 $_{a}$	0.59	2.97 $_{a}$	0.59
Morality	3.16 $_{a}$	0.56	3.14 $_{a}$	0.55	3.12 $_{a}$	0.63	3.04 $_{a}$	0.68
Humor	3.16 $_{ab}$	0.59	3.32$_{a}$	0.57	3.29$_{a}$	0.55	3.07$_{b}$	0.59
Intelligence	2.71 $_{a}$	0.49	2.81 $_{a}$	0.54	2.77 $_{a}$	0.55	2.68 $_{a}$	0.52
Health Competence	2.48 $_{a}$	0.49	2.66 $_{a}$	0.56	2.53$_{a}$	0.47	2.47 $_{a}$	0.53
Openness	3.17 $_{a}$	0.66	3.18$_{ab}$	0.60	3.31$_{a}$	0.57	2.96$_{b}$	0.69
Stress Management	2.39 $_{a}$	0.71	2.47 $_{a}$	0.72	2.43 $_{a}$	0.65	2.51 $_{a}$	0.67
Animal Science	2.66 $_{a}$	0.68	2.69 $_{a}$	0.70	2.67 $_{a}$	0.67	2.50 $_{a}$	0.63
PSSM Scale								
Feel Involved	2.93 $_{a}$	0.81	3.23 $_{a}$	0.95	2.88 $_{a}$	0.73	3.04 $_{a}$	0.91
General Belonging	3.75 $_{a}$	0.49	3.80 $_{a}$	0.69	3.78 $_{a}$	0.47	3.65 $_{a}$	0.56
Treated Well	4.02 $_{a}$	0.76	4.14 $_{a}$	0.69	3.93 $_{a}$	0.67	4.03 $_{a}$	0.80
Total PSSM Score	3.51 $_{a}$	0.59	3.67 $_{a}$	0.61	3.47 $_{a}$	0.50	3.53 $_{a}$	0.67

Different letters indicate statistically significant differences at $p < .05$
M = mean
SD = standard deviation

Table A2. Factor analysis of Self-perception Profile for College Students

Item[1]	Factor loading[2]								
	Factor 1 Work & Health	Factor 2 Social & Close Friend	Factor 3 Morality	Factor 4 Stress Management	Factor 5 Animal Science	Factor 6 Academic & Intelligence	Factor 7 Appearance	Factor 8 Creative	Factor 9 Openness
Work 1	**0.68**	-0.02	-0.07	0.09	0.02	0.05	0.03	-0.12	0.13
Work 2	**0.82**	-0.08	0.07	0.04	-0.09	0.08	0.14	-0.04	-0.04
Work 3	**0.03**	0.04	0.21	0.02	0.09	0.14	0.09	-0.01	0.04
Work 4	**0.05**	0.01	0.34	-0.01	0.04	0.17	0.23	0.14	-0.36
Health 1	**0.41**	-0.03	0.04	-0.07	-0.02	0.00	0.13	-0.38	-0.10
Health 2	**0.01**	-0.06	0.02	0.08	-0.01	0.10	0.02	0.09	-0.03
Health 3	**0.27**	0.04	-0.05	0.12	-0.11	0.04	0.55	0.09	-0.09
Health 4	0.08	-0.20	0.70	-0.10	-0.14	0.00	-0.25	-0.14	-0.14
Social	0.58	**0.32**	-0.07	0.11	-0.03	0.17	0.14	0.09	-0.15
Social	0.46	**0.45**	-0.08	0.29	-0.01	0.02	0.19	0.13	-0.05
Social	-0.04	**0.73**	0.03	0.22	0.06	0.04	0.11	0.10	-0.02
Social	-0.03	**0.45**	0.10	0.13	0.07	-0.01	0.14	0.34	0.00
Close Friend	0.02	**0.52**	0.02	-0.04	0.17	0.23	0.14	-0.36	0.18
Close Friend	0.70	**0.64**	-0.04	-0.03	-0.04	0.17	0.05	-0.07	-0.07
Close Friend	0.55	**0.66**	-0.10	-0.07	-0.05	0.15	0.07	-0.06	-0.05
Close Friend	0.00	**0.86**	0.03	0.02	-0.01	0.06	0.04	-0.02	0.03
Morality	0.63	0.03	**0.40**	0.03	-0.06	0.11	0.06	0.07	-0.06
Morality	0.03	0.01	**0.59**	-0.03	0.00	0.08	0.12	0.06	-0.03
Morality	0.63	0.00	**0.38**	0.02	0.00	0.05	0.02	0.01	0.02
Morality	0.03	-0.01	**0.64**	-0.01	0.05	0.07	0.08	0.01	0.07
Stress	0.24	0.01	-0.05	**0.72**	-0.10	0.17	0.06	-0.03	0.10
Stress	0.04	0.13	0.17	**0.34**	0.11	-0.02	0.03	0.12	0.00
Stress	0.01	0.16	0.13	**0.54**	0.15	0.04	0.00	-0.01	-0.01
Stress	0.03	0.05	-0.01	**0.75**	0.03	0.07	0.03	0.03	0.05
ANSC	0.09	0.14	-0.01	-0.07	**0.08**	0.23	0.16	0.09	0.03
ANSC	-0.06	-0.03	0.10	-0.01	**0.67**	0.16	0.04	-0.01	0.01
ANSC	0.11	0.13	0.07	0.09	**1.06**	0.00	-0.03	0.02	-0.20
ANSC	0.53	0.01	-0.05	0.11	**0.26**	0.32	-0.01	0.05	-0.06
Academic	-0.08	00.09	0.04	- 0.02	0.06	**0.38**	0.01	-0.12	0.06
Academic	0.32	0.03	0.02	0.07	-0.07	**0.47**	0.13	-0.09	-0.04
Academic	-0.06	0.10	0.26	0.02	0.10	**0.54**	0.08	-0.09	0.06
Academic	0.37	-0.01	0.06	0.10	-0.03	**0.48**	0.01	-0.06	0.05
Intelligence	0.18	0.01	-0.04	0.09	-0.04	**0.51**	0.04	0.08	-0.06
Intelligence	0.30	0.04	-0.05	0.04	-0.07	**0.45**	0.02	0.05	-0.08
Intelligence	-0.04	0.07	0.09	0.01	0.14	**0.40**	-0.02	0.13	0.07
Intelligence	-0.05	0.06	0.09	-0.02	0.12	**0.44**	0.03	0.17	0.10
Appearance	0.65	-0.02	0.13	-0.08	0.05	0.04	**0.55**	-0.10	-0.01
Appearance	0.03	0.07	0.15	0.00	0.06	-0.04	**0.68**	-0.07	0.15
Appearance	-0.07	0.15	0.06	0.05	0.03	0.14	**0.43**	0.06	0.05
Appearance	0.38	0.10	-0.02	0.06	0.00	0.11	**0.41**	0.05	-0.05
Creative	0.33	0.03	0.01	-0.02	0.00	0.12	0.02	**0.42**	0.02
Creative	-0.01	-0.05	0.04	0.17	0.12	0.03	-0.01	**0.25**	0.05
Creative	0.05	0.00	-0.01	-0.05	-0.02	0.10	0.06	**0.55**	0.03
Creative	0.00	0.09	0.21	-0.02	0.09	0.14	0.04	**0.15**	0.08
Openness	0.02	0.04	0.12	0.04	-0.09	-0.01	0.11	0.00	**0.57**
Openness	0.70	-0.06	0.07	-0.08	-0.08	0.04	-0.08	0.04	**0.41**
Openness	0.63	-0.11	0.03	-0.14	-0.08	0.05	-0.14	0.05	**0.57**
Openness	0.01	-0.03	0.05	0.09	-0.02	0.08	0.00	0.04	**0.52**
Eigenvalue	8.40	3.65	2.67	2.11	1.85	1.67	1.49	1.41	1.28
Percentage variance	18.74	8.14	5.95	4.70	4.12	3.72	3.31	3.14	2.85
Reliability, α	0.36	0.76	0.74	0.72	0.57	0.68	0.71	0.55	0.74

[1]Items in the Self-perception Profile for College Students scale adapted for this study
[2]Factor loadings of Self-perception Profile for College Students items, determined using varimax rotation
Bolded numbers in a column identify items that loaded in that factor
α = Cronbach's alpha

Table A3. Factor Analysis of Psychological Sense of School Membership

Item[1]	Factor loading[2]		
	Feel involved	General belonging	Treated well
I feel like a real part of Texas A&M Animal Science Department.	0.64		
People here notice when I'm good at something.	0.80		
It is hard for people like me to be accepted here.		-0.77	
Other students in this department take my opinions seriously.	0.50		
Most teachers in this department are interested in me.	0.70		
Sometimes I feel as if I don't belong here.		-0.70	
There's at least one teacher or other adult in this department I can talk to if I have a problem.	0.68		
People in this department are friendly to me.			0.75
Teachers here are not interested in people like me.		-0.41	
I am included in lots of activities within the department.	0.60		
I am treated with as much respect as other students.			0.75
I feel very different from most other students here.		-0.80	
I can really be myself in this department.		0.53	
The teachers here respect me.			0.78
People here know I can do good work.	0.74		
I wish I were in a different department.		-0.54	
I feel proud of belonging to TAMU ANSC department.			0.52
Other students here like me the way I am.			0.45
Eigenvalue	7.59	1.58	1.16
Percentage variance	42.14	8.78	6.47
Reliability; α	0.85	0.81	0.83

[1]Items in the Psychological Sense of School Membership scale adapted for this study
[2]Factor loadings of Psychological Sense of School Membership items, determined using exploratory factor analysis
α = Cronbach's alpha

Table A4. Correlations between Self-perception Profile for College Students subscales and Psychological Sense of School Membership factors and total belonging.

Item[1]	Feel involved[2]	General belonging[2]	Treated well[2]	Total belonging[2]
Self-Worth	0.23**	0.26**	0.27**	0.29**
Academic Competence	0.22**	0.13**	0.17**	0.21**
Social Competence	0.30**	0.27**	0.25**	0.33**
Creative Competence	0.10*	-0.07	0.06	0.06
Appearance Competence	0.13*	0.16**	0.24**	0.20**
Work competence	0.10*	0.11*	0.14*	0.13*
Close Friendship Competence	0.24**	0.21**	0.23**	0.27**
Maturity Competence	0.13*	0.02	0.11*	0.11*
Morality Competence	0.05	0.08*	0.16**	0.10*
Humor Competence	0.06	0.11*	0.14*	0.11*
Intelligence Competence	0.23**	0.41*	0.15**	0.22**
Health Competence	0.04	0.08	0.10*	0.08
Openness Competence	-0.08	-0.08	0.04	-0.05
Stress Management Competence	0.13*	0.12*	0.13*	0.15**
Animal Science Competence	0.39**	0.39**	0.26**	0.41**

[1]Items in the SPPCS scale used in this study
[2] Items in the PSSM scale used in this study
N = 559
* $p < .05$ ** $p < .001$

Table A5. Links between competence scores on Self-perception Profile for College Students instrument and Psychological Sense of School Membership factors.

Item[1]	Feel involved[2]	General Belonging[2]	Treated well[2]	Total belonging[2]
Sex	0.08	-0.04	0.12	0.05
Z - Age[3]	0.12	-0.04	0.09	0.06
GPA	0.36*	0.03	0.08	0.17
Transfer	-0.17	-0.01	-0.10	-0.09
Agricultural Background	0.19	-0.01	0.25*	0.14
Animal Science Option	0.06	0.03	0.14	0.07
Academic	-0.09	-0.05	-0.08	-0.07
Social	0.35**	0.18**	0.25*	0.27**
Creative	-0.16	-0.29**	-0.25*	-0.23*
Appearance	-0.03	0.05	0.11	0.04
Work	-0.03	-0.04	-0.06	-0.04
Close Friendships	0.00	-0.05	-0.04	-0.03
Maturity	0.06	-0.01	-0.05	0.00
Morality	0.07	0.01	0.13	0.07
Humor	-0.12	-0.02	0.01	-0.05
Intelligence	0.23	0.10	0.10	0.15
Health	-0.05	0.03	0.03	0.00
Openness	-0.11	-0.04	-0.05	-0.07
Stress Management	-0.03	0.02	0.03	0.00
Animal Science	0.51**	0.30**	0.29**	0.38**
Self-Worth	-0.08	0.00	0.10	-0.01
F	5.49**	4.76**	2.94**	5.41**
R	0.56	0.53	0.44	0.55
R_2	0.31	0.28	0.19	0.31

[1]Items in the Self-perception Profile for College Students scale used in this study

[2] Items in the Psychological Sense of School Membership scale used in this study

[3] Z-scores of age were calculated to remove outliers from the population, this impacted 6 people in the population

F = F-test of overall significance

R = multiple correlation coefficient; R_2 = multiple coefficient of determination

* $p < .05$ ** $p < .001$

Table A6. Links between freshmen students' competence scores on Self-perception Profile for College Students instrument and Psychological Sense of School Membership factors

Item[1]	Feel involved[2]	General Belonging[2]	Treated well[2]	Total belonging[2]
Sex	0.11	-0.09	0.05	0.02
Z – Age[3]	0.10*	-0.03	0.04	0.04
Transfer	-0.15	0.00	-0.09	-0.08
Agricultural Background	0.09	-0.07	0.19*	0.06
Animal Science Option	0.03	0.02	0.11	0.05
Academic	0.11	-0.01	0.04	0.05
Social	0.25**	0.13*	0.11	0.17**
Creative	-0.04	-0.18**	-0.09	-0.10
Appearance	-0.01	0.03	0.15*	0.05
Work	-0.06	0.01	-0.03	-0.03
Close Friendships	0.03	0.01	0.05	0.02
Maturity	0.09	0.00	0.00	0.04
Morality	-0.01	-0.04	0.07	0.00
Humor	-0.10	-0.04	-0.04	-0.06
Intelligence	0.09	0.03	-0.04	0.04
Health	-0.04	0.01	-0.01	-0.02
Openness	-0.07	-0.03	0.01	-0.03
Stress Management	-0.07	0.02	0.01	-0.02
Animal Science	0.45**	0.23**	0.27**	0.33**
Self-Worth	0.07	0.10*	0.12	0.09
F	8.10**	7.98**	4.72**	8.68**
R	0.51	0.50	0.41	0.52
R_2	0.26	0.25	0.17	0.27

[1]Items in the Self-perception Profile for College Students scale used in this study
[2] Items in the Psychological Sense of School Membership scale used in this study
[3] Z-scores of age were calculated to remove outliers from the population, this impacted 6 people in the population
F = F-test of overall significance
R = multiple correlation coefficient
R_2 = multiple coefficient of determination
* $p < .05$ ** $p < .001$

Table A7. Links between sophomore and junior (combined) students' competence scores on Self-perception Profile for College Students instrument and Psychological Sense of School Membership factors

Item[1]	Feel involved[2]	General Belonging[2]	Treated well[2]	Total belonging[2]
Sex	0.25	-0.01	0.26	0.15
Z - Age[3]	0.07	-0.04	-0.07	0.00
GPA	-0.05	-0.21	-0.29	-0.17
Transfer	-0.16	0.18	-0.01	-0.01
Agricultural Background	0.15	0.02	0.16	0.11
Animal Science Option	0.06	-0.01	0.00	0.02
Academic	-0.07	-0.07	-0.15	-0.09
Social	0.28*	0.09	0.16	0.19
Creative	-0.24	-0.23*	-0.16	-0.22
Appearance	-0.03	0.07	0.08	0.04
Work	-0.09	-0.03	0.04	-0.04
Close Friendships	0.01	0.07	-0.01	0.03
Maturity	0.08	0.00	-0.16	-0.01
Morality	-0.01	-0.02	0.18	0.04
Humor	-0.03	0.07	0.14	0.05
Intelligence	0.27	0.08	0.12	0.17
Health	0.19	0.23*	0.34*	0.25
Openness	-0.13	-0.08	0.04	-0.07
Stress Management	-0.09	-0.07	-0.11	-0.09
Animal Science	0.59**	0.28**	0.33**	0.41**
Self-Worth	0.02	0.01	0.13	0.05
F	3.59	3.24	2.78	4.11
R	0.65	0.63	0.60	0.67
R_2	0.42	0.40	0.36	0.45

[1]Items in the Self-perception Profile for College Students scale used in this study

[2] Items in the Psychological Sense of School Membership scale used in this study

[3] Z-scores of age were calculated to remove outliers from the population, this impacted 6 people in the population

F = F-test of overall significance

R = multiple correlation coefficient; R_2 = multiple coefficient of determination

* $p < .05$ ** $p < .001$

Table A8. Links between senior students' competence scores on Self-perception Profile for College Students instrument and Psychological Sense of School Membership factors

Item[1]	Feel involved[2]	General Belonging[2]	Treated well[2]	Total belonging[2]
Sex	-0.01	-0.03	0.06	0.00
Z - Age[3]	0.13	-0.07	0.06	0.04
GPA	0.70**	0.25*	0.38*	0.46*
Transfer	-0.12	-0.10	-0.09	-0.10
Agricultural Background	0.25	0.00	0.36*	0.20
Animal Science Option	0.12	0.11	0.31	0.17
Academic	-0.10	-0.03	-0.05	-0.06
Social	0.34*	0.19*	0.35*	0.29*
Creative	-0.12	-0.34**	-0.43*	-0.28*
Appearance	-0.07	0.09	0.12	0.04
Work	0.11	-0.02	0.06	0.06
Close Friendships	0.05	-0.12	-0.04	-0.03
Maturity	0.04	-0.03	0.01	0.01
Morality	0.07	0.00	-0.02	0.02
Humor	-0.21	-0.07	-0.08	-0.13
Intelligence	0.20	0.10	0.09	0.14
Health	-0.23*	-0.11	-0.13	-0.16
Openness	-0.07	0.01	-0.01	-0.03
Stress Management	0.01	0.07	0.15	0.07
Animal Science	0.46*	0.32**	0.20	0.34*
Self-Worth	-0.05	0.03	0.07	0.01
F	2.86**	3.30**	2.13*	3.16**
R	0.56	0.59	0.50	0.58
R_2	0.31	0.34	0.25	0.33

[1]Items in the Self-perception Profile for College Students scale used in this study

[2] Items in the Psychological Sense of School Membership scale used in this study

[3] Z-scores of age were calculated to remove outliers from the population, this impacted 6 people in the population

F = F-test of overall significance;

R = multiple correlation coefficient

R_2 = multiple coefficient of determination

* $p < .05$ ** $p < .001$

APPENDIX B

CHAPTER IV TABLES

Table B1. Rubric to assess student learning in a core animal science course.

	Content: 30				**Mechanics: 30**	
	Argument (10)	**Accuracy (10)**	**Development (10)**	**Organization & clarity (10)**	**Spelling and language (10)**	**Punctuation & grammar (10)**
Poor 0-2	Apparent misunderstanding of material. Lack of confidence with subject matter which leads to unconvincing argument	At least one, and some more, major facts are incorrect. Facts are correct but taken out of context so they are distorted. Facts are irrelevant to the argument or thesis.	Many of the points are inadequately unexplained or unsupported, or explanation or support is not present	There is no clear purpose. Response lacks logical progression of ideas. Response addresses topic but loses focus by including irrelevant ideas. Ideas are unclear and/or not well-developed	**E**rrors occur frequently and mar the reader's comprehension. The writer has not proofread. Improper language and errors in usage are frequent and mar the reader's comprehension	Punctuation and grammar errors occur frequently and mar the reader's comprehension. Reading is frequently interrupted by error. The writer has not proofread
Fair 3-5	Limited understanding of material displayed by vague, unclear language. Some confidence with material. Does not present a convincing argument	All major facts are correct but may be missing crucial contextual information or be tangential to the argument or thesis	Most points or claims are adequately explained and supported but with minimal detail. Some minor points may be left unexplained or unsupported	Attempts to communicate the purpose throughout. Response is focused on topic and includes few loosely related ideas	A few minor spelling errors but not enough to impede the reader's comprehension. Language is sometimes wrong, or too formal or informal for the audience and genre, but this does not impede comprehension	Punctuation and grammar errors may occur but are few; while they occasionally distract the reader and cause less fluency, they do not detract from comprehension
Good 6-8	Developing understanding of material. Confidence with most material, thus presenting fragmented argument	All facts are correct and complete and mostly complement the argument or reinforce the thesis	All important points or claims are adequately explained and supported with some extra detail	Generally maintains purpose. Response includes logical progression of ideas aided by clear transitions. Response is focused on the topic and includes relevant ideas	One or two spelling errors, but not of the type to make meaning obscure, and not of basic or common words. Language is in accordance with edited American English and sounds appropriate for the audience and gene. There may be a few clichés included, but they are used correctly	Punctuation and grammar are appropriate to the audience and genre. They conform to the conventions for edited American English. Errors may occur but are few and do not markedly distract the reader
Excellent 9-10	Clear understanding of material displayed by clear, concrete language and complex ideas. Confidence with all material which leads to strong, convincing, consistent argument	The points or claims are fully explained and supported. Facts compliment the argument or reinforce the thesis	The points or claims are fully explained and supported. The writer goes the extra mile to be sure the reader gets the point by providing helpful examples or details. When necessary, the writer anticipates or refutes counterarguments	Establishes and maintains clear purpose. Response is powerfully organized. The essay is focused, purposeful, and reflects clear insight and ideas	No spelling errors. Language used is in accordance with edited American English and sounds appropriate for the audience. There is no inappropriate use of slang or jargon. Words and expressions seem carefully selected	Punctuation and grammar are appropriate to the audience and genre and in fact enhance the style. They conform to the conventions for edited American English, or, if they do not, the reason is rhetorical and stylistic. Errors may occur but are few and do not markedly distract the reader

Table B2. Final essay rubric scores for students in a core animal science course at a land-grant university in the U.S.

	WPPF[2] n = 250			CON[3] n = 130	
Rubric Analytics[1]	*M*[3]	*SD*[4]	*P*-value	*M*[3]	*SD*[4]
Content					
Argument	5.99	1.75	0.24	5.76	1.76
Accuracy	5.57	1.82	0.27	5.35	1.86
Development	5.09	1.77	0.04	4.68	1.87
Content Total	16.64	5.15	0.13	15.80	5.27
Mechanics					
Organization	6.12	1.63	0.11	5.83	1.71
Spelling	7.63	1.24	0.12	7.42	1.30
Punctuation	7.60	1.26	0.06	7.34	1.35
Mechanics Total	21.35	3.73	0.06	20.60	3.84
Overall Total	37.98	8.53	0.08	36.39	8.63

[1]Rubric = an adapted combination of rubrics from the Texas A&M University Writing Center and Rezaei and Lovorn (2010)
[2]Students in the semester that participated in writing practice and peer feedback
[3]Students in the control semester that did not participate in writing practice and peer feedback
[3]*M* = mean
[4]*SD* = standard deviation

APPENDIX C

CHAPTER V FIGURES AND TABLES

Figures

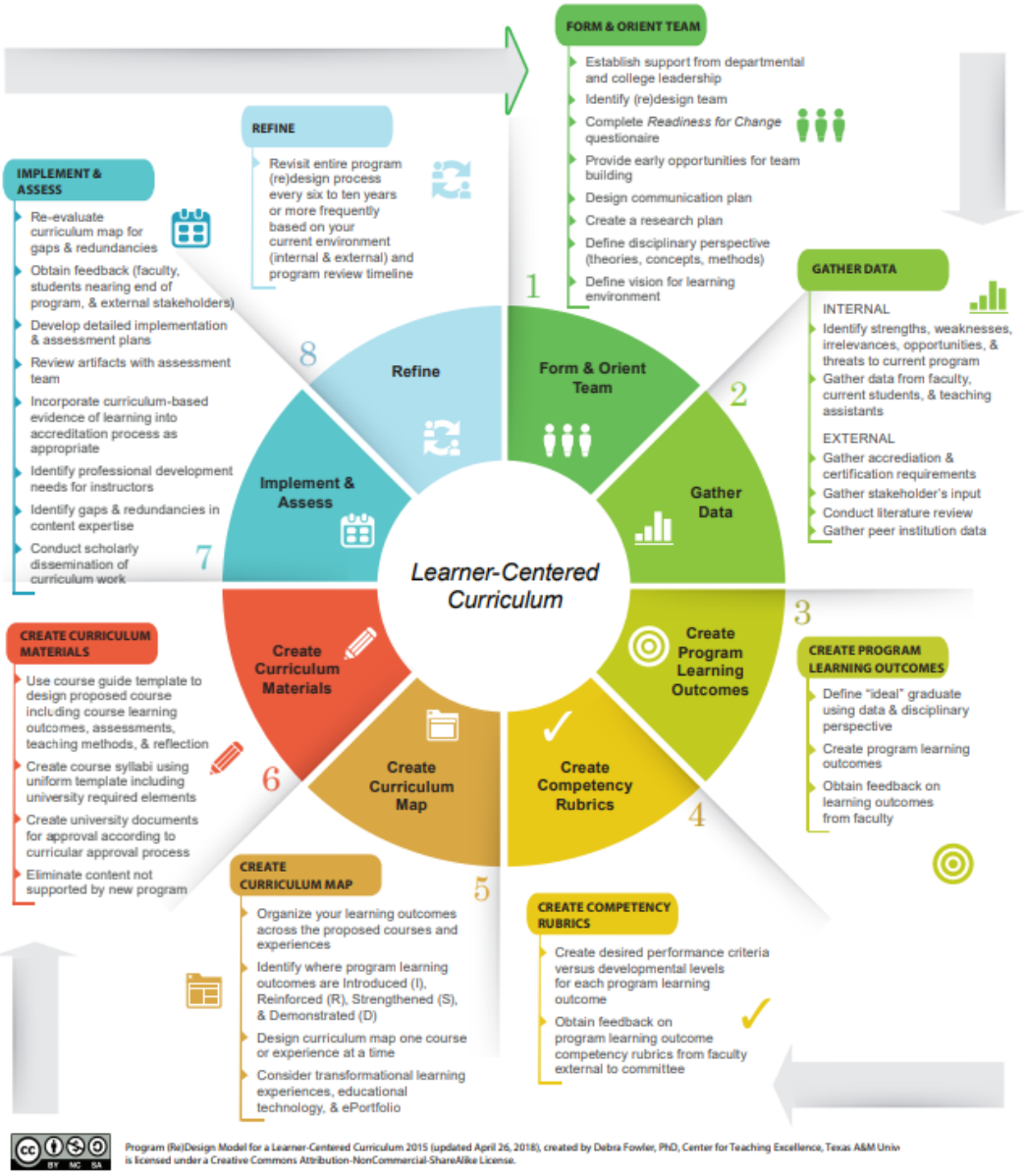

Figure C1. Reprinted under a Creative Commons Attribution from Program (Re)Design model for learner-centered 2015 (Updated April 26, 2018) created by Debra Fowler, PhD.

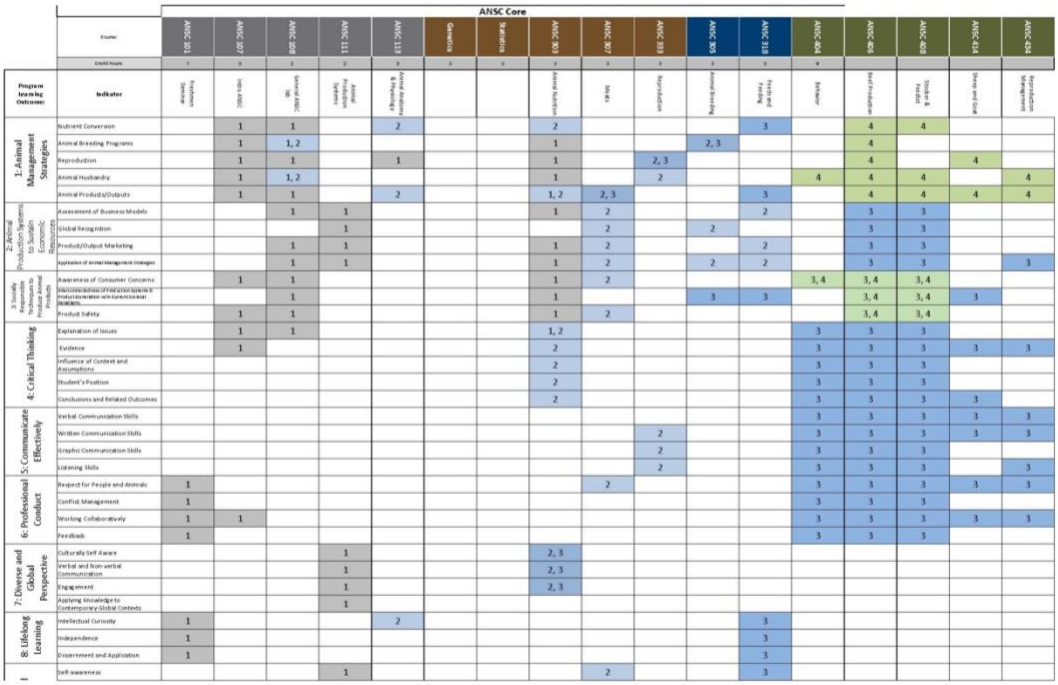

Figure C2.Curriculum Map Matrix for the Department of Animal Science at Texas A&M University.

Texas A&M University

Department of Animal Science

Science Option

2018 – 2019

Student _____ UIN _____

Core Curriculum Coursework	Hours	Completed
Communication		
ENGL 104	3	
COMM 203 or ENGL 210	3	
Mathematics		
MATH[1]	3	
MATH[1]	3	
Citizenship		
American History[1]	3	
American History[1]	3	
Government/Political Science[1]	3	
Government Political Science[1]	3	
Life and Physical Sciences		
ANSC 107 General Animal Science	3	
CHEM 101 Intro Chem I CHEM 111 Intro Chem lab	4	
BIOL 111 Intro Biology I	4	
Social and Behavioral Science		
	3	
Language, Philosophy, and Culture[1]		
	3	
Creative Arts[1]		
	3	
Total Hours	***44***	

Major Coursework	Hours	Completed
ANSC 101 Introductory Seminar	1	
ANSC 108 General Animal Science Lab	1	
ANSC 111 Animal Production Systems	3	
ANSC 113 Farm Animal Biosystems	2	
ANSC 303 Animal Nutrition	3	
ANSC 305 Animal Breeding	3	
ANSC 307 Meats	3	
ANSC 318 Feeds and Feeding	3	
ANSC 333 Reproduction	3	
ANSC 399 Animal Science Experience	0	
ANSC 498 Capstone	4	
Disciplinary Focus (ANSC 404, 406, 408, 412, 414, 420, 434, 447, DASC 418)	8	
Total Hours	***34***	

Supporting Coursework	Hours	Completed
STAT 301, 302, or 303 Statistics	3	
Total Hours	***3***	

General Electives	Hours	Completed
Total Hours	***9***	

Additional Science Coursework	Hours	Completed
BIOL 112 Intro Biology II	4	
CHEM 102 Intro Chem II CHEM 112 Intro Chem II Lab	4	
CHEM 227 Organic Chem I	3	
CHEM 237 Organic Chem I Lab	1	
CHEM 228 Organic Chem II	3	
CHEM 238 Organic Chem II Lab	1	
BICH 410 Biochemistry I	3	
BICH 411 Biochemistry II	3	
Microbiology (BIOL 206, 351, VTPB 405, or DASC 326/327)	4	
GENE 301 Genetics GENE 312 Genetics Lab	4	
Total Hours	***30***	

Additional Requirements	Hours	Completed
International & Cultural Diversity[1]		
	3	
	3	
ANSC Writing/Communications[2]		
Foreign Language[3]		

[1] See Undergraduate Catalog for choices.

[2] See Academic Advisor for approved choices.

[3] This requirement can be satisfied by satisfactory completion of two units of the same foreign language in high school **or** one year of the same language at the college level.

Other University graduation requirements:

- ☐ Minimum 120 credit hours
- ☐ 36 upper division credit hours (300-400 level)
- ☐ 2.0 Overall GPR
- ☐ Minimum grade of "C" in ANSC coursework

NOTE: Prerequisites for professional programs must be completed with a minimum grade of "C". Students pursuing prerequisites for veterinary or medical programs should take PHYS 201 and PHYS 202 in their general elective coursework.

Figure C3. Reprinted from science option degree plan of the Department of Animal Science at Texas A&M University

Texas A&M University
Department of Animal Science
Production Option
2018 – 2019

Student _____ UIN _____

Core Curriculum Coursework	Hours	Completed
Communication		
ENGLISH/COMMUNICATION[1]	3	
ENGLISH/COMMUNICATION[1]	3	
Mathematics		
MATH[1]	3	
MATH[1]	3	
Citizenship		
American History[1]	3	
American History[1]	3	
Government/Political Science[1]	3	
Government Political Science[1]	3	
Life and Physical Sciences		
ANSC 107 General Animal Science	3	
CHEM 101 Intro Chem I CHEM 111 Intro Chem lab	4	
BIOL 111 or BIOL 107	4	
Social and Behavioral Science		
AGEC 105, ECON 202, or ECON 203	3	
Language, Philosophy, and Culture[1]		
	3	
Creative Arts[1]		
	3	
Total Hours	***44***	

Major Coursework	Hours	Completed
ANSC 101 Introductory Seminar	1	
ANSC 108 General Animal Science Lab	1	
ANSC 111 Animal Production Systems	3	
ANSC 113 Farm Animal Biosystems	2	
ANSC 303 Animal Nutrition	3	
ANSC 305 Animal Breeding	3	
ANSC 307 Meats	3	
ANSC 318 Feeds and Feeding	3	
ANSC 333 Reproduction	3	
ANSC 399 Animal Science Experience	0	
ANSC 498 Capstone	4	
Disciplinary Focus (ANSC 404, 406, 408, 412, 414, 420, 434, 447, DASC 418)	8	
Total Hours	***34***	

Supporting Coursework	Hours	Completed
ACCT 209	3	
ACCT 210	3	
AG ELECTIVE[2]	3	
AGEC 330 or FINC 409 Finance	3	
AGEC 325, 340, or MGMT 309 Management	3	
STAT 301, 302, 303 or ANSC 309 Statistics	3	
Total Hours	***18***	

Additional Science Coursework	Hours	Completed
CHEM 222 Elements of Organic Chemistry	3	
GENE 301 Genetics Lecture	3	
DASC 326 or BIOL 206 Microbiology	3	
Total Hours	***9***	

Directed Electives[2]	Hours	Completed
Total Hours	***9***	

General Electives	Hours	Completed
Total Hours	***6***	

Additional Requirements	Hours	Completed
International & Cultural Diversity[1]		
	3	
	3	
ANSC Writing/Communications[2]		
Foreign Language[3]		

[1] See Undergraduate Catalog for choices.
[2] See Academic Advisor for approved choices.
[3] This requirement can be satisfied by satisfactory completion of two units of the same foreign language in high school **or** one year of the same language at the college level.

Other University graduation requirements:

- ☐ Minimum 120 credit hours
- ☐ 36 upper division credit hours (300-400 level)
- ☐ 2.0 Overall GPR
- ☐ Minimum grade of "C" in ANSC coursework

NOTE: Prerequisites for professional programs must be completed with a minimum grade of "C".

Figure C3 Continued. Production option degree plan of the Department of Animal Science at Texas A&M University

Tables

Table C1. Readiness for change survey results.

Question	***Response***				
	Strongly Disagree	Disagree	Neither Disagree or Agree	Agree	Strongly Agree
How do these statements best fit your attitude towards the [animal science] program's need for change?					
There is a significant difference between the current curriculum and the desired state of our curriculum	0	0	3	6	1
No one has explained why this change must be made	1	6	2	1	0
It doesn't make sense for us to initiate this change	7	3	0	0	0
This change is clearly needed	0	0	1	5	4
The time we are spending on this change should be spent on something else	4	5	1	0	0
I think there are real stakeholder needs that make change necessary	1	1	2	4	2
I think our program will benefit from this change	0	0	1	2	7
Our program is going to be more productive when we implement this change	0	0	2	3	5
This change will help us be better equipped to meet our student's needs	0	0	1	4	5
This change matches the priorities of our program	0	0	5	3	2
This change replaces outdated aspects of the curriculum while building on the positive attributes of the curriculum	0	1	0	5	4
This change will be an improvement over our current practices	0	0	1	7	2
How appropriate is this change project					
There is a high priority for the success of this change project	0	1	3	5	1
The potential benefits of this change are not worth the costs in time and resources required to implement it	1	8	1	0	0
This change serves and important purpose	0	0	3	5	2
This change will improve the knowledge and skills of our graduates	0	0	3	2	5
When we implement this change, I can envision financial benefits coming our way	0	3	4	3	0

Table C1. Continued: Readiness for change survey results.

Question	Response				
	Strongly Disagree	Disagree	Neither Disagree or Agree	Agree	Strongly Agree
In the long run, I feel it will be worthwhile if the program adopts this change	0	1	2	3	4
The effort required to implement this change is rather small when compared to the benefits we will see from it	1	1	2	4	2
How capable do you feel in making these changes?					
We have the skills in our program that are needed to implement this change	1	1	2	3	3
Considering the trouble we have had in previous change efforts, we will have difficulty implementing this change successfully	0	0	5	2	3
We have been through well executed changes in the past, and we are confident of our capacity to implement this change	2	3	5	0	0
How do these statements best fit your attitude towards the [animal science] program's need for change?					
I have the skills that are needed to make this change work	0	0	2	7	1
My past experiences make me confident I will be able to perform successfully after this change is made	0	0	2	5	3
I am overwhelmed by all the tasks I have to learn because of this change	3	3	4	0	0
I do not anticipate any problems adjusting to the work I will have when this change is adopted	0	1	5	4	0
After this change is implemented, I am confident I will be able to do my job	0	0	5	3	2
The leaders of this change project…					
Are committed to this change	0	1	4	4	1
Have the authority to carry out the implementation	0	2	3	3	2
Work well with the implementation team	0	1	4	1	4
Share responsibility for this project	0	0	3	6	1
Leadership has sent a clear signal this program is going to change	0	3	4	1	2

Table C1. Continued: Readiness for change survey results.

Question	**Response**				
	Strongly Disagree	Disagree	Neither Disagree or Agree	Agree	Strongly Agree
The senior leaders have served as role models for this change	0	4	5	0	1
Our program's top decision makers have put all their support behind this change effort	0	2	5	2	1
Our senior leaders have encouraged all of us to embrace this change	0	3	3	3	1
The program's senior leader has not been personally involved with the implementation of this change	1	1	4	3	1
I think we are spending a lot of time on this change when the leaders don't even want it implemented	1	5	3	1	0
The members of the curriculum (re)design team…					
Have clearly defined roles and responsibilities	1	2	7	0	0
Have release (protected) time for this change project of can combine tasks with their regular work	2	1	3	4	0
Have staff support and other resources required for the project	1	0	4	4	1
Have an incentive to participate in this change project	0	3	4	3	0
The majority of faculty members involved with teaching…					
Have a sense of personal responsibility for improving education	0	0	0	6	4
Are willing to innovate and/or experiment to improve teaching	0	1	3	6	0
Feel that many faculty members are afraid to lose power in controlling the teaching of their discipline	0	0	4	3	3
Feel that this change will increase their workload	0	0	5	3	2
Feel restricted by strong hierarchy to express their views	0	0	6	2	2

Table C1. Continued: Readiness for change survey results.

Question	**Response**				
	Strongly Disagree	Disagree	Neither Disagree or Agree	Agree	Strongly Agree
What is the quality of the communication on this project?					
There is good communication between project leaders and faculty members about the program's policy towards the change	0	4	4	2	0
The information provided about the change is clear	1	4	4	1	0
In this program we are sufficiently informed about the progress of the change	1	3	4	1	1
Our program has a clear vision regarding this change project	3	2	4	1	0
Our vision of this change project is widely communicated and understood throughout our program	4	2	3	1	0
The process for this change project…					
Identifies specific roles and responsibilities for each (re)design team member training	0	2	7	1	0
Clearly describes tasks and long-term timelines	0	1	5	4	0
Includes appropriate (re)design team member training	0	2	8	0	0
Acknowledges (re)design team member input and opinions	0	1	6	2	1
Why do you feel changes need to be made?					
We need to make change because our leadership wants us to change	0	1	4	5	0
In our program, we feel pressure to go along with this change	0	1	5	4	0
Our accreditation body and/or industry are motivating us to change	0	0	6	3	1
Project Resources (check all that apply):	**Response**				
Financial resources	4				
Professional development (such as courses/workshops regarding the change project)	3				

Table C1. Continued: Readiness for change survey results.

Question	**Response**				
	Strongly Disagree	Disagree	Neither Disagree or Agree	Agree	Strongly Agree
Current pressure to change the curriculum comes from (check all that apply)	**Response**				
Curriculum committee	3				
Dean/Provost	1				
External: Department of Education (Federal, State, THECB)	1				
External: Accreditation authorities	1				
Other: *Dept. head and assoc. dept. head* *External stakeholders*	2				
Facilities (such as teaching rooms, books, computers, etc.)	7				
Sufficient instructors	4				
Incentives for committee members that support the change project (either financial, material, or promotional)	2				
Student awareness/needs	3				
Evaluation protocol	1				
Other	0				
Current pressure to change the curriculum comes from (check all that apply)	**Response**				
Students in the program	9				
Faculty	8				
Advising staff	6				

Table C2. Texas A&M Animal Science Department Undergraduate Competency Rubrics.

1. Implement animal management strategies.

	Performance Indicator	Developing	Sufficient	Proficient	Exemplary
		1	2	3	4
a.	**Nutrient Conversion**	1. a. 1 **Describe** anatomy of common livestock species as it relates to nutrition. **Explain** the major types of nutrients.	1. a. 2 **Describe** nutrient sources and their utilization by livestock. **Explain** dietary/nutrient requirements of livestock.	1. a. 3 **Design** least cost diets to meet the requirements of livestock for a targeted level of performance. **Predict** animal performance.	1. a. 4 **Analyze** technologies designed to improve livestock performance. **Appraise** the impacts on nutrient requirements/utilization.
b.	**Animal Breeding Programs**	1. b. 1 **Identify** types of livestock and their strengths/limitations in livestock production systems.	1. b. 2 **Explain** common phenotypic and genotypic selection methods that can be used in livestock production.	1. b. 3 **Create** an animal breeding program that incorporates selection methods and mating systems to improve efficiency of a livestock system.	1. b. 4 **Evaluate** an implemented animal breeding program by predicting and explaining the expected improvement in system efficiency.
c.	**Reproduction**	1. c. 1 **Summarize** reproductive objectives of livestock systems and **identify** reproductive anatomy.	1. c. 2 **Produce** a complete description of physiological processes controlling reproduction.	1. c. 3 **Analyze** reproductive technologies and their application with regard to the physiological basis of reproduction.	1. c. 4 **Generate** a reproductive management plan that utilizes appropriate technologies to achieve livestock production system goals.
d.	**Animal Husbandry**	1. d. 1 **Recognize** benefits of optimal management of health, well-being, performance and efficiency in livestock production systems.	1. d. 2 **Handle** a class or species of livestock with awareness of personal and animal safety. **Administer** animal health measures appropriately.	1. d. 3 **Evaluate** strategies to manage health, well-being, performance and efficiency in livestock production systems.	1. d. 4 **Critique** existing animal management strategies in livestock production systems to make recommendations to improve animal health, well-being, performance and efficiency.
e.	**Animal Products/Outputs**	1. e. 1 **Identify** common products/outputs from various classes of livestock. **Discuss** quality attributes of those products.	1. e. 2 **Describe** the conversion of livestock into marketable products/outputs.	1. e. 3 **Choose** appropriate technologies to optimize quality of products/outputs and/or improve the conversion of livestock into marketable products and enhance product value.	1. e. 4 **Design** methods/process to improve the conversion of livestock into products/outputs.

2. Utilize animal production systems to sustain economic resources.

	Performance Indicator	Developing	Sufficient	Proficient	Exemplary
		1	2	3	4
a.	**Assessment of Business Models**	2. a. 1 **Summarize** why each type of livestock production system exists. **Distinguish** between inputs and outputs.	2. a. 2 **Analyze** the factors driving input costs and output values.	2. a. 3 **Create** a dynamic business model for a specific livestock production system.	2. a. 4 **Recommend** strategies to improve the probability of profitability for a specific livestock production system.
b.	**Global Integration**	2. b. 1 **Recognize** characteristics of the global market place that impact animal products/outputs.	2. b. 2 **Interpret** global policies' role in assigning value to animal products/outputs. **Compare** characteristics of the global market place that impact sale/production of animal products/outputs.	2. b. 3 **Determine** how the application of production technologies affects global market dynamics.	2. b. 4 **Explain** the impacts of cultural dynamics on the economic value of animal products/outputs.
c.	**Product/Output Marketing**	2. c. 1 **Identify** products/outputs produced from each type of livestock production system. **Identify** characteristics of markets and industry stakeholder groups/customers.	2. c. 2 **Explain** the product/output value-chain and product or output value at each link. **Illustrate** a link between a product/output value and the associated stakeholder groups or consumers.	2. c. 3 **Examine** a product/output to identify possible attributes that increase and decrease value. **Predict** impact of product/output attribute on attitude of associated stakeholder groups or consumers.	2. c. 4 **Assess** methods of managing risk and optimizing product/output value. **Design** a strategy for advocacy of a particular product/output to a diverse audience.
d.	**Application of Animal Management Strategies**	2. d. 1 **Recognize** methods of measuring animal performance/efficiency.	2. d. 2 **Identify** animal management strategies and their impact on product yield, efficiency and quality.	2. d. 3 **Combine** multiple animal management strategies to improve economic resilience.	2. d. 4 **Revise/modify** animal management strategies to adapt to changing input and output markets.

3. Evaluate socially responsible techniques to produce animal products.

	Performance Indicator	Developing	Sufficient	Proficient	Exemplary
		1	2	3	4
a.	**Awareness of consumer concerns**	3. a. 1 **Recognize** consumer concerns about animal products.	3. a. 2 **Examine** data on both consumer's concerns and related production practices. **Analyze methods for using** available data to address consumer concerns.	3. a. 3 **Construct** a rationale for the application of a chosen production practice based on data, which incorporates recognition of consumers concerns.	3. a. 4 **Articulate** to consumers the role of animal production systems in meeting human needs, while giving consideration to consumer perceptions.
b.	**Interconnectedness of production systems and product generation within current societal paradigms**	3. b. 1 **Discuss** how interaction between industry segments impacts animal production practices in domestic markets.	3. b. 2 **Describe** how altering a biological component of the animal or production system impacts product cost and value.	3. b. 3 **Connect** changes in production practices to their impact on product cost and value.	3. b. 4 **Evaluate** production strategies and associated impact on product value. **Estimate** consumer response to products associated with specific production methodologies.
c.	**Product Safety**	3. c. 1 **Identify** components of product safety for various animal products.	3. c. 2 **Illustrate** product safety concerns, including the level of risk posed and intervention strategies.	3. c. 3 **Propose** strategies to mitigate product safety risks.	3. c. 4 **Compare and Contrast** production practices/interventions and their effectiveness in improving product safety.

Texas A&M University undergraduate learning outcome: "Demonstrate critical thinking"

4. Demonstrate critical thinking.

	Performance Indicator	Developing	Sufficient	Proficient	Exemplary
		1	2	3	4
a.	**Explanation of issues**	4. a. 1 **Identify** animal science issues to be considered critically.	4. a. 2 **Recognize** all sides of animal science issues to be considered critically and summarize the foundational premises of these sides.	4. a. 3 Clearly **articulate** and comprehensively describe one side to an animal science issue/problem to be considered critically.	4. a. 4 **Summarize** all sides of an issue in animal science and compare and contrast their merits.
b.	**Evidence**	4. b. 1 **Recall and relate** information pertinent to animal sciences from general resources in communication.	4. b. 2 **Locate and integrate** information from multiple professional resources to answer questions relevant to animal sciences.	4. b. 3 **Interpret and apply** information from vetted professional resources to answer questions related to animal science.	4. b. 4 **Prepare** a comprehensive analysis or synthesis utilizing information taken from credible and thoroughly questioned source(s).
c.	**Influence of context and assumptions**	4. c. 1 **Show** an emerging awareness of present assumptions relating to the field of animal science and distinguish between assertions and assumptions.	4. c. 2 **Question** some assumptions, being aware of both own assumptions and those of others, and identify several relevant contexts when presenting a position.	4. c. 3 **Identify** own and others' assumptions and several relevant contexts when presenting a position.	4. c. 4 Thoroughly (systematically and methodically) **analyze** own and others' assumptions and carefully evaluate the relevance of contexts when presenting a position.
d.	**Student's position**	4. d. 1 **State** a specific position (perspective, thesis/hypothesis) on animal science related topic or issue.	4. d. 2 **Prepare** a specific position (perspective, thesis/hypothesis) that recognizes complexities of an animal science related topic or issue and acknowledges others' points of view on stated topic or issue.	4. d. 3 **Synthesize** an imaginative specific position (perspective, thesis/hypothesis) on an animal science related topic or issue that recognizes complexities and incorporates and values information from external perspectives as well.	4. d. 4 **Create** a comprehensive specific position on an animal science related topic or issue, which includes summary and evaluation of predicted objections, related assumptions and potential implications of the position.
e.	**Conclusions and related outcomes**	4. e. 1 **Identify** value in creating personal conclusions and recognizes that each will have implications and consequences.	4. e. 2 **Create** clear and complete personal conclusions based on critical analysis of issues, incorporating relevant information.	4. e. 3 **Practice** incorporation of information to both assess and prioritize information to predict logical conclusions and related outcomes.	4. e. 4 **Synthesize** and critique personal conclusions including acknowledgement of limitations. **Identify** and value others' perspectives and associated conclusions.

Texas A&M University undergraduate learning outcome: "Communicate effectively"

5. Communicate effectively across multiple mediums.

	Performance Indicator	Developing	Sufficient	Proficient	Exemplary
		1	2	3	4
a.	**Verbal communication skills**	5. a. 1 **Use** language choices that are imaginative, memorable, and compelling, as to enhance the effectiveness of verbal communication in a manner that is appropriate to audience(s).	5. a. 2 Consistently **utilize** technically sound organizational pattern(s) when speaking (specific introduction and conclusion, sequenced material within the body, and transitions) making content cohesive.	5. a. 3 **Demonstrate** the use of a variety of types of supporting materials (examples, statistics, analogies) making appropriate reference to information or analysis that supports or establishes the speaker's credibility/authority on the topic.	5. a. 4 **Create** a central message that is compelling (precisely stated, appropriately repeated, memorable, and strongly supported). **Practice** verbal delivery techniques (posture, gesture, eye contact, and vocal expressiveness) that make the communication compelling, and speaker appear polished and confident.
b.	**Written communication skills**	5. b. 1 **Employ** audience appropriate language that skillfully communicates meaning to readers with clarity and fluency, and is nearly error free.	5. b. 2 Consistently **utilize** technically sound organizational pattern(s) when writing, (specific introduction and conclusion, sequenced material within the body, and transitions) making content cohesive.	5. b. 3 **Demonstrate** skillful use of high quality, credible, relevant sources to develop ideas that are appropriate for the discipline and genre of the writing.	5. b. 4 **Create and disseminate** an animal science related central message that is compelling (precisely stated, relevant and strongly supported).
c.	**Graphic communication skills**	5. c. 1 **Identify** forms of graphic communication most effective for explanation of discipline specific animal science content to different audiences.	5. c. 2 **Identify and explain** information displayed via multiple graphical forms of communication within the discipline of animal science.	5. c. 3 **Evaluate** effective and appropriate graphic communication skills utilized by self and others.	5. c. 4 **Create** visual representations of information that appropriately and effectively articulate the central message, ultimately enhancing the information's meaning for a given audience.
d.	**Listening skills**	5. d. 1 **Identify** the value of listening skills in professional and personal settings.	5. d. 2 **Practice** effective listening skills through demonstration of receptive and professional body language and behaviors.	5. d. 3 **Employ** active and critical listening skills appropriate to multiple physical situations specific to the animal science discipline.	5. d. 4 **Demonstrate** comprehension of verbal communication by discussing topics with an independent, intellectual and ethical disposition so as to further or maintain disciplinary conversations.

Texas A&M University undergraduate learning outcomes: "Practice personal and social responsibility," and "Work collaboratively."

6. Demonstrate professional conduct.

	Performance Indicator	Developing	Sufficient	Proficient	Exemplary
		1	2	3	4
a.	**Respect for people & animals**	6. a. 1 **Identify** the importance of respect and explain respectful behavior.	6. a. 2 **Given** situational examples/scenarios, predict expectations for respectful behavior.	6. a. 3 **Demonstrate** respect via utilization of professional practices.	6. a. 4 **Create** a model illustrating the implementation of respectful behaviors within a division of animal science.
b.	**Conflict management**	6. b. 1 **Identify** and acknowledge conflict.	6. b. 2 **Recognize** any personal responsibility in conflict.	6. b. 3 **Analyze** components of conflict and formulate a strategy for resolution.	6. b. 4 **Address** destructive conflict directly and constructively, helping to manage/resolve the conflict through implementation of a developed resolution plan.
c.	**Working collaboratively**	6. c. 1 **Identify** characteristics of a functional team.	6. c. 2 **Describe** team roles and responsibilities.	6. c. 3 Strategically **assume/assign** responsibilities among team members.	6. c. 4 **Function** effectively as a team to achieve stated project objectives. **Communicate** to create a productive and respectful environment.
d.	**Feedback**	6. d. 1 **Accept** objective and constructive critique.	6. d. 2 **Identify** areas to provide objective and constructive critique.	6. d. 3 **Develop** a respectful approach to providing and seeking critique.	6. d. 4 **Provide** and **receive** objective and constructive critique at all levels.

Texas A&M University undergraduate learning outcome: "Demonstrate social, cultural, and global competence."

7. Value diverse and global perspectives.

	Performance Indicator	Developing	Sufficient	Proficient	Exemplary
		1	2	3	4
a.	**Culturally self-aware**	7. a. 1 **Recognize** that cultural differences exist between individuals.	7. a. 2 **Identify** one's own culture and associated impacts upon personal practices.	7. a. 3 **Recognize and incorporate** new perspectives regarding personal cultural rules and biases.	7. a. 4 **Evaluate and address** personal cultural biases, to better relate to other cultures.
b.	**Verbal and nonverbal communication**	7. b. 1 **Acknowledge** cultural differences in verbal and nonverbal communication.	7. b. 2 **Identify** cultural differences in verbal and nonverbal communication and appreciate the potential for misunderstandings in communication based on those differences.	7. b. 3 **Recognize** cultural differences in verbal and nonverbal communication and identify associated strategies to begin to negotiate a shared understanding based on those differences.	7. b. 4 **Express** a complex understanding of cultural differences in verbal and nonverbal communication, being able to skillfully compose and employ practices to negotiate a shared understanding based on those differences.
c.	**Engagement**	7. c. 1 **State** interest in learning more about other cultures.	7. c. 2 **Display** interest in learning more about other cultures through basic inquiry.	7. c. 3 **Compose** multilayer questions about other cultures and act to attain answers to those questions.	7. c. 4 **Formulate** complex questions about other cultures, attain and describes answers to these questions in a manner that incorporates multiple cultural perspectives.
d.	**Applying knowledge to contemporary global contexts**	7. d. 1 **Define** global challenges facing animal science in basic ways.	7. d. 2 **Identify** practical yet elementary solutions that incorporate multiple perspectives (such as cultural, historical, and scientific), to global challenges facing animal science.	7. d. 3 **Hypothesize and predict** potential outcomes associated with complex solutions that incorporate multiple perspectives (such as cultural, historical, and scientific), for global challenges facing animal science.	7. d. 4 **Apply** knowledge and skills to implement sophisticated, appropriate, and workable solutions to address complex global problems facing animal science using interdisciplinary perspectives.

Texas A&M University undergraduate learning outcome: "Prepare to engage in lifelong learning"

8. Prepare to engage in lifelong learning

	Performance Indicator	Developing	Sufficient	Proficient	Exemplary
		1	2	3	4
a.	**Intellectual Curiosity**	8. a. 1 **Show** interest in the subject and seek answers to develop greater comprehension.	8. a. 2 **Participate** in topic based forums.	8. a. 3 **Identify** a question of interest and **generate** a hypothesis.	8. a. 4 **Explore** new concepts and seek external resources. **Evaluate** materials and formulate a course of action.
b.	**Independence**	8. b. 1 **Recall** and **apply** previously learned concepts.	8. b. 2 **Identify** gaps in discipline knowledge and associated challenges.	8. b. 3 **Adapt** previously learned knowledge and skills to solve problems.	8. b. 4 **Create** and **employ** innovative strategies to solve identified problems.
c.	**Discernment & Application**	8. c. 1 **Outline** strategies for successful engagement of a topic.	8. c. 2 **Connect** concepts mastered in discipline specific courses to solve problems.	8. c. 3 **Identify** and **complete** a discipline related high-impact learning experience.	8. c. 4 **Integrate** knowledge and experiences to **develop** future career objectives.

9. Demonstrate ethical conduct.

	Performance Indicator	Developing	Sufficient	Proficient	Exemplary
		1	2	3	4
a.	**Self-awareness**	9. a. 1 **Identify** personal core beliefs.	9. a. 2 **Describe** personal core beliefs and the origins of those core beliefs.	9. a. 3 **Discuss** core beliefs and give examples of their relevance in regards to personal conduct.	9. a. 4 **Assess** present core beliefs, recognizing their origins and how their current state may or may not have resulted from modification.
b.	**Ethical issue recognition**	9. b. 1 **Name** basic ethical issues within the area of animal science and outline the complexities or interrelationships among the issues.	9. b. 2 **Describe** interrelationships or complexities existing among ethical issues within animal science.	9. b. 3 **Identify** ethical issues presented in a complex, multilayered context, and summarize the associated cross relationships relating to animal science.	9. b. 4 **Evaluate** ethical issues presented in a complex, multilayered context and interpret the impact of individual cross relationships upon animal sciences.
c.	**Application of ethical perspectives/concepts**	9. c. 1 **Recognize** situations in animal science that pose ethical dilemmas and require the application of ethical perspectives/concepts.	9. c. 2 **Outline** approach for application of ethical perspectives/concepts to situations in animal science posing ethical dilemmas.	9. c. 3 **Predict** outcomes for application of ethical perspectives/ concepts to an ethical question relating to situations in animal science posing ethical dilemmas.	9. c. 4 **Critique** potential effectiveness of application of ethical perspectives/concepts to an ethical question within animal science including an interpretation the implications associated with the outcome of such application.
d.	**Legal and ethical guidelines**	9. d. 1 **Identify** and comply with all legal requirements and ethical standards impacting animal science.	9. d. 2 **Explain** legal and ethical requirements impacting animal science	9. d. 3 **Evaluate** legal and ethical requirements impacting animal science.	9. d. 4 **Formulate** standards of practice that incorporate legal and ethical requirements impacting animal science.

10. Integrated Learning.

	Performance Indicator	Developing	Sufficient	Proficient	Exemplary
		1	2	3	4
a.	**Connection to Experience**	10. a. 1 **Identify** connections between life experiences and course materials.	10. a. 2 **Compare** life experiences and academic knowledge to discuss differences and similarities of perspectives other than own.	10. a. 3 **Illuminate** concepts/ theories/ frameworks of animal science by selecting an effective example.	10. a. 4 S**ynthesize** connections among experiences outside of the formal classroom (including life experiences and academic experiences such as internships and travel abroad) to deepen understanding of animal science and to broaden own points of view.
b.	**Connection to Discipline**	10. b. 1 When prompted, **identify** examples, facts, or theories from more than one academic perspective.	10. b. 2 When prompted, **connect** examples, facts, or theories from more than one academic perspective.	10. b. 3 **Present** examples, facts, or theories from more than one academic perspective.	10. b. 4 **Synthesize** disciplinary concepts by combining examples, facts, or theories from more than one academic perspective.
c.	**Transfer Knowledge**	10. c. 1 **Identify** skills, abilities, theories, or methodologies gained in one situation to another relevant situation.	10. c. 2 **Apply** skills, abilities, theories, or methodologies gained in one situation to another relevant situation.	10. c. 3 **Adapt** skills, abilities, theories, or methodologies gained in one situation to new situations to understand problems or explore issues.	10. c. 4 A**dapt** and **apply** skills, abilities, theories, or methodologies gained in one situation to new situations to solve problems or explore issues in original ways.
d.	**Reflection and Self-Assessment**	10. d. 1 **Describe** one's strengths and challenges related to a particular performance.	10. d. 2 **Articulate** one's strengths and challenges in order to effectively plan for future situations.	10. d. 3 **Evaluate** changes in own learning over time and **identify** influencing factors.	10. d. 4 **Set** future learning goals and devise a plan to reach them, taking into account one's own strengths, challenges and past experiences.

Table C3. Departmental stakeholders' perceived importance, level of proficiency, and difference between departmental stakeholders' perceived importance and proficiency (importance minus proficiency) of Texas A&M Animal Science graduates' animal science knowledge.

Knowledge	***Importance Mean***					***Proficiency Mean***					***Importance Mean - Proficiency Mean****				
	Graduating Seniors	Former Students	Industry	Internal Faculty	External Faculty	Graduating Seniors	Former Students	Industry	Internal Faculty	External Faculty	Graduating Seniors	Former Students	Industry	Internal Faculty	External Faculty
Identify different species and breeds	1.56	2.33	2.17	1.54	1.94	1.48	1.58	2.04	2.08	2.25	0.08	0.75	0.13	-0.54	-0.31
Identify basic meat cuts and qualities	2.71	2.93	2.60	1.81	2.31	1.95	1.80	2.30	2.56	2.58	0.76	1.13	0.30	-0.75	-0.27
Identify basic livestock & equine anatomy	1.80	2.19	2.02	1.35	1.69	1.78	1.69	2.11	2.36	2.18	0.02	0.5	-0.09	-1.01	-0.49
Basic animal science terminology	1.45	1.94	1.68	1.23	1.34	1.51	1.39	1.95	2.12	1.96	-0.06	0.55	-0.27	-0.89	-0.62
Discipline specific terminology	1.91	2.07	1.98	1.44	1.50	1.93	1.68	2.07	2.50	2.14	-0.02	0.39	-0.09	-1.06	-0.64
Species specific terminology	1.86	1.99	1.96	1.72	1.84	1.76	1.61	2.05	2.63	2.11	0.1	0.38	-0.09	-0.91	-0.27
Physiology (general, central nervous system, endocrine, reproductive, metabolic)	1.75	2.01	2.57	1.62	1.47	1.71	1.85	2.41	2.46	2.36	0.04	0.16	0.16	-0.84	-0.89
Animal science industry context	1.91	2.08	1.80	1.58	1.78	1.80	1.76	2.47	2.92	2.57	0.11	0.32	-0.67	-1.34	-0.79
Genetics (selection tools)	2.25	2.62	2.51	1.85	1.81	1.95	1.83	2.32	2.35	2.50	0.3	0.79	0.19	-0.5	-0.69
Production practices	2.00	2.32	1.73	1.65	1.69	1.85	1.85	2.38	2.44	2.36	0.15	0.47	-0.65	-0.79	-0.67
Animal nutrition	1.68	2.01	2.04	1.50	1.66	1.68	1.67	2.26	2.36	2.11	0	0.34	-0.22	-0.86	-0.45
Animal health	1.50	1.89	1.94	1.81	1.84	1.76	1.96	2.29	2.69	2.46	-0.26	-0.07	-0.35	-0.88	-0.62
Animal science related issues	1.70	2.05	2.03	1.69	1.91	1.83	1.79	2.24	2.58	2.36	-0.13	0.26	-0.21	-0.89	-0.45
Animal science business models	2.27	2.32	2.04	2.00	2.28	2.33	2.21	2.62	2.92	2.92	-0.06	0.11	-0.58	-0.92	-0.64

Importance scale: 1 = Essential, 2 = Important, 3 = Slightly useful, 4 = Do not use
Proficiency scale: 1 = Ideal level of preparation, 2 = Well prepared, 3 = Under prepared, 4 = Not prepared
*A negative number indicates the stakeholder perceives the level of importance is higher than the level of proficiency

Table C4. Departmental stakeholders' perceived importance, level of proficiency, and difference between departmental stakeholders' perceived importance and proficiency (importance minus proficiency) of Texas A&M Animal Science graduates' transferable skills.

Skill	***Importance Mean***					***Proficiency Mean***					***Importance Mean - Proficiency Mean****				
	Graduating Seniors	Former Students	Industry	Internal Faculty	External Faculty	Graduating Seniors	Former Students	Industry	Internal Faculty	External Faculty	Graduating Seniors	Former Students	Industry	Internal Faculty	External Faculty
Verbal communication	1.19	1.58	1.12	1.22	1.25	1.71	1.12	2.23	2.41	2.21	-0.52	0.46	-1.09	-1.19	-1.09
Written communication	1.44	1.80	1.47	1.19	1.13	1.68	1.23	2.46	2.85	2.45	-0.24	0.57	-0.98	-1.66	-1.63
Graphic communication	1.81	1.69	2.04	1.81	1.84	2.05	2.00	2.38	2.64	2.37	-0.24	-0.31	-0.33	-0.83	-0.68
Safe animal handling	1.37	1.39	1.97	1.52	1.69	1.76	2.08	2.46	2.85	2.44	-0.39	-0.69	-0.47	-1.33	-0.65
Critical thinking	1.23	1.68	1.21	1.11	1.19	1.66	1.15	2.66	2.70	2.64	-0.43	0.53	-1.43	-1.59	-1.57
Problem solving	1.26	1.61	1.16	1.11	1.13	1.66	1.12	2.66	2.74	2.64	-0.4	0.49	-1.48	-1.63	-1.53
Quantitative/analytical (statistics)	1.65	1.85	2.11	1.81	1.59	1.80	1.90	2.57	2.78	2.55	-0.15	-0.05	-0.44	-0.97	-1.1
Computer literacy	1.72	1.76	1.48	1.31	1.41	2.00	1.41	1.82	1.92	1.84	-0.28	0.35	-0.36	-0.61	-0.56
Ethical decision making	1.28	1.83	1.22	1.26	1.31	1.65	1.22	2.21	2.35	2.19	-0.37	0.61	-0.97	-1.09	-1.14
Working collaboratively	1.28	1.85	1.31	1.41	1.50	1.66	1.32	2.17	2.19	2.15	-0.38	0.53	-0.84	-0.78	-0.6
Appreciating global issues/ global impact of ANSC industry	1.72	1.67	2.10	1.56	1.97	1.68	2.07	2.45	2.58	2.42	0.04	-0.4	-0.32	-1.02	-0.62
Understanding implications of consumer & public perception	1.42	1.96	1.73	1.44	1.78	1.61	1.52	2.42	2.74	2.39	-0.19	0.44	-0.66	-1.3	-0.81
General business skills	1.60	1.79	1.71	1.78	2.25	2.17	1.42	2.58	2.81	2.57	-0.57	0.37	-0.86	-1.03	-0.47
Interact effectively and thoughtfully with a diverse population	1.47	2.21	1.64	1.59	1.69	1.73	1.30	2.22	2.44	2.20	-0.26	0.91	-0.56	-0.85	-0.56

Importance scale: 1 = Essential, 2 = Important, 3 = Slightly useful, 4 = Do not use

Proficiency scale: 1 = Ideal level of preparation, 2 = Well prepared, 3 = Under prepared, 4 = Not prepared

*A negative number indicates the stakeholder perceives the level of importance is higher than the level of proficiency

Table C5. Texas A&M Animal Science Department Undergraduate Program Learning Outcomes.

Rank	Learning Outcome
1	Implement animal management strategies
2	Utilize animal production systems to sustain economic resources
3	Evaluate socially responsible techniques to produce animal products
4	Demonstrate critical thinking
5	Communicate effectively across multiple mediums.
6	Demonstrate professional conduct
7	Value diverse and global perspectives
8	Prepare to engage in lifelong learning
9	Demonstrate ethical conduct
10	Integrated Learning

APPENDIX D

SENSE OF PERCEPTION AND BELONGING QUESTIONNAIRE

What I Am Like

Participant number_____ Current GPA_____ Age _____

Major_____ Transfer Student: YES NO Gender_____

ANSC Option_____ From an Agriculture Background: YES NO

Grade Classification_____

Directions:
The statements on the following pages allow college students to describe **themselves.** There are no right or wrong answers since students differ markedly. For each question, please follow the steps below:
Step 1: Read the sentences on both sides of the line.
Step 2: Circle the sentence that best describes you.
Step 3: Circle the appropriate box to indicate how true **that sentence** is of you.
Note: You will circle only ONE of the four boxes for each question.
Step 4: Bubble in the appropriate letter (a, b, c, or d) on your scantron for that question.

	A Really True For Me	**B** Sort of True For Me			**C** Sort of True For Me	**D** Really True For Me
1.	**A**	**B**	Some students like the kind of person they are	Other students wish that they were different.	**C**	**D**

2.	**A**	**B**	Some students have trouble figuring out homework assignments sometimes	Other students rarely have trouble figuring out their homework assignments.	**C**	**D**
3.	**A**	**B**	Some students are socially accepted by many people	Other students do not seem to be accepted by many people.	**C**	**D**
4.	**A**	**B**	Some students have a lot of original ideas	Other students do not have as many original ideas.	**C**	**D**
. 5.	**A**	**B**	Some students' weights are very appropriate for their heights	Other students' weights are not as appropriate for their heights.	**C**	**D**
. 6.	**A**	**B**	Some students are very able to do new nonacademic jobs they haven't tried before	Other students are not as able to do new nonacademic jobs they haven't tried before.	**C**	**D**
. 7.	**A**	**B**	Some students don't really have a close friend to share things with	Other students have a close friend to share things with.	**C**	**D**
. 8.	**A**	**B**	Some students are financially independent	Other students are not yet financially independent.	**C**	**D**
. 9.	**A**	**B**	Some students consistently live up to high moral standards	Other students do not always live up to the highest moral standards.	**C**	**D**

. 10.	**A**	**B**	Some students do not have a very good sense of humor about life's events	Other students have a good sense of humor about life's events.	**C**	**D**
. 11.	**A**	**B**	Some students are smarter than most of their peers	Other students may not be smarter than most of their peers.	**C**	**D**
. 12.	**A**	**B**	Some students eat junk or fast food for some of their meals	Other students eat junk or fast food for most of their meals.	**C**	**D**
. 13.	**A**	**B**	Some students are not very accepting of different religions, politics, cultures, ethnicities, etc.	Other students are very accepting of different religions, politics, cultures, ethnicities, etc.	**C**	**D**
. 14.	**A**	**B**	Some students manage stressful experiences very well	Other students find it difficult to manage stressful experiences.	**C**	**D**
. 15.	**A**	**B**	Some students ask questions in their ANSC courses	Other students do not ask questions in their ANSC courses.	**C**	**D**
. 16.	**A**	**B**	Some students usually like themselves as a person	Other students usually do not like themselves as a person.	**C**	**D**
. 17.	**A**	**B**	Some students master their coursework at a very high level	Other students do not master their coursework at a very high level.	**C**	**D**
. 18.	**A**	**B**	Some students find it very easy to interact socially with other people	Other students sometimes have trouble with social interactions.	**C**	**D**

. 19.	**A**	**B**	Some students tend to rely on the way things have been done before	Other students frequently come up with new or unique solutions to problems.	**C**	**D**
. 20.	**A**	**B**	Some students' body shape is not all that healthy	Other students have a very healthy body shape.	**C**	**D**
21.	**A**	**B**	Some students do very well at their nonacademic jobs	Other students don't do as well at their nonacademic jobs.	**C**	**D**
. 22.	**A**	**B**	Some students are able to make really close friends	Other students find it hard to make really close friends.	**C**	**D**
. 23.	**A**	**B**	Some students have some difficulty making important decisions by themselves	Other students are very capable of making important decisions by themselves.	**C**	**D**
24.	**A**	**B**	Some students do not always act more morally than other students	Other students almost always act more morally than their peers.	**C**	**D**
25.	**A**	**B**	Some students can really laugh at certain things they do	Other students have a harder time laughing at themselves.	**C**	**D**
26.	**A**	**B**	Some students are more intellectually capable than most of their peers	Other students may not be more intellectually capable than most of their peers.	**C**	**D**

27.	**A**	**B**	Some students do not get enough sleep every day	Other students almost always get enough sleep.	**C**	**D**
28.	**A**	**B**	Some students are very tolerant of ideas (including those of religions, politics, cultures, ethnicities, etc.) that are very different from their own	Other students may not be as tolerant of ideas that are very different from their own.	**C**	**D**
29.	**A**	**B**	Some students might have trouble adapting to changes (at school, home, or work)	Other students rarely have trouble adapting to changes (at school, home, or work).	**C**	**D**
30.	**A**	**B**	Some students know less about ANSC than most students in the TAMU ANSC Department	Other students know just as much or more about ANSC than most students in the TAMU ANSC Department.	**C**	**D**
31.	**A**	**B**	Some students really like the way they are leading their lives	Other students often don't like the way they are leading their lives.	**C**	**D**
32.	**A**	**B**	Some students do not frequently get the best grades in their courses	Other students almost always get the top grades in their courses.	**C**	**D**
33.	**A**	**B**	Some students sometimes find it hard to make new friends	Other students are able to make new friends very easily.	**C**	**D**

34.	**A**	**B**	Some students are much more creative than most of their peers	Other students may not be as creative as most of their peers.	**C**	**D**
35.	**A**	**B**	Some students are not that physically attractive	Other students are very physically attractive.	**C**	**D**
36.	**A**	**B**	Some students are not always very competent in their nonacademic work they do	Other students are almost always very competent in their nonacademic work they do.	**C**	**D**
37.	**A**	**B**	Some students are able to make close friends they can really trust	Other students find it hard to make close friends they can really trust.	**C**	**D**
38.	**A**	**B**	Some students are not always responsible when working in nonacademic activities	Other students are extremely responsible when working in nonacademic activities	**C**	**D**
39.	**A**	**B**	Some students almost always do what is morally right	Other students sometimes don't do what they know is morally right.	**C**	**D**

40.	**A**	**B**	Some students don't always find it easy to laugh at the ridiculous or silly things they do	Other students almost always find it easy to laugh at themselves.	**C**	**D**
41.	**A**	**B**	Some students may not be brighter than most of their peers	Other students are brighter than most of their peers.	**C**	**D**
42.	**A**	**B**	Some students have a very physically active lifestyle	Other students do not have a very physically active lifestyle.	**C**	**D**
43.	**A**	**B**	Some students are very willing to learn about different religions, politics, cultures, ethnicities, etc.	Other students may not be as interested in learning about different religions, politics, cultures, ethnicities, etc.	**C**	**D**
44.	**A**	**B**	Some students might sometimes lose emotional stability during stressful situations	Other students are very good at maintaining emotional stability during stressful situations.	**C**	**D**
45.	**A**	**B**	Some students had less ANSC experience before college than other students in the TAMU ANSC Department	Other students had just as much or more ANSC experience before college compared to other students in the TAMU ANSC Department.	**C**	**D**
46.	**A**	**B**	Some students are often disappointed with themselves	Other students are usually quite pleased with themselves.	**C**	**D**

47.	**A**	**B**	Some students are always academically competent	Other students are not always academically competent.	**C**	**D**
48.	**A**	**B**	Some students do not always use very good social skills	Other students are always very skilled socially.	**C**	**D**
50.	**A**	**B**	Some students have a very nice physical appearance	Other student's physical appearance are not quite as nice.	**C**	**D**
51.	**A**	**B**	Some students are often dissatisfied with themselves	Other students are usually satisfied with themselves.	**C**	**D**
52.	**A**	**B**	Some students avoid taking responsibility for their mistakes	Other students recognize and take responsibility for their mistakes.	**C**	**D**
53.	**A**	**B**	Some students find it hard to make close friends they can share their personal thoughts and feelings with	Other students find it very easy to make friends they can share their personal thoughts and feelings with	**C**	**D**

54.	**A**	**B**	Some students are very capable of solving nearly all of their own problems	Other students rely on others to help them solve some of their problems.	**C**	**D**
55.	**A**	**B**	Some students do not always behave as morally as they should.	Other students nearly always behave in an entirely moral manner.	**C**	**D**
56.	**A**	**B**	Some students are never bothered when they are kidded by their friends	Other students are usually bothered when friends kid them.	**C**	**D**
57.	**A**	**B**	Some students may not be extremely intelligent	Other students are extremely intelligent.	**C**	**D**
58.	**A**	**B**	Some students will occasionally use alcohol or other substances to excess	Other students almost never use alcohol or other substances to excess.	**C**	**D**
59.	**A**	**B**	Some students find it kind of hard to get along with people who have ideas (including those of religions, politics, cultures, ethnicities, etc.) that are very different from their own	Other students find it very easy to get along with people who have very different ideas from their own.	**C**	**D**
60.	**A**	**B**	Some students are very skillful at relaxing under stressful circumstances	Other students are not very skillful at relaxing under stressful circumstances.	**C**	**D**

61.	**A**	**B**	Some students will be well-prepared to enter an ANSC profession upon graduation from the TAMU ANSC program	Other students will be less well-prepared to enter an ANSC profession upon graduation	**C**	**D**
62.	**A**	**B**	Some students would really rather be different	Other students are very happy being the way they are.	**C**	**D**

What Is Important to Me

Directions:
The following are statements which allow college students to describe the **importance** of each descriptor to themselves. There are no right or wrong answers since students differ markedly.
Step 1: Read the sentences on both sides of the line.
Step 2: Circle the sentence that best describes you.
Step 3: Circle the appropriate box to indicate how true **that sentence** is of you.
Note: You will circle only ONE of the four boxes for each question.
Step 4: Bubble in the appropriate letter (a, b, c, or d) on your scantron for that question.

	Really True For Me	Sort of True For Me			Sort of True For Me	Really True For Me
63.	**A**	**B**	Some students find it important to master their coursework at a very high level	Other students do not find it important to master their coursework at a very high level.	**C**	**D**
64.	**A**	**B**	Some students feel it is important to be socially accepted by many people	Other students do not feel it is important to be accepted by many people.	**C**	**D**
65.	**A**	**B**	Some students find it important to be very creative	Other students do not find it important to be very creative.	**C**	**D**
66.	**A**	**B**	Some students do not feel it is important to be very physically attractive	Other students feel it is important to be very physically attractive.	**C**	**D**
67.	**A**	**B**	Some students find it important to manage stressful experiences very well	Other students do not find it important to manage stressful experiences very well.	**C**	**D**

68.	**A**	**B**	Some students feel it is important to be very good at their nonacademic jobs	Other students do not feel it is important to be very good at their nonacademic jobs.	**C**	**D**
69.	**A**	**B**	Some students feel it is important to make close friends they can really trust	Other students do not feel it is important to make close friends they can really trust.	**C**	**D**
70.	**A**	**B**	Some students find it important to be financially independent	Other students do not find it important to be financially independent.	**C**	**D**
71.	**A**	**B**	Some students feel it is important to live up to high moral standards	Other students do not find it important to live up to high moral standards.	**C**	**D**
72.	**A**	**B**	Some students do not find it important to laugh at the ridiculous or silly things they do	Other students find it important to laugh at the ridiculous or silly things they do.	**C**	**D**
73.	**A**	**B**	Some students do not find it important to be very smart	Other students find it important to be very smart.	**C**	**D**
74.	**A**	**B**	Some students find it important to live a very healthy lifestyle	Other students do not find it important to live a very healthy lifestyle.	**C**	**D**
75.	**A**	**B**	Some students find it important to be very open-minded about different religions, politics, cultures, ethnicities, etc.	Other students do not find it important to be very open-minded about different religions, politics, cultures, ethnicities, etc.	**C**	**D**
76.	**A**	**B**	Some students feel it is not as important to ask questions in their ANSC courses	Other students do feel it’s important to ask questions in their ANSC courses.	**C**	**D**

77.	**A**	**B**	Some students do not find it important to be very competent academically	Other students find it important to be very competent academically.	**C**	**D**
78.	**A**	**B**	Some students do not always find it important to interact well with other people socially	Other students always find it important to interact well with other people socially.	**C**	**D**
79.	**A**	**B**	Some students do not feel it is important to be very inventive	Other students feel it is important to be very inventive.	**C**	**D**
80.	**A**	**B**	Some students find it important to have a good physical appearance	Other students do not find it important to have a good physical appearance.	**C**	**D**
81.	**A**	**B**	Some students do not find it important to be very competent in the nonacademic work they do	Other students find it important to be very competent in the nonacademic work they do.	**C**	**D**
82.	**A**	**B**	Some students do not find it important to make close friends they can share their personal thoughts and feelings with	Other students find it important to make close friends they can share their personal thoughts and feelings with.	**C**	**D**
83.	**A**	**B**	Some students do not find it important to be capable of making important decisions by themselves	Other students find it important to be capable of making important decisions by themselves.	**C**	**D**
84.	**A**	**B**	Some students do not feel it is important to behave in a completely moral manner	Other students feel it is important to behave in a completely moral manner.	**C**	**D**

85.	**A**	**B**	Some students find it important to not be bothered when they are kidded by their friends	Other students do not find it important to not be bothered when they are kidded by their friends.	**C**	**D**
86.	**A**	**B**	Some students find it important to be very intelligent	Other students do not find it important to be very intelligent.	**C**	**D**
87.	**A**	**B**	Some students do not find it important to practice healthy behaviors throughout the school year	Other students find it important to practice healthy behaviors throughout the school year.	**C**	**D**
88.	**A**	**B**	Some students do not find it important to get along with people who have ideas (e.g., religious, political, cultural) that are very different from their own	Other students find it important to get along with people who have ideas (e.g., religious, political, cultural) that are very different from their own.	**C**	**D**
89.	**A**	**B**	Some students do not find it important to be skillful at relaxing during stressful situations.	Other students find it important to be skillful at relaxing during stressful situations.	**C**	**D**
90.	**A**	**B**	Some students feel like it is important that they know just as much or more about ANSC than most students in the TAMU ANSC Department	Others do not feel like it is important if they know just as much or more about ANSC than most students in the TAMU ANSC Department.	**C**	**D**

Adapted from the Self-Perception Profile for College Students Questionnaire (Neemann and Harter, 2012)

Psychological Sense of School Membership (PSSM)

Directions: We are interested in learning more about how students feel about the experience in the Texas A&M Animal Science Department. Please answer the following questions by marking the corresponding letter on your scantron.

		Not true at all	Slightly True	Somewhat true	Very True	Extremely True
91.	I feel like a real part of Texas A&M Animal Science Department.	A	B	C	D	E
92.	People here notice when I'm good at something.	A	B	C	D	E
93.	It is hard for people like me to be accepted here.	A	B	C	D	E
94.	Other students in this department take my opinions seriously.	A	B	C	D	E
95.	Most teachers in this department are interested in me.	A	B	C	D	E
96.	Sometimes I feel as if I don't belong here.	A	B	C	D	E
97.	There's at least one teacher or other adult in this department I can talk to if I have a problem.	A	B	C	D	E
98.	People in this department are friendly to me.	A	B	C	D	E
99.	Teachers here are not interested in people like me.	A	B	C	D	E
100.	I am included in lots of activities within the department.	A	B	C	D	E
101.	I am treated with as much respect as other students.	A	B	C	D	E
102.	I feel very different from most other students here.	A	B	C	D	E
103.	I can really be myself in this department.	A	B	C	D	E
104.	The teachers here respect me.	A	B	C	D	E
105.	People here know I can do good work.	A	B	C	D	E
106.	I wish I were in a different department.	A	B	C	D	E
107.	I feel proud of belonging to TAMU ANSC department.	A	B	C	D	E
108.	Other students here like me the way I am.	A	B	C	D	E

Adapted from Psychological Sense of School Membership Instrument (Goodenow, 1993b)

Open-ended Questions

1. What, if anything, has helped you feel like you are accepted in the TAMU ANSC department?

2. What, if anything, has made you feel like you are not accepted in the TAMU ANSC department?

3. What, if anything, could make you feel more accepted in the TAMU ANSC department?

APPENDIX E

CURRICULUM REDESIGN FOCUS GROUP QUESTIONS

1. (*Facilitator, please say aloud how many students raise their hands for each of the following)* Please raise your hand if you are a senior? Junior? Sophomore? Freshmen?
2. (*Facilitator, please say aloud how many students raise their hands)*
3. How many of you transferred to A&M's ANSC program?
4. (*Facilitator, please say aloud how many students raise their hands for each of the following)* How many of you are in the ANSC production option? Science option?
5. What has been the most memorable part of your experience participating in the Animal Science curriculum/program at Texas A&M?
6. Please think back on your experiences in the program and share what you think are some of its strengths?
7. Please think back on your experiences in the program and share what you think are some of the areas of improvement for the program?
8. Take a minute to reflect on the courses you've taken (ANSC or other). On the provided index card, jot down, in rank order, the three courses where you feel you learned the most. Now please jot down, in rank order, the three courses where you feel you learned the least. Can you please share in more detail?
9. What academic support services (e.g. tutoring, supplemental instruction, and peer groups) were you aware of while you were completing your degree? Did you take advantage of these resources and if so, how?
10. How well do you feel the core animal science curriculum (including: 107/108 general ANSC, 303 nutrition, 307 meats, 305 breeds, 318 feeds & feeding, 433 repro, 481 senior seminar and the production classes) has prepared you to enter an animal science related profession?
11. What are your career goals upon graduation?
12. Do you already have post-graduation employment?
13. Imagine you were in charge of the program and could make one change that would make it better. What would you do?
14. What one recommendation would you share with someone who is interested in animal science programs and is considering TAMU?
15. Please take a moment to reflect on our discussion today. Have we missed anything?

APPENDIX F

CURRICULUM REDESIGN STAKEHOLDER SURVEY

DEPARTMENT OF ANIMAL SCIENCE

GRADUATING SENIOR SURVEYS 2014-2015

Howdy,

The Texas A&M Animal Science Department (ANSC) is currently studying its degree programs to ensure that we are meeting the needs of our students. As a graduating senior you have unique insight into how well your coursework prepared you for your career and/or further education. We would like to ask you to take this brief 10-15 minute survey. Your responses to this survey are confidential and will not affect your relationship with Texas A&M University. The data collected from this survey is part of an animal science education research study and will be published during the research dissemination phase of the project. Thanks for helping us to improve the experience of future Aggies.

May we use your survey responses in an animal science education research publication? This is an anonymous survey; therefore, your name will not be associated with your responses in the publication.

By selecting yes, you consent that you have read the attached information sheet and are willing to participate in the study.

- ❍ Yes
- ❍ No, I would like to opt-out of the research study

Note: if you would **not** like to participate in the study, you may opt-out using the questions above. If you opt-out, your responses will be used internally at Texas A&M to make decisions about the animal science curriculum, but they will not be published.

1. When you entered as a student at Texas A&M University were you an Animal Science major?
2. Did you transfer from another institution prior to Texas A&M?
3. Did you participate in ANSC 291 Research?
4. Did you participate in ANSC 485 Directed Studies?
5. Did you participate in ANSC 491 Research?
6. Were you involved in ANSC Department Organizations/Activities?
7. Please select any Departmental Organizations/Activities you participated in during your undergraduate career.
    - Saddle and Sirloin, Texas Aggie Cattlewomen, Dairy Science Club, Horsemen's Association, Beef Cattle Association, Aggie Reps, other.
8. Were you active in a College of Agriculture and Life Sciences (COALS) Organization? If so, please list.
9. Were you active in any Activities/Organizations at Texas A&M University outside of the College of Agriculture & Life Sciences? If so, please list.
10. Were you involved in Judging Teams in the ANSC Department?
11. Please select the Judging Teams you were a member of during your undergraduate career.
    - Wool, horse, meats, livestock, academic quadrathalon, meat animal evaluation, dairy, other.
12. If applicable, what was the greatest benefit of your experience on a judging team?
13. Did you complete an internship during your undergraduate career at TAMU? If so, where was your internship, and for how long were you there?
14. Did you receive academic credit for the internship?
15. How beneficial was your internship experience?
    - Very beneficial, beneficial, moderately beneficial, not beneficial, not applicable.

16. Upon completion of your internship, do you feel more prepared to work in a diverse setting? Why or why not?
17. Did you participate in a Study Abroad program while at Texas A&M University? If so, where?
18. How beneficial was your Study Abroad experience?
    - Very beneficial, beneficial, moderately beneficial, not beneficial, not applicable.
19. Upon completion of your study abroad experience, do you feel you are more prepared to work in a diverse setting? Why or why not?
20. Have you applied for admission to a professional or graduate school program?
21. If you have applied to professional or graduate school, please indicate which program you have applied to:
    - Graduate school, vet school, med school, dental school, law school, physical therapy school, nursing, second BS degree, MBA, other.
22. Did you receive an interview for the program you applied for?
23. What is your current status?
    - Accepted, denied, still in review

24. What is your expected area of employment?

- Production, sales, farm (self-employed), products, research/ science, vet med (DVM), graduate school, agribusiness/finance, vet technician or assistant, other.

25. Post-Graduation Employment:

- Found employment, still seeking employment, currently not seeking employment.

26. Salary Range

1. $20,000-$30,000
2. $30,000-$40,000
3. $40,000-$50,000
4. $50,000-$60,000
5. $70,000 or above

27. How well did your degree plan facilitate your critical thinking skills?

- Very well, well, average, somewhat, not at all.

28. Please select the appropriate response for this statement: My Animal Science degree has enhanced my ability to communicate effectively.

- Agree, somewhat agree, neutral, somewhat disagree, disagree.

Q29 For each knowledge area below, rate its importance on the left and your preparedness in that knowledge area on the right.

	How important are the knowledge areas in your current position?				How well did your coursework prepare you in each area?			
Disciplinary Knowledge:	Essential (3)	Important (2)	Slightly Useful (1)	Do not use (0)	Ideal level of preparation (3)	Well prepared (2)	Under-prepared (1)	Not prepared at all (0)
Identify different species and breeds (1)	❍	❍	❍	❍	❍	❍	❍	❍
Identify basic meat cuts and qualities (2)	❍	❍	❍	❍	❍	❍	❍	❍
Identify basic livestock & equine anatomy (3)	❍	❍	❍	❍	❍	❍	❍	❍
Basic ANSC terminology (4)	❍	❍	❍	❍	❍	❍	❍	❍
Discipline specific terminology (5)	❍	❍	❍	❍	❍	❍	❍	❍
Species specific terminology: (6)	❍	❍	❍	❍	❍	❍	❍	❍
Physiology (general, central nervous system, endocrine, reproductive, metabolic) (7)	❍	❍	❍	❍	❍	❍	❍	❍
ANSC industry context (8)	❍	❍	❍	❍	❍	❍	❍	❍
Genetics (selection tools) (9)	❍	❍	❍	❍	❍	❍	❍	❍
Production practices (10)	❍	❍	❍	❍	❍	❍	❍	❍
Animal nutrition (11)	❍	❍	❍	❍	❍	❍	❍	❍
Animal health (12)	❍	❍	❍	❍	❍	❍	❍	❍
ANSC related issues (13)	❍	❍	❍	❍	❍	❍	❍	❍
ANSC business models (14)	❍	❍	❍	❍	❍	❍	❍	❍
Other:_____	❍	❍	❍	❍	❍	❍	❍	❍
Other:_____	❍	❍	❍	❍	❍	❍	❍	❍

Q30 For each skill below, rate its importance on the left and your preparedness in the skill on the right.

	How important are the following skills in your current position?				How well did your coursework prepare you in each area?			
Disciplinary Skill:	Essential (3)	Important (2)	Slightly Useful (1)	Do not use (0)	Ideal level of preparation (3)	Well prepared (2)	Under-prepared (1)	Not prepared at all (0)
Verbal communication (1)	❍	❍	❍	❍	❍	❍	❍	❍
Written communication (2)	❍	❍	❍	❍	❍	❍	❍	❍
Graphic communication (3)	❍	❍	❍	❍	❍	❍	❍	❍
Safe animal handling (4)	❍	❍	❍	❍	❍	❍	❍	❍
Critical thinking (5)	❍	❍	❍	❍	❍	❍	❍	❍
Problem solving (6)	❍	❍	❍	❍	❍	❍	❍	❍
Quantitative/analytical (statistics) (7)	❍	❍	❍	❍	❍	❍	❍	❍
Computer literacy (8)	❍	❍	❍	❍	❍	❍	❍	❍
Ethical decision making (9)	❍	❍	❍	❍	❍	❍	❍	❍
Working collaboratively (10)	❍	❍	❍	❍	❍	❍	❍	❍
Appreciating global issues/ global impact of ANSC industry (11)	❍	❍	❍	❍	❍	❍	❍	❍
Understanding implications of consumer and public perception (12)	❍	❍	❍	❍	❍	❍	❍	❍
General business skills (13)	❍	❍	❍	❍	❍	❍	❍	❍
Interact effectively and thoughtfully with a diverse population (14)	❍	❍	❍	❍	❍	❍	❍	❍
Other? _____	❍	❍	❍	❍	❍	❍	❍	❍
Other? _____	❍	❍	❍	❍	❍	❍	❍	❍