frontiers | Frontiers in Animal Science

TYPE Original Research
PUBLISHED 25 October 2023
DOI 10.3389/fanim.2023.1268719

OPEN ACCESS

EDITED BY
Jill MacKay,
University of Edinburgh, United Kingdom

REVIEWED BY
Merritt L. Drewery,
Texas State University, United States
Meagan King,
University of Manitoba, Canada

*CORRESPONDENCE
Lily Edwards-Callaway
lily.edwards-callaway@colostate.edu

RECEIVED 28 July 2023
ACCEPTED 25 September 2023
PUBLISHED 25 October 2023

CITATION
Sullivan P, Smith C, Machuca E, Figan A, Mijares S, Roman-Muniz N, Cramer C, Ahola J, Stallones L and Edwards-Callaway L (2023) Exploring undergraduate students' perceptions of food animal production and their sense of belonging in an introductory animal science course.
Front. Anim. Sci. 4:1268719.
doi: 10.3389/fanim.2023.1268719

Exploring undergraduate students' perceptions of food animal production and their sense of belonging in an introductory animal science course

Paxton Sullivan[1], Colton Smith[1], Erica Machuca[1], Abigail Figan[2,3], Sage Mijares[1], Noa Roman-Muniz[1], Catie Cramer[1], Jason Ahola[1], Lorann Stallones[2,3] and Lily Edwards-Callaway[1]*

[1]Department of Animal Sciences, Colorado State University, Fort Collins, CO, United States, [2]Department of Psychology, Colorado State University, Fort Collins, CO, United States, [3]One Health Institute, Colorado State University, Fort Collins, CO, United States

New animal science undergraduates are further removed from agriculture than ever before, many coming from non-agricultural backgrounds lacking experience with food animals. In addition to beginning a degree program in which they have little experience, undergraduates face unique challenges during their transition to college, which could impact retention and success in their chosen major. The focal course, Food Animal Science: ANEQ 101, is an introductory animal science course composed primarily of first year animal science students. This course utilized experiential learning by implementing laboratories with dairy calves providing hands-on experience. Pre- and post-surveys were developed to assess students' perceptions of food animal production, welfare, and sense of belonging in the Animal Science major at the beginning and end of this course that was characterized by hands-on opportunities; quantitative and qualitative analyses were performed on 114 paired survey responses. Respondents were mostly female (79%, n = 91), white (80.7%, n = 92), and from non-agricultural backgrounds (83.3%, n = 95). Despite only half (51.8%, n = 59) of respondents indicating that they had experience with food animals, most respondents indicated that they agreed being comfortable with food animal production (96.5%, n = 110) and working with food animals (95.6%; n = 109); agreement with these statements was similar in the post-survey ($P > 0.05$). More students agreed with the statement "In the United States, food animals are raised with an acceptable level of animal welfare" ($P = 0.016$) in the post-survey as compared with the pre-survey. In the pre- and post-survey, questions related to belonging garnered positive responses, consequently, there was no evidence that students' sense of belonging in the major was altered during the course. Two free-response questions asked respondents to comment on their sense of belonging in the major. Thematic analysis of these answers identified themes related to belonging, including Learning and Curriculum,

Career Goals and Aspirations, Passion for Working with Animals, Self-Assurance, and Community and Classroom Environment. The majority of students had positive views about production and their sense of belonging within the major highlighting the value of integrating experiential learning opportunities for students studying animal science.

KEYWORDS

animal science students, animal handling, animal welfare, experiential learning, livestock experience, livestock production, student attitudes

1 Introduction

Enrollment data from a population of animal science undergraduates in 1986 indicated that the vast majority of students came from rural backgrounds and had experience with livestock or poultry prior to starting college (Reese et al., 1987). Since that study was published nearly four decades ago, the demographic landscape of undergraduate students enrolled in animal science departments nationwide has been changing (Sterle and Tyler, 2016; Wickenhauser et al., 2021). Contemporary data on animal science student demographics shows that upon entering their degree programs, students are further removed from agriculture than ever before, e.g., the majority come from suburban or urban backgrounds (Parrish et al., 2015; Mijares et al., 2021) and lack tangible, hands-on experience with food animals (Reiling et al., 2003; McNeil et al., 2015; Bundy et al., 2019). Yet most students studying animal science express a desire to work with and improve the lives of animals, with many aspiring to become veterinarians (Reiling et al., 2003; Mijares et al., 2021). Additionally, undergraduate students currently attending college are also increasingly interested in how their food is raised (Asioli et al., 2017; FMI, 2022) and place a particular emphasis on the importance of animal welfare within production systems (Prickett et al., 2010; Cleere et al., 2012; Sullivan et al., 2022a), a potential reason for them choosing an agriculturally based education. In most animal science programs across the United States, students who select an animal science major enroll in an introductory animal science course in their first semester of university. This introductory course is intended to provide basic knowledge about livestock and/or poultry production to incoming students. For many students, this may be their first substantial exposure to learning about and working with livestock or poultry.

In addition to beginning their degree program, first-year students are transitioning from home to university life, which can be both exciting and challenging as students adapt to a new social and cultural environment (Chow and Healey, 2008). The first year of university greatly influences student retention (Yorke and Longden, 2004); additionally, rates of student departure from a university are particularly high in first-year students (Tinto, 1993). In particular, the first semester is critical as students' sense of belonging at the university is being established (Kane et al., 2014) and students are more susceptible to feeling marginalized (Tinto, 1987). Goodenow (1993) defined the sense of belonging within educational institutions 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." A sense of belonging felt by a student is crucial for their academic self-confidence and is positively correlated to their success and their overall development (Freeman et al., 2007; Pittman and Richmond, 2008; Bettencourt, 2021). Many students currently enrolling in undergraduate programs are part of a generation (i.e., Generation Z) characterized as being at increased risk for isolation, insecurity, and mental health challenges (Chicca and Shellenbarger, 2018), perhaps enhancing the significance of the first semester of study.

Although there is a lack of research focused on a sense of belonging within the animal sciences discipline specifically, there is considerable research on the sense of belonging within STEM (Science, Technology, Engineering, and Mathematics) fields (Murphy et al., 2007; Wilson et al., 2015; Lewis et al., 2016; Rainey et al., 2018; Apriceno et al., 2020). Students who feel like they belong in their major are more likely to be motivated and find enjoyment in their studies, and the inverse is also true (Pedler et al., 2021). Research has shown that positive interactions with professors enhance not just a student's sense of belonging, but also their persistence in the STEM major (Seymour and Hunter, 2019). It is worth acknowledging that although the current generation of undergraduate students are constantly and quickly connected with friends and family via the internet, they spend less time with people face-to-face (Chicioreanu and Amza, 2018). Consequently, this generation is often characterized as having underdeveloped social and relationship skills (Chicca and Shellenbarger, 2018), thus emphasizing the importance of relationship building with professors and peers during the first semester attending university. There is also a positive correlation between a student's sense of belonging and the number of students of the same gender, race and ethnicity represented in their major (Rainey et al., 2018). As Rainey and others (2018) report, seeing other students that outwardly appear to be similar to the learner can create a "like me" notion that translates to "I belong here." Although this concept is unexplored for animal science students in the current literature, it may be possible that students' lack of experience and limited

knowledge of food animals contribute to a negative sense of belonging among animal science students. Thus, the dedicated effort of faculty, staff, and peers to ensure a positive sense of belonging in students, especially among those who may lack prior livestock experience, is critical to student success and engagement within their courses as well as the field.

Over time, a great deal of focus has been placed on increasing the use of pedagogical methods in higher education that improve student outcomes, performance, and retention (Smart and Csapo, 2007; Jones and Lerner, 2019; Ferree et al., 2022). This change in teaching can be described as a transition from lecture-based learning, which is typically teacher-centered, to learning through methods that actively involve students in the observations, experiences, and reflections of their own learning processes known as experiential learning (Kolb, 1984; Bredow et al., 2021). In the wake of changing student demographics and an ever growing and evolving food production industry, teaching and learning strategies in the animal sciences have rapidly evolved and advanced to meet the changing needs of both students and the industry (Taylor and Kauffman, 1983; Buchanan, 2008; Erickson et al., 2020a). One way that education in the animal sciences has evolved to cater to evolving student interests, backgrounds, and experiences is the adoption of experiential learning into the current animal science curriculum (McNeil et al., 2015; Erickson et al., 2019; Wells et al., 2019; Ruiz-Romero and Vargas-Bello-Pérez, 2022; Sullivan et al., 2022b). Previous research has indicated that students are eager to engage in activities that promote active, hands-on learning in the classroom (Seguino et al., 2014; Lumpkin et al., 2015) and have higher interest and motivation during hands-on activities compared to lecture alone (Erickson et al., 2020b). For example, in a survey of animal science undergraduates that participated in a humane stunning simulation using model cow heads, 100% of respondents agreed or strongly agreed that they "would like to see hands-on activities similar [to the stunning simulation] integrated into other animal science courses" (Sullivan et al., 2022b). Additionally, the current generation of students (i.e., Generation Z) are pragmatic, among other traits, and experiential learning activities offer a way to engage undergraduate students in a way that supports their learning style by providing them with relevant and readily applicable information and skills (Chicca and Shellenbarger, 2018). In the context of animal science programs, experiential learning can be a valuable tool for teaching undergraduate students with limited livestock experience or non-agricultural backgrounds and is critical for developing the next generation of animal scientists (Daigle, 2016). Without a baseline understanding of the field, it can be challenging for students to visualize and understand the purpose behind various animal handling and management procedures (Reiling et al., 2003). Experiential learning provides students who may lack prior knowledge the opportunity to practice and gain experience among their peers and instructors in a safe, controlled, and low-stakes environment (Seguino et al., 2014; Free et al., 2021; Sullivan et al., 2022b).

Animal science undergraduate students' limited experiences with food animals, non-agricultural backgrounds, and diverse career goals can give rise to various perceived and real challenges, particularly during their first year of an undergraduate degree program. Innovative teaching approaches and a deeper understanding of students' perceptions of food animal production may help bridge the gap between students' backgrounds, experiences, knowledge, and the complexities and evolving needs of the field of animal science. Therefore, the objectives of this study were to explore student perceptions regarding food animal production and sense of belonging at this critical juncture at the beginning of the students' animal science education.

2 Materials and methods

The Colorado State University (CSU) Institutional Review Board approved the study protocols prior to study initiation (#3634). A pre- and post-survey was administered in an introductory food animal science course to investigate undergraduate student perceptions of food animal production and their sense of belonging in the animal science major within the Department of Animal Sciences at CSU.

2.1 Study population

The target population for this study was undergraduate students enrolled in Food Animal Science (ANEQ 101), a required introductory course composed primarily of students in their first semester of the Animal Science major in the Department of Animal Sciences within the College of Agricultural Sciences at CSU. The focal course in this study (ANEQ 101) provides fundamental knowledge and understanding of the livestock industry to students and aims to lay a foundation for career paths within the field of animal science. The course includes a 50-minute lecture three times per week and a weekly two-hour laboratory session; there are six different laboratory sections per week, comprised of approximately 35 students each. This study was conducted during the Fall 2022 semester during which 212 students were enrolled in the course, 189 (89.2%) of whom were Animal Science majors.

In 2021, the course was redesigned to provide incoming Animal Science students with more hands-on livestock experience at the beginning of their degree programs. In brief, newborn dairy calves are purchased at the start of the semester and raised at a CSU research facility for approximately eight weeks, at which point the calves are weaned and sold. During the first weeks of the semester, the dairy calves are used in a series of four hands on laboratories. In their laboratory sections, students learn how to properly handle their calves, assess animal health and welfare, administer vaccines and medications as necessary under veterinary supervision, and carry out routine management procedures including the castration and dehorning of the calves. As an additional learning experience, ANEQ 101 students volunteer to help with the twice daily feeding and care of the calves until the calves are weaned. An outline of activities for the remaining laboratories is described in Supplementary Material.

2.2 Study format and content

The surveys were developed by an interdisciplinary team of researchers with expertise in various animal science disciplines,

veterinary medicine, social sciences, and teaching research. Prior to study initiation, the surveys were tested by graduate students in related disciplines to ensure clarity and functionality. The survey was created using online software (Qualtrics, Provo, UT). The pre-survey consisted of 24 Likert scale questions, 14 related to perceptions about food and fiber animal production and animal welfare and 10 related to sense of belonging which were adapted from Gopalan et al. (2022). There were three free-response questions included as follow-up questions. Fourteen additional demographic questions were included. The post-survey included the same questions as the pre-survey but did not include the demographic questions. The surveys took approximately 10 minutes to complete. Both surveys are available in Supplementary Material.

2.3 Survey administration

During the first week of class, a researcher with no role in the course attended a lecture session to introduce the study and review the informed consent information. This information was provided both verbally and in writing prior to administering the survey online. During the last week of class, the same researcher returned to review the same information. All enrolled students were expected to complete both surveys as part of a class assignment and were given the choice to consent to participate in the research or not. Students that did not consent to participate in the research were excluded from analysis, although they were still awarded class credit for completing the class assignment. For both the pre- and post-surveys, the students had one week to complete the assignment online outside of class time. Students were asked to include their first and last names on both surveys to receive credit for the survey completion assignment and to facilitate matching pre-and post-responses. An alphabetical list of names of students who completed the surveys, with no information regarding consent nor specific survey responses, was provided to the instructor so that points could be allocated for completing the survey. A researcher with no role in the course used student names to match pre- and post-surveys and remove duplicates after which all survey responses were de-identified and assigned a random identification number.

2.4 Statistical analysis

After both surveys were completed at the end of the semester, all data were exported from Qualtrics (Provo, UT) into Microsoft Excel (Microsoft Corporation, Redmond, WA). Of the respondents that were majors (n = 189), pre- and post-surveys that could not be matched, duplicate surveys, and students that did not consent to participate in research for either survey (n = 75) were excluded from statistical analysis; a total of 114 surveys were analyzed.

2.4.1 Quantitative analysis

Statistical analysis was performed in R Software (v4.2.2, R Core Team, 2021) and summary statistics were calculated for all variables of interest. Wilcoxon signed-rank tests were used to analyse all Likert scale questions to determine if student responses differed between the pre- and post-surveys. For each question, Wilcoxon signed-rank tests were conducted with all five Likert scale categories included (i.e., 1 = Strongly Agree; 2 = Agree; 3 = I do not know; 4 = Disagree; 5 = Strongly Disagree).

Based on the Wilcoxon signed-rank test results, only questions that were significantly different between the pre- and post-surveys ($P \leq 0.05$) were further analysed; ordinal logistic regression with a proportional odds assumption was used to assess the relationship between pre-survey Likert responses and respondent demographic factors (VGAM package). For modelling purposes, Likert scale responses from the subset of questions (Q6, Q8, and Q11-13 on the pre-survey) were collapsed into three ordinal response variables: 1 = "Agree" ("Strongly Agree" and "Agree"); 2 = "I do not know"; 3= "Disagree" ("Strongly Disagree" and "Disagree"). The demographic factors considered for regression analysis were gender (man or woman), ethnicity (white or non-white), region (West, Southwest, Midwest, Northeast, Southeast, Alaska/Hawaii, or not from the U.S.), hometown type (rural, suburban, or urban), agricultural background (from a farm or ranch or not from a farm or ranch), and experience with food animals (yes or no). Model selection was conducted through backwards manual elimination based on parameter significance ($P \leq 0.05$), keeping only significant parameters in the final models.

2.4.2 Qualitative analysis

Thematic analysis was conducted for two free-response questions following the methods outlined in Braun and Clarke (2006). Eight collaborators reviewed all survey responses to the questions of interest and identified initial themes. Three individuals then independently coded each survey response using the defined themes. Coders were selected to represent diverse backgrounds and perspectives. One coder has earned a bachelor's degree in biology and is a current master's student studying public health. A second coder earned a Doctor of Veterinary Medicine degree, is a Professor in Animal Sciences, and has conducted extensive research and outreach with the Colorado dairy industry for the last 20 years. The third coder has a bachelor's degree in animal science and is currently working towards a master's degree in the animal sciences. Coding was validated through discussion of differences between coders after which agreement was reached for each survey response.

3 Results

3.1 Demographics

A total of 114 survey respondents were included in the study, and a detailed description of respondent demographics is available in Table 1. In brief, the majority of survey respondents identified as female (79.8%, n = 91) and white (80.7%, n = 92). The largest proportion of respondents were from the West (44.7%, n = 51), followed by those from the Midwest or Southwest regions (18.4%, n = 21; 12.3%, n = 14, respectively). Forty-seven percent (n = 54) of respondents came from suburban areas, and a smaller proportion of

TABLE 1 Summary of survey respondent demographics (n = 114).

Demographics	n	Frequency, %
Gender		
Male	20	17.5
Female	91	79.8
Non-binary	3	2.6
Ethnicity		
White	92	80.7
Non-white[1]	20	17.5
Undefined	2	1.8
Identify as Hispanic/Latino/Spanish		
Yes	19	16.7
No	94	82.5
Undefined	1	0.9
U.S. Region of Origin[2]		
Alaska/Hawaii	1	0.9
Midwest	21	18.4
Northeast	10	8.8
Southeast	13	11.4
Southwest	14	12.3
West	51	44.7
Not from the U.S.	4	3.5
Hometown type[3]		
Rural	39	34.2
Suburban	54	47.4
Urban	20	17.5
Other	1	0.9
Educational background		
Out of state	74	64.9
In-state	35	30.7
First generation	33	29.0
Transfer	14	12.3
Agricultural background[4]		
From a farm or ranch	19	16.7
Not from a farm or ranch	95	83.3
Dietary preference		
Non-vegetarian	107	93.9
Vegetarian	3	2.6
Other	4	3.5
Animal experience[5]		
Food animal	59	51.8
Non-food animal	114	100.0
Career goals[6]		
Companion animals	39	34.2
Food animal industry	27	23.7
Wildlife/exotic	40	35.1
Veterinary school	94	82.5
Not working with animals	1	0.9
Unsure	3	2.6

[1]Includes: Black or African American, Asian, American Indian or Alaska Native, and Other.
[2]The Midwest region included Iowa, Illinois, Indiana, Kansas, Michigan, Minnesota, Mississippi, North Dakota, Nebraska, Ohio, South Dakota, and Wisconsin. The Northeast region included Connecticut, Delaware, Massachusetts, Maine, Maryland, New Hampshire, New Jersey, New York, Pennsylvania, Vermont, and Rhode Island. The Southeast region included Alabama, Arkansas, Florida, Georgia, Louisiana, Kentucky, Mississippi, North Carolina, South Carolina, Tennessee, Virginia, and West Virginia. The Southwest region included Arizona, New Mexico, Oklahoma, and Texas. The West region included California, Colorado, Idaho, Montana, Nevada, Oregon, Utah, Washington, and Wyoming.
[3]Region was defined as: Rural = countryside; Suburban = outlying area of a city; Urban = city, non-agricultural.
[4]Agricultural background was defined as: From a farm or ranch = at least a portion of family income comes from production agriculture; Not from a farm or ranch = no family income comes from production agriculture.
[5]Animal experience (either raising or working with) was defined as: Food animal = Livestock (e.g., cows, pigs, sheep, etc.) and Poultry (e.g., chickens, turkeys, etc.); Non-food animal = cats or dogs, small companion animals, exotic animals, reptile or amphibian, fish, horses or other equids, laboratory animals in research setting, wildlife, or other.
[6]Respondents were allowed to select multiple answers.

respondents were from rural or urban areas (34.2%, n = 39; 17.5%, n = 20, respectively). While most respondents reported having non-agricultural backgrounds (83.3%, n = 95), slightly over half of respondents reported having some experience working with or raising food animals (51.8%, n = 59). Lastly, even though respondents reported having a diverse set of career interests (i.e., working with companion animals, in the food animal industry, or with wildlife or exotic animals), over 80% of students (n = 94) stated that they had goals to attend veterinary school.

3.2 Quantitative analysis

Quantitative analysis was conducted on n = 114 survey responses, representing 53.8% of total class enrollment. Overall, responses to the Likert-scale statements regarding perceptions of food and fiber animal production, animal welfare, and sense of belonging in the Animal Science major were overwhelmingly positive; a complete compilation of pre- and post-survey results for each Likert-scale statement are available in Tables 2–4, respectively. The Likert scale statements that differed significantly between the pre- and post-surveys based on Wilcoxon signed-rank testing ($P \leq 0.05$) are visualized in Figure 1. Pertaining to the subset of questions analyzed with regression models, there was no evidence of a relationship between any respondent demographic factors of interest (e.g., race, gender, agricultural background, experience with food animals) with respondents' answers to Likert statements

10.3389/fanim.2023.1268719

TABLE 2 Summary of both pre- and post-survey responses to Likert questions related to perceptions of food and fiber animal production (n = 114).

Statement	Level of Agreement	Pre-Survey		Post-Survey		P-value[1]
		n	%	n	%	
I am comfortable with food animal production.	Strongly Agree	57	50.0	52	45.6	0.25
	Agree	53	46.5	58	50.9	
	I do not know	3	2.6	1	0.9	
	Disagree	1	0.9	2	1.8	
	Strongly Disagree	0	0	1	0.9	
I support animals being used for food.	Strongly Agree	54	47.4	52	45.6	0.87
	Agree	50	43.9	58	50.9	
	I do not know	9	7.9	3	2.6	
	Disagree	1	0.9	1	0.9	
	Strongly Disagree	0	0	0	0	
I support animals being used for fiber (e.g., wool).	Strongly Agree	57	50.0	67	58.8	0.03**
	Agree	49	43.0	45	39.5	
	I do not know	7	6.1	0	0	
	Disagree	1	0.9	2	1.8	
	Strongly Disagree	0	0	0	0	
I am comfortable working hands-on with food animal livestock (e.g., cows, pigs, sheep, etc.).	Strongly Agree	79	69.3	74	64.9	0.60
	Agree	30	26.3	37	32.5	
	I do not know	5	4.4	2	1.8	
	Disagree	0	0	1	0.9	
	Strongly Disagree	0	0	0	0	
I am comfortable working hands-on with non-food animal livestock (e.g., horses or other equids).	Strongly Agree	74	64.9	63	55.3	<0.0001**
	Agree	36	31.6	36	31.6	
	I do not know	2	1.8	6	5.3	
	Disagree	2	1.8	9	7.9	
	Strongly Disagree	0	0	0	0	
I am comfortable discussing and learning about standard on-farm management practices.	Strongly Agree	75	65.8	69	60.5	0.19
	Agree	37	32.5	40	35.1	
	I do not know	1	0.9	3	2.6	
	Disagree	1	0.9	2	1.8	
	Strongly Disagree	0	0	0	0	

[1]Statistical significance is denoted by P-value** and statistical trends are denoted by P-value*.
P-values correspond to Wilcoxon signed-rank testing, which was used to determine if student responses to Likert questions differed between the pre- and post-surveys. For all Likert scale questions, Wilcoxon signed-rank tests were conducted with all five Likert scale categories (i.e., 1 = Strongly Agree; 2 = Agree; 3 = I do not know; 4 = Disagree; 5 = Strongly Disagree). Statistical significance was determined at $P \leq 0.05$ and statistical trends were declared at $0.05 < P \leq 0.10$.

regarding perceptions about animal agriculture or food animal welfare ($P > 0.05$).

3.2.1 Perceptions of food and fiber animal production

Ninety-one percent (n = 104) of respondents agreed or strongly agreed with the statement "I support animals being used for fiber (e.g., wool)" on the pre-survey compared to 98.2% (n =112) that agreed with the same statement on the post-survey (P = 0.027; Table 2). Additionally, on the pre-survey, 96.5% (n = 110) of respondents agreed or strongly agreed with the statement "I am comfortable working hands-on with non-food animal livestock (e.g., horses or other equids)"; the proportion of respondents agreeing with this statement was reduced to 86.8% (n = 99) of respondents on the post-survey ($P < 0.0001$). For the remaining

four questions regarding perceptions of food animal production, survey responses were not statistically different between the pre- and post-surveys.

3.2.2 Perceptions of food animal welfare

For the statement "In the United States, food animals are raised with an acceptable level of animal welfare," 58.8% (n = 67) of respondents agreed or strongly agreed on the pre-survey, compared with 78.9% (n = 90) on the post-survey (P = 0.016; Table 3).

Regarding the statement "The United States' meat industry prioritizes animal welfare during the handling, transport, and slaughter of food animals," agreement (agree or strongly agree) rose from 50.1% (n = 58) on the pre-survey to 75.4% (n = 86) on the post-survey (P < 0.0001). A similar trend was observed for the statement "Food animal producers take measures to mitigate pain during routine management procedures such as castration and dehorning." While 68.4% (n = 78) of respondents agreed or strongly agreed with the statement on the pre-survey, the proportion of students agreeing with the same statement increased to 86.8% (n = 99) on the post-survey (P = 0.019). Lastly, for the other five questions related to perceptions of food animal welfare, there was no evidence that the pre- and post-survey responses differed (P > 0.05).

3.2.3 Sense of belonging

Although there was no evidence that survey responses were different between the pre- and post-surveys for any of the questions regarding students' sense of belonging in the animal sciences major, some trends arose from the analysis. The overwhelming majority of respondents (94.7%, n = 108; Table 4) stated that they agreed or strongly agreed with the statement "I feel like I belong in the animal sciences major" on the pre-survey; similarly, 91.2% (n = 104) agreed with this statement on the post-survey. In addition, answers were generally positive in response to the statement "When you think about the animal sciences major, how often, if ever, do you wonder: Maybe I do not belong here?". Approximately 72% (n = 82) of respondents replied "Never" or "Rarely" in response to the given statement. In the post-survey, a similar proportion of students (67.5%, n = 77) stated that they "Never" or "Rarely" felt like they did not belong (P = 0.051). Strong agreement was also observed for the statement "I feel like I can succeed in the animal sciences major"; on both the pre- and post-surveys, with most students either agreeing or strongly agreeing (pre-survey: 99.1%, n = 113; post-survey: 93.9%, n = 107).

3.3 Qualitative analysis

Thematic analysis was conducted on n = 106 pre-survey and n = 103 post-survey responses for two open-ended survey questions (described below).

Initial review of survey responses identified five initial themes: Learning and Curriculum, Career Goals and Aspirations, Passion for Working with Animals, Self-Assurance, and Community and Classroom Environment. After initial coding meetings, the theme of Self-Assurance was divided into two subthemes identified as Showing Confidence in Self and Lack of Self-Assurance due to a high prevalence of contrasting statements of self-assurance among responses. All theme definitions and examples of each theme used for coding are shown in Table 5. The most common theme seen in both pre- and post-survey results was Self-assurance (Subthemes: Confidence in Self and Lack of Self-Assurance).

3.3.1 The following results are for the thematic analysis pertaining to Question 1 (i.e., Please explain your answer to the question: When you think about the Animal Sciences major, how often, if ever, do you wonder: "Maybe I do not belong here?")

3.3.1.1 Learning and curriculum

This theme included any responses involving learning preferences, challenges in learning, and mention of course curriculum. Learning and Curriculum was identified in approximately 11% and 18% of total responses for pre- and post-survey, respectively. This theme was almost always present with other themes, most commonly with the Confidence in Self and Lack of Self-assurance sub-themes. The theme of Learning and Curriculum was also commonly found with the theme of Career Goals and Aspirations. Responses coded for Learning and Curriculum in the pre-survey consisted of positive responses with specific phrases in reference to excitement for learning, anticipation for the type of content taught, as well as how that content is presented specifically mentioning the hands-on nature of the major. For example, *"I enjoy learning about large animals and gaining important hands on experience"*; *"I feel like Animal Science is a place where I belong because I love learning about animals and hands on experience"*; and *"I … believe that the information I am learning here will help me with my future endeavors."* There were also responses with a more negative perspective that showed a common trend of concern for keeping up with course rigor (e.g., *"I question if I will be able to handle the rigorous courses"* and *"I feel like there are times where I get really upset with myself or have a hard time understanding things in some of classes and that leads me to think that I'm not smart enough to continue in my major however I love most [sic] everything that I'm learning in my classes so I know that this is something that I am truly interested in").*

Post-survey responses had specific details regarding apprehension about course content and struggling to keep up in class. Responses displaying apprehension for course content were commonly observed in relation to respondents' career goals and passions in which respondents felt that the major and/or course content did not align with their interests (e.g. *"I did not know animal science was mainly about livestock and production, whereas I'm more interested in the biology of animals"*, *"I'm learning more about food animal production than I thought I would be"*, *"I think sometimes I would like to learn more about all kinds of animals"*). This trend was seen in all post-survey responses that coded Learning and Curriculum and Career Goals and Aspirations together. These responses focused on the major's emphasis on livestock and food animal management whereas students were interested in other areas.

10.3389/fanim.2023.1268719

TABLE 3 Summary of both pre- and post-survey responses to Likert questions related to perceptions of food animal welfare (n = 114).

Statement	Level of Agreement	Pre-Survey		Post-Survey		P-value[1]
		n	%	n	%	
Animal welfare is an important consideration in food animal production systems.	Strongly Agree	95	83.3	95	83.3	0.58
	Agree	17	14.9	19	16.7	
	I do not know	1	0.9	0	0	
	Disagree	1	0.9	0	0	
	Strongly Disagree	0	0	0	0	
In the United States, food animals are raised with an acceptable level of animal welfare.	Strongly Agree	16	14.0	15	13.2	0.02**
	Agree	51	44.7	75	65.8	
	I do not know	25	21.9	4	3.5	
	Disagree	21	18.4	18	15.8	
	Strongly Disagree	1	0.9	2	1.8	
The United States' meat industry prioritizes animal welfare during the handling, transport, and slaughter of food animals.	Strongly Agree	11	9.6	18	15.8	<0.0001**
	Agree	47	41.2	68	59.6	
	I do not know	25	21.9	7	6.1	
	Disagree	24	21.1	17	14.9	
	Strongly Disagree	7	6.1	4	3.5	
Food animal producers take measures to mitigate pain during routine management procedures such as castration and dehorning.	Strongly Agree	22	19.3	23	20.2	0.02**
	Agree	56	49.1	76	66.7	
	I do not know	22	19.3	5	4.4	
	Disagree	14	12.3	10	8.8	
	Strongly Disagree	0	0	0	0	
Judicious use of antibiotics is important in food animal production systems.	Strongly Agree	29	25.4	32	28.1	0.21
	Agree	53	46.5	63	55.3	
	I do not know	29	25.4	14	12.3	
	Disagree	3	2.6	4	3.5	
	Strongly Disagree	0	0	1	0.9	
Social media influences my perceptions of food animal welfare.	Strongly Agree	8	7.0	16	14.0	0.45
	Agree	45	39.5	31	27.2	
	I do not know	8	7.0	4	3.5	
	Disagree	40	35.1	50	43.9	
	Strongly Disagree	13	11.4	13	11.4	
My friends or family influence my perceptions of food animal welfare.	Strongly Agree	9	7.9	14	12.3	0.88
	Agree	40	35.1	35	30.7	
	I do not know	7	6.1	2	1.8	
	Disagree	51	44.7	54	47.4	
	Strongly Disagree	7	6.1	9	7.9	
My instructors influence my perceptions of food animal welfare.	Strongly Agree	20	17.5	40	35.1	0.95
	Agree	74	64.9	48	42.1	
	I do not know	9	7.9	3	2.6	

(Continued)

TABLE 3 Continued

Statement	Level of Agreement	Pre-Survey		Post-Survey		*P*-value[1]
		n	%	*n*	%	
	Disagree	8	7.0	20	17.5	
	Strongly Disagree	3	2.6	3	2.6	

[1]Statistical significance is denoted by P-value** and statistical trends are denoted by P-value*.
P-values correspond to Wilcoxon signed-rank testing, which was used to determine if student responses to Likert questions differed between the pre- and post-surveys. For all Likert scale questions, Wilcoxon signed-rank tests were conducted with all five Likert scale categories (i.e., 1 = Strongly Agree; 2 = Agree; 3 = I do not know; 4 = Disagree; 5 = Strongly Disagree). Statistical significance was determined at $P \leq 0.05$ and statistical trends were declared at $0.05 < P \leq 0.10$.

3.3.1.2 Career goals and aspirations

This theme appeared in approximately 32% and 23% of responses for the pre- and post-survey, respectively. This theme included phrases referring to career goals with specific mention of wanting to "work with animals." The Career Goals and Aspirations theme was commonly found with one or two other themes. The most common themes coded with Career Goals and Aspirations for both the pre- and post-survey were Confidence in Self and Lack of Self-assurance. Responses coded for this theme in the pre-survey commonly referred to respondents' level of confidence in their career goals and their hope for the major to assist them in achieving those goals, both with certainty and uncertainty. Some pre-survey responses indicated overall uncertainty in career goals or having different interests outside of the animal science major (e.g., *"I want to specialize in exotic animals, so I'm not sure if Zoology would be a better fit or not"*, *"I'm still not sure if this is the major I want to choose, because I'm not sure if I can find a job that interests me"*). Pre-survey responses indicating a greater level of certainty made direct reference to respondents knowing they want to work with animals and wanting to become a veterinarian (e.g., *"I've always known I have to work with animals. Animal science is the one subject I'm extremely interested in…"*; *"I love this major, I know it will help me become a vet"*; and *"…I left California into Colorado state for the vet program so all I can do is try hard and succeed!"*). Phrases coded for this theme in the post-survey were often coded with the Lack of Self-Assurance sub-theme; responses referred to uncertainty in overall career goals as well as questioning how the major will assist them in achieving their career goals (e.g., *"I just want to make sure becoming a vet is worth it"*; *"I like learning about livestock but it isn't my goal career"*; and *"classes that focus very heavily on processing meat, make it feel like maybe I don't belong in this major because I want to pursue veterinary school"*).

3.3.1.3 Passion for working with animals

This theme included any mention of love for animals or passion in general for the field. Passion for working with animals was the second least common recorded theme in the pre-survey and the least common recorded theme in the post-survey with approximately 13% and 8% of responses, respectively. Passion for working with animals was almost always recorded with one or two additional themes, most commonly Confidence in Self or Career Goals and Aspirations. Most pre- and post-survey responses coded for this theme were positive, such as: *"I have a passion for animals and their well-being"*; *"I love working with large animals"*; and *"Animals are one of the few things that I genuinely love and care about"*. Additionally, many comments reflected on this passion for working with animals as a lifetime desire (e.g., *"Working with livestock has always been a passion of mine"*; *"I wanted to study animals since I was a kid"*; and *"I love animals and have been wanting to be around animals and help them all my life"*).

3.3.1.4 Self-assurance

The Self-Assurance theme consisted of two subthemes: Showing Confidence in Self and Lack of Self-Assurance. Responses coded for these subthemes included respondents' perceptions of themselves, their capabilities, and their major (i.e., Animal Science). Frequencies of these themes varied between the pre- and post-survey, but both subthemes were the most commonly occurring themes present in about 40-50% of all responses.

3.3.1.4.1 Subtheme: confidence in self

Phrases that were coded for Confidence in Self in pre- and post-survey responses mentioned enjoying the class, the professors, and the animal science major, as well as having confidence in career goals, and self-determination to succeed. Pre-survey responses identifying Confidence in Self were often seen in phrases coded for confidence in career goals and passion for animals; for example, *"I know I want to be an Ag teacher so I know this is where I belong"* and *"I do belong in the animal science major since I love animals"*). Many pre-survey phrases coded for this theme specifically mentioned prior livestock and animal handling experience such as: *"I have been around meat animals most of my life so I believe I am in the right place"*; *"Growing up surrounded by beef cattle it was always a passion of mine to help out on the farm and establish an understanding of the meat production, so I do not feel out of place with my choice of major"*; and *"I grew up working with livestock and I've always wanted a career in animal science, so there is never a doubt in my mind that the animal science department is where I belong"*. In post-survey responses coded for confidence in self, respondents mentioned knowing they are in the right major, loving the classes, and having certainty in what they want to do in the future. For example, *"I've grown to come very excited about this major and love it more as I learn more"*; *"I feel like this major sets me up for success"*; and *"I work hard to do well in my classes and I'm passionate about what I'm learning, I don't think I would be as happy or successful in another major."*

3.3.1.4.2 Subtheme: lack of self-assurance

Phrases coded for the Lack of Self-Assurance sub-theme mentioned feelings of not fitting in, feeling less capable than others,

10.3389/fanim.2023.1268719

TABLE 4 Summary of both pre- and post-survey responses to Likert questions related to sense of belonging and comfort in the Animal Sciences major (n = 114).

Statement	Level of Agreement	Pre-Survey		Post-Survey		P-value[1]
		n	%	n	%	
I feel like I belong in the Animal Sciences major.	Strongly Agree	79	69.3	79	69.3	0.26
	Agree	29	25.4	25	21.9	
	I do not know	4	3.5	4	3.5	
	Disagree	2	1.8	3	2.6	
	Strongly Disagree	0	0	3	2.6	
When you think about the Animal Sciences major, how often, if ever, do you wonder: "Maybe I do not belong here?"	Never	47	41.2	33	28.9	0.051*
	Rarely	35	30.7	44	38.6	
	Sometimes	24	21.1	31	27.2	
	Frequently	7	6.1	4	3.5	
	Always	0	0	2	1.8	
	I do not know	1	0.9	0	0	
I feel like I can succeed in the Animal Sciences major.	Strongly Agree	64	56.1	61	53.5	0.09*
	Agree	49	43.0	46	40.4	
	I do not know	0	0	3	2.6	
	Disagree	1	0.9	2	1.8	
	Strongly Disagree	0	0	2	1.8	
I feel comfortable discussing difficult or controversial topics with my instructors.	Strongly Agree	43	37.7	42	36.8	0.45
	Agree	54	47.4	64	56.1	
	I do not know	15	13.2	4	3.5	
	Disagree	2	1.8	4	3.5	
	Strongly Disagree	0	0	0	0	
I feel comfortable discussing difficult or controversial topics with my peers.	Strongly Agree	37	32.5	33	28.9	0.85
	Agree	58	50.9	67	58.8	
	I do not know	13	11.4	5	4.4	
	Disagree	6	5.3	9	7.9	
	Strongly Disagree	0	0	0	0	
I feel comfortable asking questions and sharing my perspective in class about topics related to animal welfare.	Strongly Agree	38	33.3	29	25.4	0.07*
	Agree	63	55.3	68	59.6	
	I do not know	5	4.4	6	5.3	
	Disagree	8	7.0	10	8.8	
	Strongly Disagree	0	0	1	0.9	
My background and prior experiences with animals have prepared me for success in the Animal Sciences major.	Strongly Agree	43	37.7	40	35.1	0.17
	Agree	38	33.3	43	37.7	
	I do not know	17	14.9	5	4.4	
	Disagree	15	13.2	17	14.9	
	Strongly Disagree	1	0.9	9	7.9	

(Continued)

TABLE 4 Continued

Statement	Level of Agreement	Pre-Survey		Post-Survey		*P*-value[1]
		n	%	*n*	%	
My instructors foster classroom environments where I feel comfortable sharing my ideas, opinions, and perspectives.	Strongly Agree	40	35.1	48	42.1	0.08*
	Agree	62	54.4	61	53.5	
	I do not know	12	10.5	4	3.5	
	Disagree	0	0	1	0.9	
	Strongly Disagree	0	0	0	0	
My peers foster classroom environments where I feel comfortable sharing my ideas, opinions, and perspectives.	Strongly Agree	30	26.3	30	26.3	0.15
	Agree	56	49.1	72	63.2	
	I do not know	25	21.9	5	4.4	
	Disagree	3	2.6	7	6.1	
	Strongly Disagree	0	0	0	0	
I feel welcomed, supported, and valued in this major.	Strongly Agree	66	57.9	63	56.2	0.75
	Agree	40	35.1	42	37.5	
	I do not know	6	5.3	4	3.6	
	Disagree	2	1.8	2	1.8	
	Strongly Disagree	0	0	1	0.9	

[1]Statistical significance is denoted by P-value** and statistical trends are denoted by P-value*.
P-values correspond to Wilcoxon signed-rank testing, which was used to determine if student responses to Likert questions differed between the pre- and post-surveys. For all Likert scale questions, Wilcoxon signed-rank tests were conducted with all five Likert scale categories (i.e., 1 = Strongly Agree; 2 = Agree; 3 = I do not know; 4 = Disagree; 5 = Strongly Disagree). Statistical significance was determined at $P \leq 0.05$ and statistical trends were declared at $0.05 < P \leq 0.10$.

struggle with course rigor, questioning career choices and questioning how the major aligns with their career goals. Lack of Self-Assurance was coded with Career Goals and Aspirations at the greatest frequency compared to other themes in the pre- and post-surveys. Most commonly, phrases coded for this theme referred to general uncertainty about career goals and uncertainty in picking the right major. Respondents expressed uncertainty regarding learning about livestock while having interests in other species or fields (e.g., *"I feel*

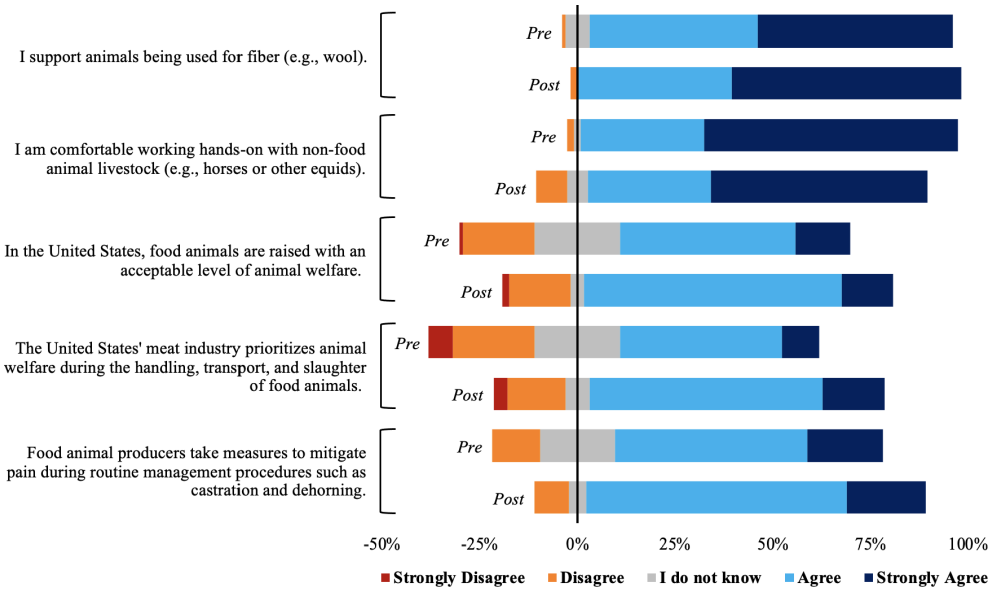

FIGURE 1
Five Likert scale statements that differed significantly between the pre- and post-surveys based on Wilcoxon signed-rank testing ($P \leq 0.05$) are visualized in the above figure. Quantitative analysis was performed on $n = 114$ paired survey responses.

TABLE 5 Respondents were asked to explain their answer to the question: "When you think about the Animal Sciences major, how often, if ever, do you wonder: "Maybe I do not belong here?".

Theme	Main Concepts	Primary Examples	Pre-Survey		Post-Survey	
			n	%	*n*	%
Learning and Curriculum	Learner preferences and styles; challenges and successes associated with learning; curriculum was included in this category, but mentioned infrequently	*"…sometimes I believe that I am behind and just don't have the skills to pass the classes."* *"…I really enjoy my classes and enjoy what I'm learning about."* *"…I love learning about animals and hands on experience."*	12	11.3	19	18.4
Career Goals and Aspirations	Direct mention of a career (more broadly), specific job, or specialization; future aspirations and goals	*"…I've always wanted a career in animal science…"* *"I've wanted to be a veterinarian since I was 5…"* *"I want to specialize in exotic animals…"*	34	32.1	24	23.3
Passion for Working with Animals	Love or passion to work with animals; desire to improve animal wellbeing; most often associated with a "lifelong" component	*"I've always loved animals and I've had a lot since I was a kid all the way up until now and now I want to help animals anyway I can."* *"I have a passion for animals and their wellbeing."* *"I not only love animals, but I believe they are essential to human welfare. From cuddle companions to large cows, all animals serve a purpose."*	14	13.2	8	7.8
Self-Assurance (2 subthemes)						
Showing Confidence in Self	Strong sense of ability or belonging as it pertains to the major; referring to confidence due to: experiences, background, work ethic, knowledge; frequently appeared alongside the Lack of Self-Assurance subtheme	*"I know this major is for me."* *"I've been involved in animal sciences throughout most of my life, and I've never considered that I dislike it."* *"I was raised on a ranch with large animals and raised around a large animal hospital my whole life. I grew a passion for it at such a young age and that passion has just grown stronger over the years. I know this is the major for me because I am loving what I am learning."* *"Ever since I started at CSU, I have felt very comfortable with my choice to be an animal science major and I feel like it suits me."*	53	50.0	49	47.6
Lack of Self-Assurance	Questions sense of ability or belonging as it pertains to the major; referring to confidence due to: experiences, background, work ethic, knowledge; frequently appeared alongside the Showing Confidence in Self subtheme	*"I wonder if it is the right major for me as I am interested in vet school and so far the major seems 100% focused on food animals…"* *"…I question if maybe my calling is somewhere else or I'm not meant for this major."* *"Sometimes I worry that I do not have the skill set or background to work with livestock."* *"I've had my doubts since I come from a background of not having any experience with cattle or any type of livestock."*	49	46.2	42	40.8
Community and Classroom Environment	Interactions with people, including with faculty, staff, peers, and others; details specific to the classroom (i.e., class size, judgement from others, etc.) was included in this category, but mentioned infrequently	*"I always feel so welcomed by everyone in the Animal Science department."* *"All of the faculty in the Department of Animal Sciences have been very helpful in reassuring me that I have made the right decision with my major."* *"I have felt very welcomed by everyone and it has made me even more excited about my transition to CSU and my major!"* *"There has been some points at this semester when all of my classmates around me would talk about their previous experience with animals such as 4H, so I feel like I may not be qualified enough to be here."*	9	8.5	12	11.7

Thematic analysis was conducted on respondent answers. Definitions of each theme, the main concepts within each theme, and a sample of respondent explanations are detailed in the table below (Pre: n = 106; Post: n = 103).

zoology is a better fit for me rather than animal science"; *"The animal science major here does not focus on small animals"*; and *"I am on the fence about switching my major to equine sciences or zoology"*). Respondents also mentioned feeling less capable compared to peers that had prior knowledge and experience with livestock (e.g., *"I'm coming into the program with little to no hands on experience so it's a little intimidating when I compare myself to others who already have years of experience under their belt"*; *"Sometimes I feel that I might not be smart enough"*; and *"It is a little discouraging since there are many people with lots of hands on experience with livestock and I do not have any"*). Additionally, some respondents mentioned struggling "to keep up" with course content compared to their peers, leading to respondents doubting their capabilities (e.g., *"sometimes I feel that I have to work harder to keep up with other students, which makes me question if this major is for me"* and *"Sometimes, meaning I get in my own head and think maybe I don't have enough time management for the resources available to further my understanding and help with my career path"*).

3.3.1.5 Community and classroom environment

This theme was found infrequently relative to other themes in both the pre- and post-survey responses (pre-survey: 8.5%, post-survey: 11.7%). Phrases coded with this theme mentioned students' perceptions of belonging among their peers and belonging within the College of Agricultural Sciences and Animal Science major itself. This theme was most often recorded with the sub-themes Confidence in Self or Lack of Self-Assurance, demonstrating contrasting views on Community and Classroom Environment between respondents. In both pre- and post-surveys, responses with positive perceptions of the environment almost always referenced interactions with professors and staff while negative perceptions were most often in reference to interactions with peers. Responses coded for this theme that were positive in nature included phrases such as: *"I think the major is very inclusive, no matter what career path you want to go on"*; *"It is an [accepting] environment"*; and *"I feel like it's a very diverse group of students"*). Additionally, there were several responses related to faculty and staff creating an inclusive environment such as: *"I feel welcomed by staff"*; *"I've grown to be very comfortable with all of my professors"*; and *"All the faculty seems kind and accepting and also want our success"*. Responses with a more negative perspective included phrases such as*: "Sometimes I feel intimidated by the other students because they seem to have a lot more knowledge and hand-on experience on animals, especially livestock, and I have none"*; *"I'm usually by myself because nobody wanted to work with someone who doesn't own livestock"*; and *"I feel like sometimes I can be judged on how I present myself (I am queer and dress in alternative fashion mostly) and how much knowledge I have within my major"*). Many of these negative responses were related to respondent's perception of self and feeling like they don't fit in.

3.3.2 The following results are for the thematic analysis pertaining to Question 2 (i.e., What would make you more comfortable sharing your ideas, opinions, or perspectives in the classroom)?

3.3.2.1 Community and classroom environment

Using survey branching logic, this question was only presented to respondents who disagreed or strongly disagreed with at least one of the following statements: "My peers foster classroom environments where I feel comfortable sharing my ideas, opinions, and perspectives" or "My instructors foster classroom environments where I feel comfortable sharing my ideas, opinions, and perspectives." Therefore, only a small proportion of respondents answered this question in the pre-survey (2.6%) and post-survey (7.0%). Although the difference was small and not statistically significant, post-survey results saw a greater proportion of responses to this question compared to pre-survey responses. The only theme coded in 100% of responses for this question was Community and Classroom Environment. All responses gave reference to the classroom environment and acceptance from peers. The common trend seen throughout these responses mentioned feelings of "judgment" from peers within the major and feeling that peers are not "open-minded" or "accepting" of different opinions and the desire for smaller class sizes. Examples of this include, *"People still have judgement based on what people say, so having a judge free zone would be ideal"*; *"…people could be more open minded"*; and *"Smaller class size where we can talk with everyone in the class."*

4 Discussion

This study had multiple aims, all focused on understanding perceptions of undergraduate students enrolled in an introductory Animal Science course at CSU. This course was unique in that it utilized experiential learning to provide students with hands-on livestock experience and in that for most students, it occurred during the first semester that students attended the university, a pivotal time in their educational journey. The objectives of this study were to explore student perceptions regarding food animal production and sense of belonging at this critical juncture at the beginning of the students' animal science education. Understanding student perceptions is crucial for evaluating educational programming, improving teaching approaches, and fostering student engagement, retention, and success. Gaining insight into contemporary student perceptions of food animal production is also essential for maintaining an educational program that effectively equips future professionals to tackle emerging industry challenges and champion responsible food animal production practices.

In the present study, most students who took the class identified as white women, and in general, this aligns with previously reported data on animal science student populations (Lyvers Peffer, 2011; Parrish et al., 2015; Mijares et al., 2021). In the current study, the vast majority of students surveyed wanted to be veterinarians (over 80%) and approximately one-third indicated having a companion animal interest. Similarly, researchers at the University of Florida collected data over a three-year period from a population of animal science students who participated in a multispecies large-animal management and production practicum and found that 64% of students aspired to attend veterinary school, of which nearly 50% were interested in companion animals, followed by wildlife, horses, or zoo animals (Reiling et al., 2003). The low interest in food animals found in incoming animal science students could be related to limited experience interacting with livestock prior to university enrollment. In the Reiling et al. (2003) study, only four percent of respondents were raised on a farm or ranch and 86% had minimal or no experience working with large food animals. The data from Reiling et al. (2003), although now several decades old, underscores current trends pertaining to the shift in student backgrounds and experience levels with livestock. In 1987, Reese et al. (1987) reported that 92.5% of animal science majors had experience with food animals upon starting their degree programs. Since then, in more recent surveys of animal science undergraduates, the percentage of incoming students with livestock experience has fallen, ranging from 13.9% to 42.9% depending on the study and type or level of animal experience (Reiling et al., 2003; Bundy et al., 2019). Interestingly, over half of the respondents in the current study stated they had prior experience working with food animals (e.g., cows, pigs, sheep, chickens, etc.), which was an unexpected finding since the majority of students grew up in population areas not as

commonly associated with large livestock populations (i.e., two-thirds came from suburban or urban hometowns and over three-quarters came from non-agricultural backgrounds). In the current study, the survey tool did not define what "experience with food animals" meant and thus, it is possible that "experience" was interpreted differently between respondents (i.e., hands-on experience vs attending a farm tour). In a previous survey of animal science undergraduates, 26.4% of respondents indicated having prior poultry handling experience but when asked to rank their level of experience (i.e., none, low, moderate, high), only 11.8% stated that they had a moderate or high level of experience (Bundy et al., 2019). Bundy et al. (2019) also noted that although an average of 42.9% of students stated that they had experience with livestock species (i.e., categorized as beef cattle, dairy cattle, equine, poultry, sheep, and swine), the experience was heavily weighted (70.1%) towards experience with horses. Therefore, it is possible that students in the current study inadvertently conflated their experience working with other animals, such as with horses, companion, or exotic animals, to working with livestock raised for food production.

As a response to the change in the hands-on livestock experience of incoming undergraduate students and to equip students with the skills and knowledge necessary to work in the animal sciences, one of the major objectives of the ANEQ 101 course is to provide students with experiential learning opportunities with food animals early on in their degree programs. An added benefit of doing so is that this may help incoming students, particularly those with little to no food animal experience, feel like they belong and can succeed in the Animal Science major regardless of their backgrounds or prior experiences. Although the course has incorporated in-class demonstrations and some hands-on experiences in past iterations, in 2021, the course was redesigned to expand students' experiences with food animals and improve the overall student experience by incorporating an experiential learning component into the curriculum. Previous research conducted in animal science courses, although limited, has shown that hands-on learning experiences stimulate students' interest and understanding of the material being taught (Reiling et al., 2003; Ruiz-Romero and Vargas-Bello-Pérez, 2022; Sullivan et al., 2022b) – further highlighting the importance of integrating innovative teaching strategies that improve student experiences and outcomes into the animal science curriculum. During the first four weeks of ANEQ 101, dairy calves, purchased from a commercial dairy and raised at a CSU research facility, are used in a series of four hands-on laboratories in which students learn how to properly handle animals, assess animal health and welfare, administer vaccines and medications as necessary under veterinary supervision, and carry out routine management procedures including the castration and dehorning of the calves. Novel to ANEQ 101, this experiential learning opportunity – the first of its kind in the Department of Animal Sciences at CSU, aligns with the goals of CSU's 'First Four Weeks' (FFW) Initiative, which was launched as a university-wide student success initiative in 2018 (Source, 2018). It is well established that a student's first few weeks in a course are associated with their success (Wilson et al., 2016; Van Rooij et al., 2018) and, therefore, inextricably linked to retention and graduation rates; according to data collected internally at CSU, a student that is meeting course expectations at week four has an observed success rate in the course of 90.4% (Barone, 2019). The FFW initiative stresses relationship building, encourages faculty to foster a sense of belonging among their students, and promotes active and engaged learning that integrates student support into every teaching and learning practice (Source, 2018; TILT, 2022). Although informal class surveys have been administered to understand how students feel about ANEQ 101 course activities, this study is the first formal assessment of how the course impacts perceptions about food animal production and sense of belonging.

Responses to the pre- and post-survey indicated that almost all students were comfortable with food animal production and their perceptions were not significantly altered during the semester. Considering that all the students included in the study were Animal Science majors, it seems reasonable to think that the selection of an agriculturally based major is in part due to a desire to be involved in and learn more about food production and thus related to potentially more positive viewpoints about production agriculture. Generally, consumers, which includes students, are becoming more interested in understanding where their food comes from (Asioli et al., 2017; FMI, 2022) and have expectations for animal care and welfare (Prickett et al., 2010; Vanhonacker and Verbeke, 2013; Sánchez-Bravo et al., 2021) that can influence their food choices. Despite this growing interest in the credence attributes (i.e., welfare friendly practices, humanely raised) of food, there is a considerable gap in knowledge of the public on how food is produced and raised (Schröder and McEachern, 2004; Cornish et al., 2016). Thus, an introductory course such as ANEQ 101 is critical in preparing students for and getting them excited about careers as animal scientists. It should be noted that not all students within the course participated in the survey and therefore students who were potentially uncomfortable with food animal production were not captured in the study; there were 189 animal science majors enrolled in the course but only 114 were included in the study. For study inclusion, respondents had to consent to participate in the research and complete both a pre- and post-survey. While the sample of students included more than half of the class population, there may be some bias in the study sample as students who were potentially uncomfortable with the lecture or laboratory content, or the course or the major in general, potentially did not attend class on a consistent basis or consent to participate and were thus not represented in the survey data. In future research, it is important to understand the perspectives of students that do not participate and their rationale for doing so, i.e., lack of interest, discomfort with the topic, or simply a lack of engagement in class activities.

Specifically looking at animal welfare, student agreement with the statements "food animals are raised with an acceptable level of animal welfare" and "producers take measures to mitigate pain during routine management procedures" increased in the post survey results. Animal welfare has been identified as a top concern for many consumers (Clark et al., 2016; FMI, 2022) and students (Sullivan et al., 2022a) alike. Sometimes, livestock production is criticized for some of its animal care and management practices, including confinement housing and painful procedures

like castration or dehorning (Weary et al., 2016; Olynk Widmar et al., 2017) and thus it was encouraging to see students' positive responses to welfare topics prior to being exposed to the animal science curriculum. In a recent nationwide survey of animal science student perceptions of animal welfare, there were differences in opinions regarding the level of animal welfare provided to different types of food animals in current production systems (Sullivan et al., 2022a). Depending on the species, between 19.4% and 49.7% of the study participants did not agree that current methods used to raise specific food or fiber animals provided an appropriate level of animal welfare (Sullivan et al., 2022a). Additionally in the Sullivan et al. (2022a) study, depending on species, between 5.8% and 17.8% of participants did not think they had enough information to answer the question. Therefore, it is possible that students in the current study came into this introductory course with an elevated level of positivity towards the welfare of food animals in production systems. This positive shift in perception of animal welfare seen in the current study may be attributed to class content, which included guest lectures providing students with information about animal production practices in the United States and opportunities to participate in hands-on labs related to common production practices. More specifically, in one lab, students participated in castrating bull calves and learned about pain mitigation techniques and protocols. By actively participating in these hands-on experiences, students had the opportunity to witness and apply practical measures to alleviate pain, fostering a deeper understanding of the importance of pain mitigation to animal welfare. These firsthand experiences likely influenced their perceptions of animal welfare in livestock production. A study examining the impact of an experiential learning activity (i.e., using a model cow head in a stunning simulation) on students' perceptions of humane slaughter demonstrated that participation in the experiential learning activity was highly effective for students' overall understanding and comfort with the material (Sullivan et al., 2022b). In the Sullivan et al. (2022b) study, the majority of respondents strongly agreed that the model head and captive bolt activity they engaged in was beneficial to their learning (72.4%) and improved their understanding of slaughter (55.2%). Additionally, nearly all students (96.6%) either agreed or strongly agreed that the experiential model improved their comfort with the slaughter process (Sullivan et al., 2022b). While the available literature on the impact and efficacy of experiential learning in the animal sciences discipline is limited, it is evident from available literature that incorporating hands-on activities into the animal science curriculum gives students the opportunity to become familiarized with new experiences while promoting active learning, engagement, and comfort with the process.

In addition to understanding the impact of this course on perceptions of food animal production, one of the objectives of this study was to understand students' sense of belonging (i.e., sense of being accepted, valued, and included, Goodenow, 1993) during the first semester within this major. It has been shown that a sense of belonging is significant to overall student performance, success, and retention while attaining a STEM degree (Freeman et al., 2007; Pittman and Richmond, 2008; Chen et al., 2021), of which animal science is a part. In the current study, the majority of the respondents strongly agreed or agreed that they belonged in the animal science major. Interestingly, for all agreement statements related to a sense of belonging, there was no change between the pre- and post-survey likely related to the fact that, overall, the sense of belonging and level of comfort with communication and the classroom environment was relatively high coming into the course. Students were also asked how frequently they thought they may not belong in the major with the opportunity to explain why they chose the answer they did. One of the most common themes resulting from the qualitative analysis of this free response question was the theme of Self-Assurance. This theme included both feelings of Showing Confidence in Self and Lack of Self-Assurance, sometimes even seen together within the same response (e.g., *"…I believe I do belong in the animal science major since I love animals and have been wanting to be around animals and help them all my life, but sometimes it can get a little too hard to understand which kind of sets an alarm in my head that I can't do this but I won't give up on this major I just have to keep pushing."*). Responses demonstrating a Lack of Self-Assurance often included mentions of the difficulty in understanding the subject area and the struggle to keep up with peers. It should be noted that most respondents were in their first semester of post-secondary education, a time point when students have the highest expectations of themselves both socially and academically (Smith and Wertlieb, 2005). Additionally, the pre-survey was conducted during the first week of the semester, when students can be both excited and anxious about transitioning to university life (Chow and Healey, 2008), which could have contributed to their high (or low) self-assessments of their skills. Although the scope of this study was not to measure course outcomes in terms of letter grade received, lack of self-assurance and belonging could have been influenced by students' overall course grade, especially in the post-survey as it was administered during the last week of the semester. Student success in a course as measured by their grade performance has been demonstrated to increase a student's sense of self-worth and belonging within a college major (Krause-Levy et al., 2021; Cwik and Singh, 2022), of which the opposite can also be true. In future research, the use of a mid-semester survey would help elucidate struggles students face in terms of belonging and self-assuredness at a different point in the semester.

Interestingly, despite the mentions of personal characteristics that made students feel inferior or not belong, i.e., agricultural background and livestock experience primarily, there was no impact of demographics (e.g., ethnicity, gender, hometown, livestock background) on respondents' answers to questions regarding sense of belonging or perceptions about agriculture. It is important to note, however, that not all students consented to participate in the current study which could have introduced a potential source of bias into the results (e.g., those that did not feel like they belonged or had more negative perceptions of agriculture may not have participated). Other studies have found that race and gender, and the unbalanced representation of minority demographic groups, can impact the sense of belonging in STEM majors (Rainey et al., 2018; Sax et al., 2018; Mooney and Becker, 2020; Drewery et al., 2023); for example, compared to their white counterparts, ethnoracial minority students enrolled in an agricultural major were less likely to report that they

belonged in agriculture (Drewery et al., 2023). In regard to perceptions about food production, much of the past research focuses on how consumer demographics, such as age, gender, and household income, relate to food purchase decisions, preferences for, perceptions of, and willingness to pay for livestock and poultry (Prickett et al., 2010; Bejaei et al., 2011; McKendree et al., 2014; Miranda-de la Lama et al., 2018). Perhaps in this study population there was not enough variation in responses to identify any relationships with student attributes. It would be helpful to understand how students' identities influence perceptions as that would aid in the development of supportive resources for students. Future research should ask for more details around certain questions such as livestock experience and agricultural background to enable identification of influential factors in both perceptions of food animal production and sense of belonging.

Several other themes were present in the answers to the free response question pertaining to frequency of doubts about belonging in the major. However, these responses were less frequent. Research has shown that students who major in STEM fields, including animal science, have been shown to find belonging at the classroom level more impactful and significant to their success than belonging at the university level (Wilson et al., 2015), thus one theme worth noting is Community and Classroom Environment. Responses within this theme were very positive, identifying comfort with faculty and a welcoming environment. Students' sense of belonging is affected by interactions with faculty and faculty engagement inside and outside the classroom (Hurtado et al., 2011; Christe, 2013; Whitten et al., 2020) and thus it is meaningful that students in the current study had positive interactions with the professors they interacted with during their first semester, (e.g., *"The Ag professors at CSU simply go above and beyond, and my experience at this school is exemplary as a result"* and *"All of the faculty in the Department of Animal Sciences have been very helpful in reassuring me that I have made the right decision with my major…").* It is important to share this feedback with faculty so that they can see the value in their interactions with students during this critical first semester.

Although many students reported a positive sense of belonging in both the quantitative and qualitative analysis, a small proportion of students disagreed or strongly disagreed with the statement "I feel like I belong in the Animal Sciences major" (i.e., 8 students across both surveys). While the number of students who indicated having a negative sense of belonging was low, it is important to identify the reasons for students not feeling welcomed in their chosen major. When respondents were asked to explain why they felt as though they did not belong in the Animal Science major, common sentiments surrounding the concept of belonging arose in answers to this question, which included students' self-reported non-agricultural backgrounds, inexperience with food animals, lack of interest in food production, or even how they present themselves to the world (e.g., the way they speak or dress). Even though the vast majority of students in the survey lacked an agricultural background (greater than 80%) and almost half reported having no prior food animal experience, some students still felt like their non-agricultural backgrounds and lack of experiences with food animals made them a minority and were potential barriers to their success in the major. For the benefit of students who express concerns about lack of belonging, perhaps it would be helpful for students to engage in discussions about previous experiences they and their classmates have had with livestock at the start of the semester to highlight the similarities between them. There are also opportunities to interact with students outside of the classroom (i.e., during office hours or before or after class) who have identified feeling as though they do not fit in or maybe have limited participation in class to help promote a sense of belonging. A novel teaching opportunity, i.e., an immersive field trip of the beef cattle industry in the Texas panhandle, improved minority students' sense of belonging in the agricultural field (Drewery et al., 2023), which is a promising teaching tool for improving sense of belonging among animal science students, particularly among minority students in agriculture.

4.1 Conclusion

Student demographics from the current study align with previously reported data on animal science student populations. The novel student-centered pedagogical approach integrated into the ANEQ 101 curriculum served as a useful tool for providing students with diverse backgrounds and experience levels the opportunity to gain practical understanding of the animal production industry and acquire tangible food animal experience. Overall, students' perceptions of food and fiber animal production were overwhelmingly positive as the majority of respondents reported being comfortable with animal agriculture. Even though perceptions of food animal welfare were mostly positive at the beginning of the course, there was still a positive shift in attitudes regarding animal welfare at the end of the course. The results of this survey indicate that engaging students in active, hands-on learning activities are effective methods for teaching animal science students about animal agriculture, and, more specifically, about topics related to animal welfare. This study also provided novel data regarding students' sense of belonging in the animal sciences field. The vast majority of students had a strong sense of belonging in the Animal Science major at both the beginning and end of the course. The results indicate that most students enjoyed what and how they were learning, the community that they found in their major, and the job outlook that their education would provide them, all contributing to their sense of belonging in the animal sciences. Additionally, students repeatedly reported that their interactions with faculty and staff, both inside and outside of the classroom, had a strong influence on their positive perceptions about their sense of belonging in the major, an encouraging finding that warrants future investigation. Although the occurrence of this was limited, some students felt they lacked belonging in the major. Consequently, more work is necessary to understand how student demographics impact belonging in agriculture and how best to support students who feel like they do not belong. Lastly, it is evident that this course plays an important role in shaping students' perceptions of food animal production, especially with the trend towards students having less experience with food animal production when they enter an agriculturally based major.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving humans were approved by Colorado State University Institutional Review Board. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

PS: Conceptualization, Data curation, Formal Analysis, Methodology, Project administration, Writing – original draft, Writing – review & editing. CS: Formal Analysis, Writing – original draft, Writing – review & editing. EM: Formal Analysis, Writing – original draft, Writing – review & editing. AF: Formal Analysis, Writing – original draft, Writing – review & editing. SM: Writing – original draft, Writing – review & editing. NR-M: Conceptualization, Formal Analysis, Methodology, Supervision, Writing – review & editing. CC: Conceptualization, Formal Analysis, Methodology, Writing – review & editing. JA: Conceptualization, Methodology, Writing – review & editing. LS: Conceptualization, Supervision, Writing – review & editing. LE-C: Conceptualization, Data curation, Formal Analysis, Methodology, Project administration, Supervision, Writing – original draft, Writing – review & editing.

Funding

The author(s) declare financial support was received for the research, authorship, and/or publication of this article. The authors would like to thank the Colorado State University One Health Institute and the Patten-Davis Foundation Y-Cross teaching support funds for making this project possible.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fanim.2023.1268719/full#supplementary-material

References

Apriceno, M., Levy, S. R., and London, B. (2020). Mentorship during college transition predicts academic self-efficacy and sense of belonging among STEM students. *JCSD* 61, 643–648. doi: 10.1353/csd.2020.0061

Asioli, D., Aschemann-Witzel, J., Caputo, V., Vecchio, R., Annunziata, A., Næs, T., et al. (2017). Making sense of the "clean label" trends: A review of consumer food choice behavior and discussion of industry implications. *Food Res. Int.* 99, 58–71. doi: 10.1016/j.foodres.2017.07.022

Barone, R. (2019). Internal data from: The Essential First Four Weeks: Student Success Initiatives, Data, Context, and Demographics.

Bejaei, M., Wiseman, K., and Cheng, K. M. (2011). Influences of demographic characteristics, attitudes, and preferences of consumers on table egg consumption in British Columbia, Canada. *Poult. Sci.* 90, 1088–1095. doi: 10.3382/ps.2010-01129

Bettencourt, G. M. (2021). "I Belong Because It Wasn't Made for Me": Understanding working-class students' sense of belonging on campus. *J. Higher Educ.* 92, 760–783. doi: 10.1080/00221546.2021.1872288

Braun, V., and Clarke, V. (2006). Using thematic analysis in psychology. *Qual. Res. Psychol.* 3, 77–101. doi: 10.1191/1478088706qp063oa

Bredow, C. A., Roehling, P. V., Knorp, A. J., and Sweet, A. M. (2021). To flip or not to flip? A meta-analysis of the efficacy of flipped learning in higher education. *Rev. Educ. Res.* 91, 878–918. doi: 10.3102/00346543211019122

Buchanan, D. S. (2008). ASAS Centennial Paper: Animal science teaching: A century of excellence. *J. Anim. Sci.* 86, 3640–3646. doi: 10.2527/jas.2008-1366

Bundy, J. M., Sterle, J. A., Johnson, A. K., and Krahn, G. T. (2019). The impact of an introductory animal handling course on undergraduate students who lack previous livestock handling experience. *J. Anim. Sci* 97, 3588–3595. doi: 10.1093/jas/skz095

Chen, S., Binning, K. R., Manke, K. J., Brady, S. T., McGreevy, E. M., Betancur, L., et al. (2021). Am I a science person? A strong science identity bolsters minority students' sense of belonging and performance in college. *Pers. Soc Psychol. Bull.* 47, 593–606. doi: 10.1177/0146167220936480

Chicca, J., and Shellenbarger, T. (2018). Connecting with Generation Z: approaches in nursing education. *Teach. Learn. Nurs.* 13, 180–184. doi: 10.1016/j.teln.2018.03.008

Chicioreanu, T. D., and Amza, C. G. (2018). Adapting your teaching to accommodate the next generation/Generation-Z of learners. 3, 13–20. doi: 10.12753/2066-026X-18-143

Chow, K., and Healey, M. (2008). Place attachment and place identity: First-year undergraduates making the transition from home to university. *J. Environ. Psychol.* 28, 362–372. doi: 10.1016/j.jenvp.2008.02.011

Christe, B. (2013). The importance of faculty-student connections in STEM disciplines: A literature review. *J. Stem Educ.* 14, 22–26.

Clark, B., Stewart, G. B., Panzone, L. A., Kyriazakis, I., and Frewer, L. J. (2016). A systematic review of public attitudes, perceptions and behaviours towards production diseases associated with farm animal welfare. *J. Agric. Environ. Ethics* 29, 455–478. doi: 10.1007/s10806-016-9615-x

Cleere, J. J., Loux, S., Holub, G., Degenhart, S. H., and Hairgrove, T. (2012). Animal science and veterinary student perception of farm animal welfare practices. *Bov. Pract.* 46, 112–119. doi: 10.21423/bovine-vol46no2p112-119

Cornish, A., Raubenheimer, D., and McGreevy, P. (2016). What we know about the public's level of concern for farm animal welfare in food production in developed countries. *Animals* 6, 74. doi: 10.3390/ani6110074

Cwik, S., and Singh, C. (2022). Students' sense of belonging in introductory physics course for bioscience majors predicts their grade. *Phys. Rev. Phys. Educ. Res.* 18, 10139. doi: 10.1103/PhysRevPhysEducRes.18.010139

Daigle, C. L. (2016). In search of the urban cowboy: The need to incorporate animal husbandry into the United States higher education curriculum and its implications for production animal welfare. *Front. Vet. Sci.* 3. doi: 10.3389/fvets.2016.00084

Drewery, M. L., Cooper, J. V., Waliczek, T. M., and Wickersham, T. A. (2023). An immersive field trip focused on beef production increases the sense of belonging in ethnoracial minority college students. *Transl. Anim. Sci.* 7, txad001. doi: 10.1093/tas/txad001

Erickson, M. G., Guberman, D., Zhu, H., and Karcher, E. (2019). Interest and active learning techniques in an introductory animal science course. *NACTA J.* 63, 293–298.

Erickson, M., Marks, D., and Karcher, E. (2020b). Characterizing student engagement with hands-on, problem-based, and lecture activities in an introductory college course. *TLI* 8, 138–153. doi: 10.20343/teachlearninqu.8.1.10

Erickson, M. G., Ranathunga, S. D., and Wattiaux, M. A. (2020a). Animal sciences undergraduate education since the ASAS centennial: A national survey and scoping review. *Transl. Anim. Sci.* 4, txaa202. doi: 10.1093/tas/txaa202

Ferree, L., Román-Muñiz, N., Edwards-Callaway, L., Buchan, T., Todd, J., and Cramer, C. (2022). Assessing the effect of case-based teaching compared with lecture-based teaching on students' knowledge and perceptions in a senior undergraduate dairy cattle management course. *Transl. Anim. Sci.* 6, txac033. doi: 10.1093/tas/txac033

FMI (2022). The Power of Meat: An in-depth look at meat through the shopper's eyes.

Free, N., Menendez, H. M., and Tedeschi, L. O. (2021). A paradigm shift for academia teaching in the era of virtual technology: The case study of developing an edugame in animal science. *Educ. Inf. Technol.* 27, 625–642. doi: 10.1007/s10639-020-10415-w

Freeman, T. M., Anderman, L. H., and Jensen, J. M. (2007). Sense of belonging in college freshmen at the classroom and campus levels. *J. Exp. Educ.* 75, 203–220. doi: 10.3200/JEXE.75.3.203-220

Goodenow, C. (1993). Classroom belonging among early adolescent students: Relationships to motivation and achievement. *J. Early Adolesc.* 13, 21–43. doi: 10.1177/0272431693013001002

Gopalan, M., Linden-Carmichael, A., and Lanza, S. (2022). College students' sense of belonging and mental health amidst the COVID-19 Pandemic. *J. Adolesc. Health* 70, 228–233. doi: 10.1016/j.jadohealth.2021.10.010

Hurtado, S., Eagan, M. K., Tran, M. C., Newman, C. B., Chang, M. J., and Velasco, P. (2011). "We Do Science Here": Underrepresented students' interactions with faculty in different college contexts. *J. Soc Issues.* 67, 553–579. doi: 10.1111/j.1540-4560.2011.01714.x

Jones, C. K., and Lerner, A. B. (2019). Implementing a course-based undergraduate research experience to grow the quantity and quality of undergraduate research in an animal science curriculum. *J. Anim. Sci.* 97, 4691–4697. doi: 10.1093/jas/skz319

Kane, S., Chalcraft, D., and Volpe, G. (2014). Notions of belonging: First year, first semester higher education students enrolled on business or economics degree programmes. *Int. J. Manage. Educ.* 12, 193–201. doi: 10.1016/j.ijme.2014.04.001

Kolb, D. A. (1984). *Experiential learning: Experience as the source of learning and development. 1st ed* (NJ: Prentice Hall. Englewood Cliffs).

Krause-Levy, S., Griswold, W. G., Porter, L., and Alvarado, C. (2021). "The relationship between sense of belonging and student outcomes in CS1 and beyond," in *Proceedings of the 17th ACM Conference on International Computing Education Research* (New York, NY: Association for Computing Machinery), 29–41. doi: 10.1145/3446871.3469748

Lewis, K. L., Stout, J. G., Pollock, S. J., Finkelstein, N. D., and Ito, T. A. (2016). Fitting in or opting out: A review of key social-psychological factors influencing a sense of belonging for women in physics. *Phys. Rev. Phys. Educ. Res.* 12, 20110. doi: 10.1103/PhysRevPhysEducRes.12.020110

Lumpkin, A., Achen, R. M., and Dodd, R. K. (2015). Student perceptions of active learning. *Coll. Stud. J.* 49, 121–133.

Lyvers Peffer, P. A. (2011). Demographics of an undergraduate animal sciences course and the influence of gender and major on course performance. *NACTA J.* 55, 26–31.

McKendree, M. G. S., Croney, C. C., and Widmar, N. J. O. (2014). Effects of demographic factors and information sources on United States consumer perceptions of animal welfare. *J. Anim. Sci.* 92, 3161–3173. doi: 10.2527/jas.2014-6874

McNeil, B. M., Jennings, H. A., Jackson, C. G., Johnson, A. K., and Sterle, J. A. (2015). An experimental course: Animal Handling, Safety, and Well-Being. *Iowa State Univ. Anim. Industry Rep* 12. doi: 10.31274/ans_air-180814-1356

Mijares, S., Sullivan, P., Cramer, C., Román-Muñiz, N., and Edwards-Callaway, L. (2021). Perceptions of animal welfare and animal welfare curricula offered for undergraduate and graduate students in animal science departments in the United States. *Transl. Anim. Sci.* 5, txab222. doi: 10.1093/tas/txab222

Miranda-de la Lama, G. C., Estévez-Moreno, L. X., Villarroel, M., Rayas-Amor, A. A., María, G. A., and Sepúlveda, W. S. (2018). Consumer attitudes toward animal welfare-friendly products and willingness to pay: Exploration of Mexican market segments. *J. Appl. Anim. Welf. Sci.* 22, 13–25. doi: 10.1080/10888705.2018.1456925

Mooney, C., and Becker, B. A. (2020). "Sense of belonging: The intersectionality of self-identified minority status and gender in undergraduate computer science students," in *United Kingdom & Ireland Computing Education Research conference* (New York, NY: Association for Computing Machinery), 24–30. doi: 10.1145/3416465.3416476

Murphy, M. C., Steele, C. M., and Gross, J. J. (2007). Signaling threat: How situational cues affect women in math, science, and engineering settings. *Psychol. Sci.* 18, 879–885. doi: 10.1111/j.1467-9280.2007.01995.x

Olynk Widmar, N., Morgan, C. J., A. Wolf, C., A. Yeager, E., Dominick, S. R., and Croney, C. C. (2017). US resident perceptions of dairy cattle management practices. *AS* 08, 645–656. doi: 10.4236/as.2017.87049

Parrish, J. J., Smith, M. F., Geisert, R. D., Davis, D. L., Wilson, M. E., and Flowers, W. L. (2015). How to communicate with undergraduate students that lack an animal science or agricultural background. *Anim. Front.* 5, 54–59. doi: 10.2527/af.2015-0035

Pedler, M. L., Willis, R., and Nieuwoudt, J. E. (2021). A sense of belonging at university: Student retention, motivation and enjoyment. *J. Furth. High. Educ.* 46, 397–408. doi: 10.1080/0309877X.2021.1955844

Pittman, L. D., and Richmond, A. (2008). University belonging, friendship quality, and psychological adjustment during the transition to college. *J. Exp. Educ.* 76, 343–362. doi: 10.3200/JEXE.76.4.343-362

Prickett, R. W., Norwood, F. B., and Lusk, J. L. (2010). Consumer preferences for farm animal welfare: Results from a telephone survey of US households. *Anim. Welf.* 19, 335–347. doi: 10.1017/S0962728600001731

Rainey, K., Dancy, M., Mickelson, R., Stearns, E., and Moller, S. (2018). Race and gender differences in how sense of belonging influences decisions to major in STEM. *Int. J. Stem Educ.* 5, 10. doi: 10.1186/s40594-018-0115-6

Reese, D. E., Burson, D. E., Gilster, K. E., Kinder, J. E., Owen, F. G., and Brink, D. R. (1987). Demographics of animal science students and factors influencing choice of major. *NACTA J.* 31, 23–25.

Reiling, B. A., Marshall, T. T., Brendemuhl, J. H., McQuagge, J. A., and Umphrey, J. E. (2003). Experiential learning in the animal sciences: Development of a multispecies large-animal management and production practicum. *J. Anim. Sci.* 81, 3202–3210. doi: 10.2527/2003.81123202x

Ruiz-Romero, R. A., and Vargas-Bello-Pérez, E. (2022). Promoting active learning and student engagement in two different graduate courses for veterinary and animal sciences: Cases from Mexico and Denmark. *Front. Vet. Sci.* 9. doi: 10.3389/fvets.2022.822409

Sánchez-Bravo, P., Chambers V, E., Noguera-Artiaga, L., Sendra, E., Chambers, E.IV, and Carbonell-BarraChina, Á.A. (2021). Consumer understanding of sustainability concept in agricultural products. *Food Qual. Prefer.* 89, 104136. doi: 10.1016/j.foodqual.2020.104136

Sax, L. J., Blaney, J. M., Lehman, K. J., Rodriguez, S. L., George, K. L., and Zavala, C. (2018). Sense of belonging in computing: The role of introductory courses for women and underrepresented minority students. *Soc Sci.* 7, 122. doi: 10.3390/socsci7080122

Schröder, M. J. A., and McEachern, M. G. (2004). Consumer value conflicts surrounding ethical food purchase decisions: A focus on animal welfare. *Int. J. Consum. Stud.* 28, 168–177. doi: 10.1111/j.1470-6431.2003.00357.x

Seguino, A., Seguino, F., Eleuteri, A., and Rhind, S. M. (2014). Development and evaluation of a virtual slaughterhouse simulator for training and educating veterinary students. *J. Vet. Med. Educ.* 41, 233–242. doi: 10.3138/jvme.1113-150R

E. Seymour and A.-B. Hunter (Eds.) (2019). *Talking about Leaving Revisited: Persistence, Relocation, and Loss in Undergraduate STEM Education* (Cham: Springer International Publishing). doi: 10.1007/978-3-030-25304-2

Smart, K. L., and Csapo, N. (2007). Learning by doing: Engaging students through learner-centered activities. *Bus. Commun. Q.* 70, 451–457. doi: 10.1177/1080569907070040302

Smith, J. S., and Wertlieb, E. C. (2005). Do first-year college students' expectations align with their first-year experiences? *NASPA J.* 42, 153–174. doi: 10.2202/1949-6605.1470

Source (2018) *Move in 2018: Student success efforts focus on the First Four Weeks and having Momentum Year*. Available at: https://source.colostate.edu/move-in-2018-student-success-efforts-focus-on-the-first-four-weeks-and-having-a-momentum-year/ (Accessed July 24, 2023).

Sterle, J. A., and Tyler, H. D. (2016). 396 The next generation of animal science students: Changing demographics dictate curriculum changes. *J. Anim. Sci.* 94, 185–186. doi: 10.2527/msasas2016-396

Sullivan, P., Mijares, S., Davis, M., Oselinsky, K., Cramer, C., Román-Muñiz, N., et al. (2022a). A nationwide survey of animal science students' perceptions of animal welfare across different animal categories at institutions in the United States. *Animals* 12, 2294. doi: 10.3390/ani12172294

Sullivan, P., Davis, M., Smith, C. L., Delmore, R., Román-Muñiz, N., Cramer, C., et al. (2022b). A preliminary exploration of the impact of experiential learning on animal science undergraduates' perceptions of humane stunning and slaughter. *Transl. Anim. Sci.* 6, txac108. doi: 10.1093/tas/txac108

Taylor, R. E., and Kauffman, R. G. (1983). Teaching animal science: Changes and challenges. *J. Anim. Sci.* 57, 171–196. doi: 10.2527/animalsci1983.57Supplement_2171x

TILT (2022) *First 4 Weeks*. Available at: https://tilt.colostate.edu/wp-content/uploads/2022/03/First4Weeks.pdf (Accessed July 24, 2023).

Tinto, V. (1987). *Leaving college: Rethinking the causes and cures of student attrition* (Chicago: The University of Chicago Press).

Tinto, V. (1993). *Leaving college: Rethinking the causes and cures of student attrition. 2nd ed* (Chicago: The University of Chicago Press).

Vanhonacker, F., and Verbeke, W. (2013). Public and consumer policies for higher welfare food products: Challenges and opportunities. *J. Agric. Environ. Ethics* 27, 153–171. doi: 10.1007/s10806-013-9479-2

Van Rooij, E. C. M., Jansen, E. P. W. A., and Van De Grift, W. J. C. M. (2018). First-year university students' academic success: The importance of academic adjustment. *Eur. J. Psychol. Educ.* 33, 749–767. doi: 10.1007/s10212-017-0347-8

Weary, D. M., Ventura, B. A., and Von Keyserlingk, M. A. G. (2016). Societal views and animal welfare science: Understanding why the modified cage may fail and other stories. *Animal* 10, 309–317. doi: 10.1017/S1751731115001160

Wells, K., VanLeeuwen, D., Seevers, B., and White, L. (2019). Impact of traditional lecture and hands-on learning on students' knowledge gain in animal science courses. *NACTA J.* 63, 319–321.

Whitten, D., James, A., and Roberts, C. (2020). Factors that contribute to a sense of belonging in business students on a small 4-year public commuter campus in the Midwest. *J. Coll. Stud. Retent.: Res. Theory Pract.* 22, 99–117. doi: 10.1177/1521025117726520

Wickenhauser, J. L., Brennan, P., Erasmus, M., Karcher, D. M., and Karcher, E. L. (2021). Recruiting the next generation of poultry professionals. *JAPR* 30, 100130. doi: 10.1016/j.japr.2020.100130

Wilson, D., Jones, D., Bocell, F., Crawford, J., Kim, M. J., Veilleux, N., et al. (2015). Belonging and academic engagement among undergraduate STEM students: A multi-institutional study. *Res. High. Educ.* 56, 750–776. doi: 10.1007/s11162-015-9367-x

Wilson, K. L., Murphy, K. A., Pearson, A. G., Wallace, B. M., Reher, V. G. S., and Buys, N. (2016). Understanding the early transition needs of diverse commencing university students in a health faculty: Informing effective intervention practices. *Stud. High. Educ.* 41, 1023–1040. doi: 10.1080/03075079.2014.966070

Yorke, M., and Longden, B. (2004). *Retention and Student Success in Higher Education* (UK: McGraw-Hill Education).