

Undergraduate student attitudes to current poultry industry issues over four semesters: surveying an introductory poultry science course

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Abstract

Individual background and demographics affect student perceptions of animal production. Understanding how science-based education alters these opinions is a critical aspect of improving university instruction as well as increasing consumer engagement in the poultry industry. The study objectives were to quantify the effects of student background, career interests, and science-based instruction on opinions regarding current issues in the poultry industry. Undergraduate students enrolled in a one semester poultry science course at Iowa State University between 2018 and 2021 were anonymously surveyed at the start and end of the semester as part of a 4-yr study. Students who opted to take the survey answered three demographic questions indicating their 1) livestock experience, 2) sex, and 3) career goals. The body of the survey consisted of 16 “poultry issue statements” where students were directed to mark a vertical dash on a 130 mm horizontal line indicating their level of agreement with each statement. Post-survey collection, the line was separated into 5 sections for discussion: responses within 0%–20% indicated strongly disagree, 21%–40% disagree, 41%–60% neutral, 61%–80% agree, and 81%–100% indicated strongly agree. Responses were analyzed using Proc Mixed in SAS Version 9.4 with a Tukey–Kramer adjustment for all pairwise comparisons using main effects including demographic categories, education (pre- or post-instruction), and year the survey was taken. Responses to various issue statements were affected by students’ livestock experience ($P < 0.05$; 6 out of 16 statements affected), sex ($P < 0.05$; 5 out of 16 statements), and ultimate career goals ($P < 0.05$; 4 out of 16 statements). Pre- vs. post-education responses differed significantly in 6 out of 16 statements ($P < 0.05$), and in 2 out of 16 poultry issue statements, the year of instruction affected student response ($P < 0.05$). These data indicate that individual student background, sex, and differing career interests impact opinions of current topics in the broiler and layer industries. Further, science-based education as well as the year the course was taken over consecutive semesters significantly altered student opinions.

Lay Summary

Individual experience and demographics affect perceptions of animal production. Understanding how science-based education alters these opinions is a critical aspect of improving instruction and increasing consumer engagement in the poultry industry. Undergraduate students enrolled in a poultry science course at Iowa State University between 2018 and 2021 were surveyed at the start and end of the semester as part of a 4-yr study. Students answered three demographic questions and indicated their agreeability with 16 “poultry issue statements.” Responses to various issue statements were affected by students’ livestock experience (6 out of 16 statements), sex (5 out of 16 statements), and ultimate career goals (4 out of 16 statements). Pre- vs. post-education responses changed in 6 out of 16 statements, and in 2 out of 16 poultry issue statements, the year of instruction affected student response. Individual student background, sex, and career interests impacted opinions on current topics in the broiler and layer industries, including laying hen housing systems, selective poultry breeding, environmental enrichment availability, culling practices, commercial stocking density, purchasing decisions, and more. Science-based instruction with hands-on farm experience as well as the year the course was taken over consecutive semesters significantly altered student opinions.

Key words: animal welfare, broiler industry, education, layer industry, undergraduate teaching

Abbreviations: GAP, Global Animal Partnership; IRB, Institutional Review Board; LSMs, least-squares means; NCC, National Chicken Council; UEP, United Egg Producers; USDA, United States Department of Agriculture

Introduction

Increased public interest in farm animal production and welfare is unsurprising considering the ease of access to information (and misinformation) worldwide by consumers through the internet and social media. Only 1.4% of the U.S. population is employed in the agriculture sector (USDA, 2020), and in a recent U.S. survey, only 6%–8% of respondents out of 1,000 report being involved in farming or even having family who owns or operates a farm (Cummins et al., 2015). The majority of consumers lack firsthand experience with animal

agriculture and rely on external sources in order to make informed, ethical purchasing decisions (Alonso et al., 2020). However, these purchasing decisions do not consistently align with beliefs: it is well-known that while consumers report being unhappy with perceived animal welfare in conventional production systems, they are not proportionally paying premium prices for products labeled with alternative programs (de Jonge and van Trijp, 2013a).

In the poultry industry, consumers struggle to differentiate between alternative housing system labels on egg cartons,

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such as cage-free vs. free-range, but perceive animal welfare similarly in alternative systems compared to conventional cage housing, despite self-reported lack of knowledge (Ochs et al., 2018). When it comes to poultry meat product purchasing, consumers maintain a more positive perception of animal welfare in organic vs. conventionally raised flocks, but prioritize factors such as outdoor access above genetic line of bird used, highlighting a lack of understanding on broiler production and welfare (de Jonge and van Trijp, 2013b).

Iowa State University students represent a subpopulation within the United States; out of approximately 25,000 undergraduates, roughly 15% are enrolled in the College of Agriculture and Life Sciences (Iowa State University Registrar, 2022), and 4% of Iowa State undergraduates are students majoring in animal science. Animal science-focused students are of interest from a survey perspective not only because they are consumers and will themselves eventually become professionals in the animal industry, but because their pre-undergraduate livestock experience varies greatly. Surveys have previously been conducted to gauge student opinions before and after animal science-based education, including high school students taking a 7-part poultry science module (Erickson et al., 2019), undergraduate students enrolled in a general introductory animal science semester-long course (Bobek et al., 2014), and undergraduates taking either an introductory animal science or applied animal behavior semester-long course (Heleski and Zanella, 2006). However, no existing research could be found specifically focused on current topics of discussion in the poultry industry or given to students taking a poultry science course.

Survey data from Heleski and Zanella (2006) show that animal science undergraduate students had a lower knowledge base in farm animal welfare than the authors expected for animal science majors pre-education, and results from Bobek et al. (2014) showed that students maintained greater agreeability with farmer concern for animal welfare and purchasing products based on price after a semester of instruction. Within the Iowa State University undergraduate curriculum, students would have exposure to poultry, but limited depth in the subject prior to this sophomore-level species course. While the authors acknowledge that animal science undergraduates are exposed to general livestock courses, other species-specific courses, and that each student comes with varying degrees of knowledge and personal experience, there exists an opportunity to measure student attitudes to poultry industry issues before and after specific education with the clear understanding that topics included in the survey would be covered in the course. In addition, a survey of animal science faculty in the United States, a population highly informed in the animal agriculture industry, showed that demographic variables (respondent sex and political views) impact level of concern with animal welfare issues (Heleski et al., 2004), making demographics key to surveys of this nature. Therefore, the current study objectives were to determine whether individual background, sex, career interests, and a semester of poultry science-based instruction altered student opinions on current issues in the poultry industry over 4 yr of surveying.

Materials and Methods

The undergraduate survey protocol was approved by the Iowa State University Institutional Review Board under IRB ID #18-269 and was declared exempt from the requirements

of human subject protection as of November 7, 2018 as subjects were not identified by researchers.

Survey administration

The survey was administered during the 16-wk fall semesters of Animal Science 223, Poultry Science, during the first and last lecture period of the course from 2018 to 2021. The survey and a preceding consent form were administered to students by the graduate student researcher and were returned anonymously into a manilla envelope following completion. Student participants aged 18 and older indicated their willingness to participate in the survey via a printed consent form that described the research purpose of the survey, that participation would not be reflected in course grading, and that it would take approximately 20 min of class time during the semester (10 min each survey).

The course instructor provided oral directions to students each time before surveys were completed, instructing them to indicate level of agreeability with the provided statements using the constant 130 mm line beneath each statement: the left end of the line was labeled “disagree” and the right end of the line was labeled “agree”. Written instructions immediately before the “poultry issue statements” were also provided, stating that a dash on the far left indicates “strongly disagree,” a dash in the center indicates “neutral,” and a dash on the far right indicates “strongly agree.” The surveys administered before and after taking the course were identical in content, and students were asked only to provide a “code name” of their favorite animal followed by their favorite food to allow researchers to anonymously compare responses pre- and post-instruction. Additionally, through the consent form students were provided with the contact information of the principal investigator/course instructor, the graduate student researcher, and the Iowa State University IRB Office.

Survey content

The survey began with three multiple choice demographic questions written as follows 1) previous animal experience (ruminants, swine, poultry): a) I grew up on a livestock farm, b) I grew up in an urban/city environment with little/no farm contact, and c) I did not grow up on a farm, but have significant livestock experience (work or significant personal experience); 2) sex, and 3) career goals: a) poultry industry, b) livestock industry (other than poultry), and c) non-animal industry. The body of the survey was made up of 16 “poultry issue statements” written in first person for individual attitude analysis. The complete list of poultry issue statements is provided in Table 1.

Course content

The instructor for Animal Science 223 remained constant over the four semesters surveyed, as did the core concepts covered in the course. A brief overview of topics relevant to the survey is included in Table 2 for the purpose of establishing student exposure to information specific to poultry issue statements. Course material not relevant to the issue statements included in the survey (e.g., internal anatomy) has not been included in Table 2. Additionally, a knowledge-based pre- and post-tests were administered each year the survey was given at the start of the semester as a pre-test and an identical test at end of the semester as the final exam. This test focused on key concepts covered in the course to validate education and was not based on agreeability but was graded on incorrect/correct answers.

Table 1. Sixteen poultry issue statements as written in student survey. Each statement was followed by a 130 mm bolded horizontal line with “disagree” to the left and “agree” to the right

1.	Chickens have innate worth and value
2.	Raising chickens for meat or eggs is morally acceptable
3.	Animal well-being is the top priority of commercial poultry producers
4.	The selective breeding of commercial poultry (layers and broilers) is ethical
5.	The early culling of male layer-type chicks is ethical
6.	Housing of commercial laying hens in battery cages is ideal for bird welfare
7.	Housing of commercial laying hens in an enriched colony is ideal for bird welfare
8.	Cage-free laying hen housing is ideal for bird welfare
9.	Stocking density in commercial poultry houses is acceptable
10.	Leg lameness prevalence in the broiler industry is at acceptable percentages in flocks
11.	I purchase poultry products or eggs based on price
12.	I purchase poultry products based on advertised welfare standards on commercials or the package
13.	I purchase poultry products based on marketing words or photos on the package (cage-free, organic, Vitamin D-enriched, antibiotic-free, etc.)
14.	Raising chickens without the use of antibiotics is ideal for poultry welfare
15.	Raising chickens without the use of antibiotics is ideal for consumer welfare
16.	Environmental enrichment options available to commercial poultry producers are adequate

While the purpose of this article is to present changes in student attitudes over the course of the semester through poultry issue statement assessment, pre- and post-test results by year are presented in Table 3 to establish that knowledge of poultry and the poultry industry were significantly increased as a result of instruction specific to poultry.

Data analysis

Student responses to demographic questions were used as independent variables to analyze agreeability with poultry issue statements. Responses to issue statements were converted to percent agreeability by physically measuring the distance from the far left of the horizontal line to the vertical mark drawn by the student and converting to percent of the total length of line (130 mm). Hence, all results are presented as a percent, and were analyzed with the fixed effects of demographic variables: livestock experience, sex, career goals, as well as the year the course was taken. Additionally, the effect of education (pre- or post-instruction) was included in the statistical model and is presented where there were interaction effects with demographic variables. Data were assessed for normality using Proc Univariate and were analyzed using a generalized mixed liner model (Proc Mixed) in SAS Version 9.4 (Cary, NC, USA) with a Tukey–Kramer

Table 2. A subset of topics taught in Animal Science 223 at Iowa State University over the 2018–2021 semesters the survey was administered. Only topics relevant to poultry issue statements are included

Classroom or farm setting	Topic
Farm	Laying hen housing systems and bird handling
Classroom	Nutrition
Farm	Broiler chicken grow-out experiment
Classroom	Laying hen production
Classroom	Broiler production
Classroom	Embryology and incubation
Classroom	Hatchery management
Classroom	Commercial genetics
Farm	Production laying hen selection
Classroom	Poultry marketing and trends
Farm	Layer health
Classroom	Poultry processing and products
Classroom	Commercial housing and ventilation
Classroom	Current topics in poultry industry
Classroom	Poultry diseases
Farm	Poultry necropsy
Classroom	Comparative production: layers and meat birds
Classroom	Commercial broiler welfare
Classroom	Commercial layer welfare

adjustment for all pairwise comparisons. For meaningful interpretation, only poultry issue statements with significant demographic effects and/or pairwise differences between education by demographic LSMeans are presented and discussed ($P \leq 0.05$). Additionally, percent agreeability was categorized as follows: 0%–20% agreeability was considered strongly disagree, 21%–40% was considered disagree, 41%–60% was considered neutral, 61%–80% was considered agree, and 81%–100% was considered strongly agree for discussion purposes.

Results

Survey respondent number varied by semester based on course enrollment and student presence for both the start and end of semester surveys. Participants totaled 108 over four semesters: 29, 27, 26, and 26 students participated from Fall 2018–2021, respectively.

Livestock experience

Over the multi-year study, livestock experience demographics were as follows: 43% of students grew up on a livestock farm, 31% reported that they had little/no livestock experience, and 26% reported other significant livestock experience. The main effect of individual livestock experience was significant for 6 out of 16 poultry issue statements ($P \leq 0.05$). Students with little/no livestock experience agreed with the statement “raising chickens for meat or eggs is morally acceptable” approximately 6.5% less than students who grew up on a livestock farm or had other significant livestock experience ($P = 0.004$; Figure 1A), although all responses fell into the strongly agree category. A similar effect was observed for the statement “the selective breeding of commercial poultry (layers & broilers) is ethical,” where students

with little/no livestock experience agreed 9.4% less than those who grew up on a livestock farm ($P = 0.007$; Figure 1B). Students who grew up on a livestock farm also showed greater agreeability with the statement “the early culling of male layer-type chicks is ethical” than students with little/no livestock experience or students with other significant livestock experience ($P = 0.003$; Figure 1C), but all responses to this statement fell into the agree range.

Following the same trend, students who grew up on a livestock farm showed 14% greater percent agreeability with the statement “cage-free laying hen housing is ideal for bird welfare” than students with other or little/no livestock experience ($P = 0.011$; Figure 1D); livestock farm student responses fell into the agree category vs. a neutral response. In analysis of responses to the statement “I purchase poultry products based on advertised welfare standards on commercials or the package”, students in the little/no livestock experience group showed 13% greater percent agreeability than students in the other livestock experience group, while students who

grew up on a livestock farm were intermediate ($P = 0.044$; Figure 1E). In this case, the little/no livestock experience group of students fell into the neutral category, while the remaining groups were in the disagree category of responses.

Students who grew up on livestock farms agreed with the statement “stocking density in commercial poultry houses is acceptable” at a greater percentage than students with little/no or other significant livestock experience ($P = 0.005$). All student responses fell into the agree category with this statement, but this represents an 11.75% increase in agreeability between the livestock farm group and the other livestock experience group of students. However, differences existed in education by livestock experience pairwise comparisons (Figure 2A), showing that students who grew up on livestock farms agreed with this statement significantly more after taking the course than little/no or other livestock experience group of students did before the course. Differences existed before and after taking the course in the education by livestock experience pairwise comparisons in responses to the statement “leg lameness prevalence in the broiler industry is at acceptable percentages” (Figure 2B), showing that students with other significant livestock experience agreed with the statement more after taking the course than they did, or those raised on a livestock farm did, before taking the course. Finally, pairwise differences existed in the education by livestock experience responses to the statement “environmental enrichment options available to poultry producers are adequate,” indicating that after taking the course, students who grew up on a livestock farm had greater percent agreeability with the statement than students with little/no livestock experience did before taking the poultry science course (Figure 2C).

Table 3. Animal Science 223 pre- and post-test scores at Iowa State University fall semesters 2018–2021. These mean scores are provided to establish poultry-specific knowledge was obtained over the semesters that may have influenced student attitudes

Year	Pre-test score (%)	Post-test score (%)	SEM	Education P-value
2018	21.8	83.6	1.58	<0.001
2019	28.4	70.2	2.19	<0.001
2020	18.8	82.5	1.77	<0.001
2021	30.0	72.4	1.86	<0.001

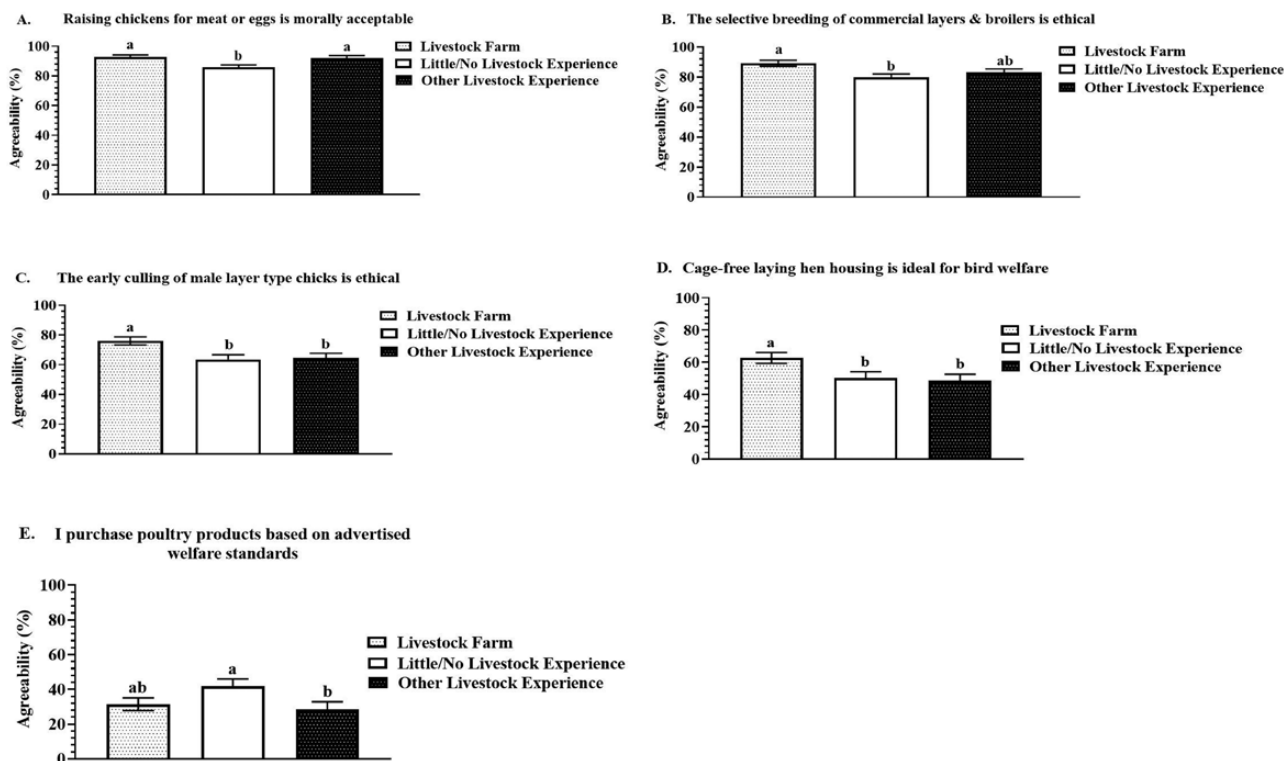


Figure 1. Student percent agreeability to poultry issue statements: LSMeans by the main effect of livestock experience (A–E). Bars with different letters indicate means that differ between groups ($P \leq 0.05$).

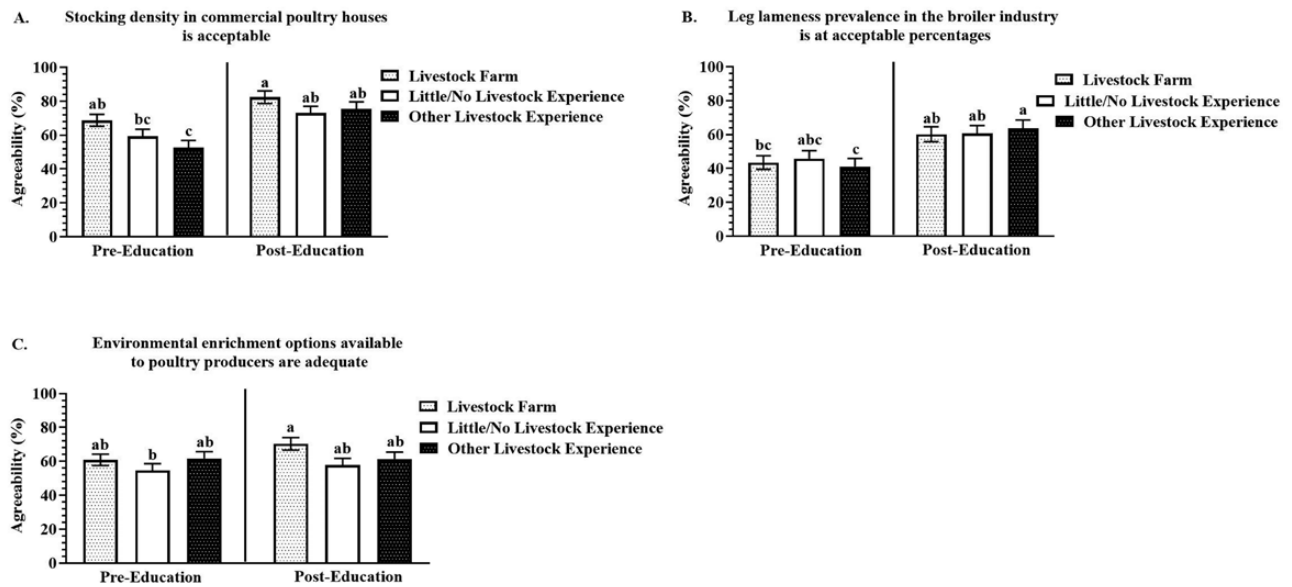


Figure 2. Student percent agreeability to poultry issue statements: LSMs by the interaction of education and livestock experience (A–C). Bars with different letters indicate means that differ between groups ($P \leq 0.05$).

Sex

Over the four semesters surveyed, 61% of respondents were female and 39% were male. Sex had a significant impact on student responses to 5 out of 16 poultry issue statements. Females agreed with the statement “chickens have innate worth and value” 5.6% more than males, although both sexes fell into the strongly agree category of responses ($P = 0.033$; Figure 3A). Responding to the statement, “the early culling of male layer-type chicks is ethical,” males showed 11% greater percent agreeability than females, while both groups of responses fell into the agree category ($P = 0.004$; Figure 3B).

In response to the poultry issue statement “housing of commercial laying hens in battery cages is ideal for bird welfare,” male students showed 9% greater percent agreeability than females ($P = 0.04$), indicating that males agreed with the statement while females fell into the neutral category. There were pairwise differences when looking at the education by sex interaction, showing that males agreed with this statement more after taking the course than females did before taking the course (Figure 4A). For the other poultry issue statement focused on laying hen housing systems, “housing of commercial laying hens in an enriched colony is ideal for bird welfare,” the effect of sex was not significant, but there was an effect of education ($P = 0.036$) leading to education by sex pairwise differences where females showed 12.5% greater agreeability with the statement after taking the course than males did before taking the course (Figure 4B).

Males agreed with the statement “stocking density in commercial poultry houses is acceptable” 7% more than females ($P = 0.044$), but both groups of responses were in the agree range. When looking at the education by sex pairwise comparisons, males agreed with this statement more after the semester compared to either sex before taking the course (Figure 4C), hence education affected student opinions of poultry stocking density ($P < 0.0001$). Males also agreed with the statement “leg lameness prevalence in the broiler industry is at acceptable percentages in flocks” 9.5% more than female students, although both groups of responses were in the neutral category ($P = 0.018$). An education

by sex pairwise comparison showed that males agreed with this statement significantly more after taking Animal

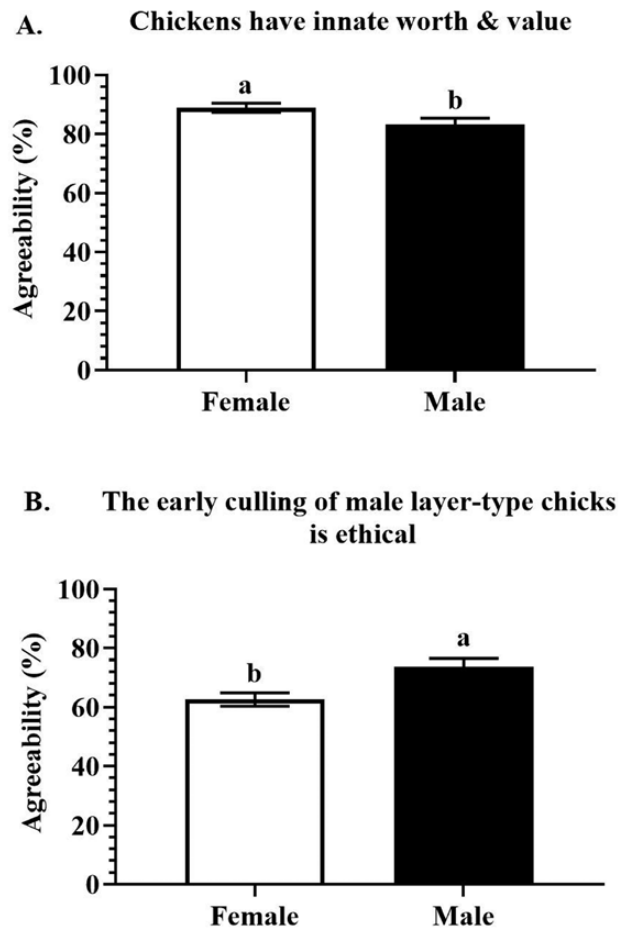


Figure 3. Student percent agreeability to poultry issue statements: LSMs by the main effect of sex (A and B). Bars with different letters indicate means that differ between groups ($P \leq 0.05$).

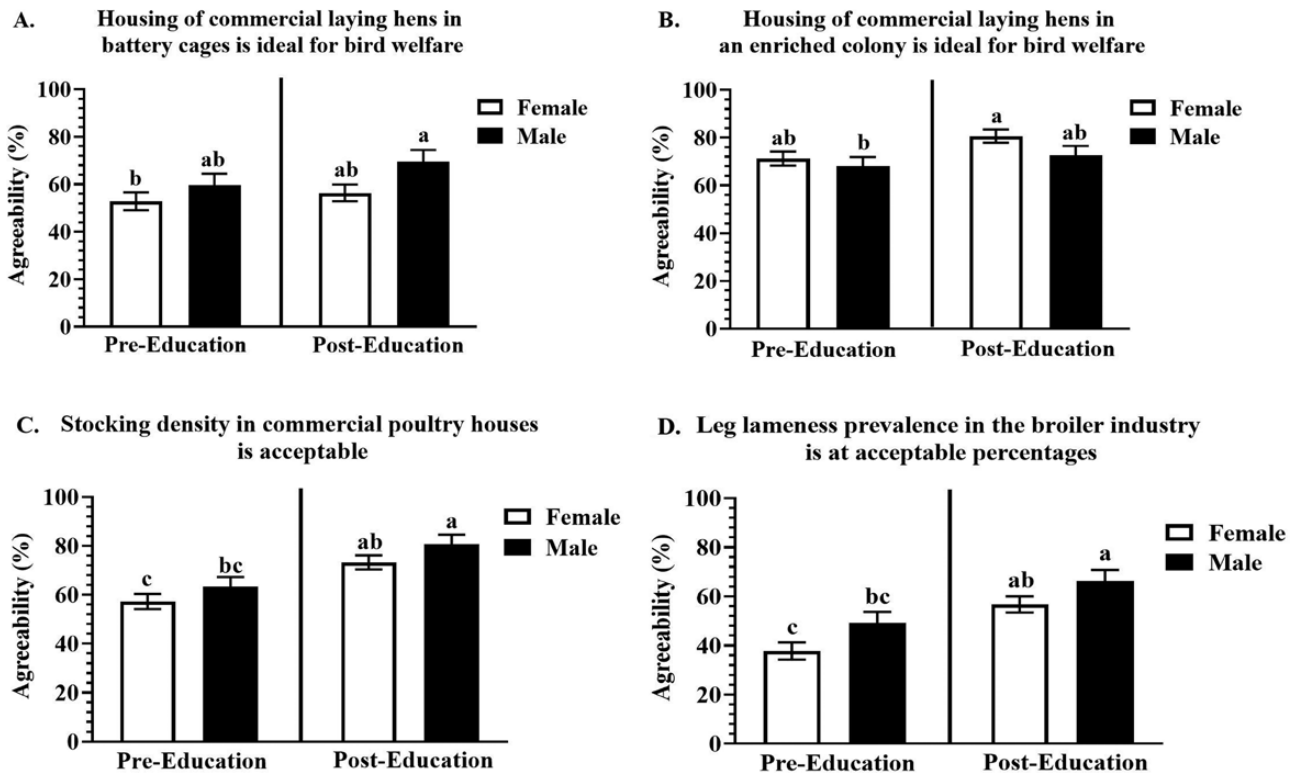


Figure 4. Student percent agreeability to poultry issue statements: LSMMeans by the interaction of education and sex (A–D). Bars with different letters indicate means that differ between groups ($P \leq 0.05$).

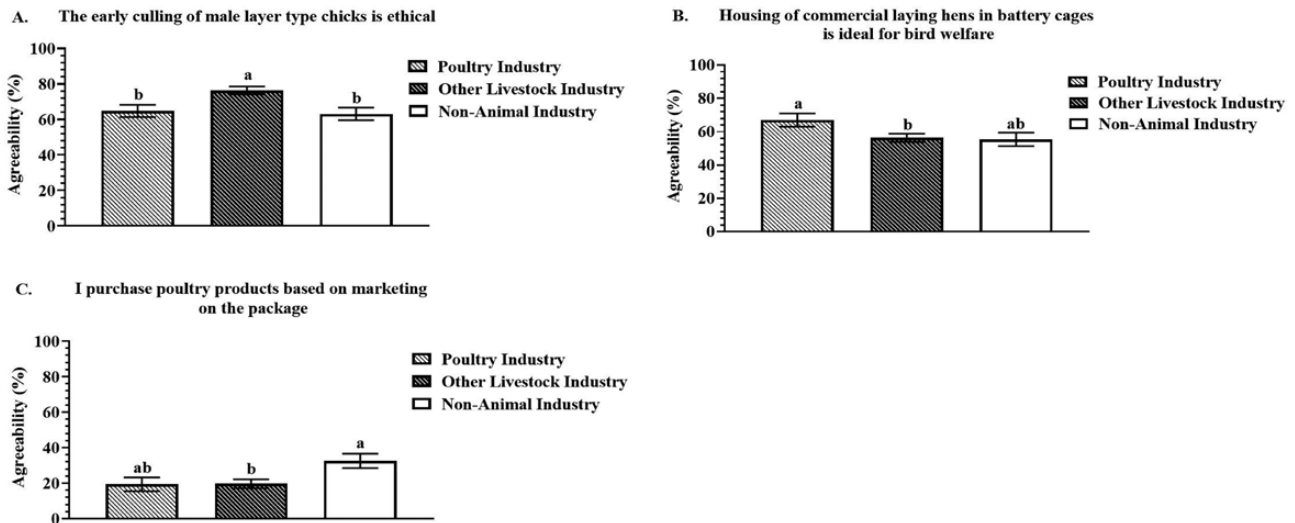


Figure 5. Student percent agreeability to poultry issue statements: LSMMeans by the main effect of career goal (A–C). Bars with different letters indicate means that differ between groups ($P \leq 0.05$).

Science 223 than both females and males did before taking the course (Figure 4D).

Career goals

Over all surveys conducted, 14% of students reported that they planned to go into the poultry industry, 61% planned to go into the livestock industry (other than poultry), and 25% planned to enter a non-animal industry. Student self-designated career goals had an impact on agreeability with 4 out of 16 poultry issue statements. Responses to “the early

culling of male layer-type chicks is ethical” were affected by career goals, with students planning to enter the non-poultry livestock industry agreeing 11.3% more than those planning a career in the poultry industry or a non-animal industry ($P < 0.001$; Figure 5A). All student responses fell into the agree category with this statement. Poultry career-focused students agreed with the statement “housing of commercial laying hens in battery cages is ideal for bird welfare” 11.6% more than students planning to go into the non-poultry livestock industry, while non-animal industry student responses were intermediate ($P = 0.047$; Figure 5B).

Non-animal career students agreed with the statement “I purchase poultry products based on marketing words or photos on the package (cage-free, organic, Vitamin D enriched, antibiotic-free, etc.)” more than students planning to enter the non-poultry livestock industry, while poultry-focused students were intermediate ($P = 0.023$; Figure 5C). This represents 12.8% increased agreeability and responses in the neutral rather than disagree category.

The other statement in the survey focused on poultry product purchasing decisions, “I purchase poultry products or eggs based on price” showed differences in a pairwise comparison of education by career goals. Students planning a career in the non-poultry livestock industry agreed with the statement 16% more after taking the course than they did before taking the course (Figure 6A). Education by career goals pairwise differences also existed within responses to the statement “stocking density in commercial poultry houses is acceptable,” with poultry and other livestock industry students agreeing with the statement more after a semester of poultry science instruction than the same groups of students did before the semester (Figure 6B).

Education by career goals means also differed on the statement, “leg lameness prevalence in the broiler industry is at acceptable percentages,” with the other livestock and non-animal industry students showing greater agreeability after taking the course than they did before taking the course (Figure 6C), hence a semester of Animal Science 223 altered student attitudes on leg lameness prevalence ($P < 0.0001$). Percent agreeability with the statement “environmental enrichment options available to commercial poultry producers are adequate,” showed that students aiming to go into a non-animal industry agreed more than students planning to go into the poultry industry ($P = 0.009$). This represents a shift from neutral to the agree category and a 14% increase in agreeability. However, education by career goal pairwise differences existed, with students planning a career in a non-animal industry agreeing significantly more after taking the poultry science course than students planning to work in the poultry industry did before taking the course (Figure 6D).

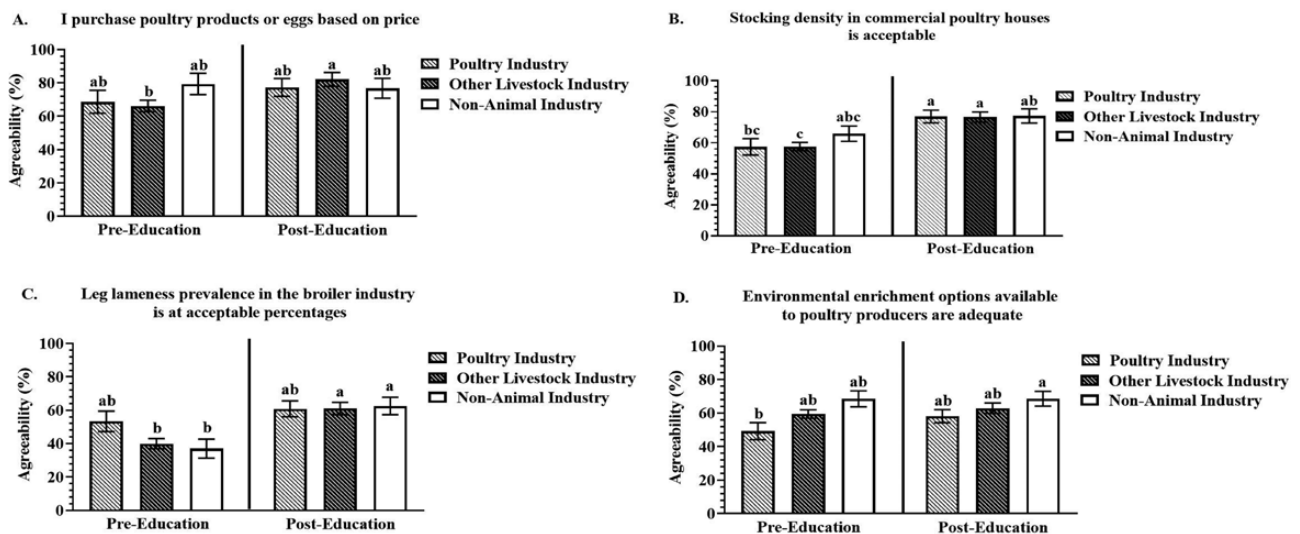


Figure 6. Student percent agreeability to poultry issue statements: LSMeans by the interaction of education and career goals (A–D). Bars with different letters indicate means that differ between groups ($P < 0.05$).

Year

As the same survey was conducted over four semesters of undergraduates, the year administered was included as a fixed effect in the statistical model. Year alone affected 2 out of 16 poultry issue statements. While there was no main effect of year, differences existed within education by year responses to the statement “stocking density in commercial poultry houses is acceptable,” showing that student responses from 2020 were higher after taking the course than responses were in 2018 or 2020 before taking the course (Figure 7A).

The statement “leg lameness prevalence in the broiler industry is at acceptable percentages in flocks” was affected by year ($P = 0.002$), with students from 2018 agreeing with the statement less than the remaining 3 yr. However, there were pairwise education by year differences, showing that students in 2020 and 2021 agreed with the statement more after taking Animal Science 223 than students in 2018 and 2020 did before taking the course (Figure 7B), indicating that year alone did not affect agreeability. It is worth noting that this statement was also affected by sex and education, and that over four semesters, all responses to this statement were in the neutral category of agreement. The last statement affected by year of survey was “environmental enrichment options available to commercial poultry producers are adequate” ($P < 0.001$). Responses to this statement varied in a pairwise comparison between education and year, with students from 2020 agreeing with the statement more after taking the poultry science course than students in 2018 did after, and more than students in 2019 did before or after the semester (Figure 7C).

Discussion

Agreeability regarding the moral acceptability of raising chickens for meat or eggs was affected only by the livestock experience of students, yet all backgrounds of students strongly agreed with this statement. While it is understood that a “meat paradox” exists, where people care about animals and simultaneously realize that animals must die to produce meat, most people continue to eat meat (Loughnan et al., 2010, 2014). Hence, our data indicating that

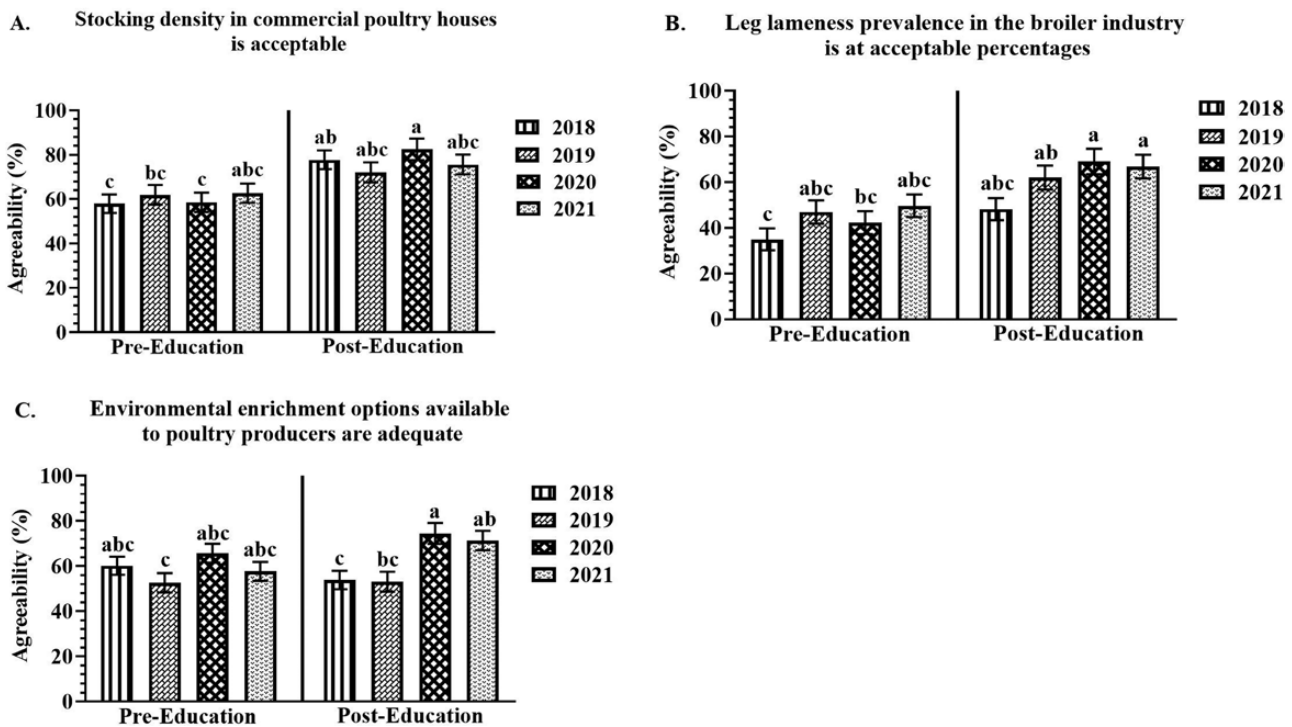


Figure 7. Student percent agreeability to poultry issue statements: LSMeans by the interaction of education and year (A–C). Bars with different letters indicate means that differ between groups ($P \leq 0.05$).

undergraduate students agree with the morality of poultry production may be unsurprising; also not altogether unexpected is the drop in agreeability from students with significant, personal livestock experience to those without. A similar result was found from the survey administered by [Bobeck et al. \(2014\)](#), where undergraduate students with an urban background taking an introductory animal science course showed lower agreeability with the statement “it is morally acceptable to farm animals” than those from a farming background.

It is possible that livestock experience, whether poultry-specific or not, increased student belief that farm animals are raised humanely, therefore increasing agreeability on the moral acceptability of raising chickens. Although human concern regarding the treatment and welfare of animals depends on perception of the individual species’ sentience and multiple other characteristics ranging from size and familiarity to historical relationship, a differentiation termed “speciesism” ([Bradley et al., 2020](#)). Biologically, chickens are just as “cognitively, emotionally, and socially complex as most other birds and mammals” ([Marino, 2017](#)). However, a survey conducted by Devine and others showed that veterinary students were less likely to associate poultry with the ability to think or feel emotions not only in comparison with companion animals, but with other livestock species including cows, small ruminants, and pigs ([2015](#)). It is therefore possible that students with a livestock farm background perceive poultry as less sentient than other species despite no physiological evidence for this perception, and perhaps consider the morality of farming chickens more acceptable than those with no livestock experience. On the other hand, it is well-known that considerable cultural differences in beliefs on moral acceptability of farming animals exist ([Bradley et al., 2020](#)), therefore the differences observed here may be

reflective not only of the students’ livestock background but in personally held moral beliefs, which we did not attempt to quantify demographically.

Similarly, a statement on the selective breeding of poultry was affected by individual livestock experience: students who grew up on a livestock farm had greater percent agreeability than those with no livestock background. This may be because farm students had previous experience with animal breeding, as students with other significant livestock experience showed intermediate agreeability. Work by Walter and Reisner showed that animal science undergraduates without backgrounds in agriculture did not report strong opinions on agricultural issues and that students from an urban background were less likely to hold opinions on these issues; the authors believed this to be due to a lack of knowledge ([1994](#)). Hence, this response in our survey may be a result of a lack of knowledge influencing strength of opinion. Alternatively, a lack of first-hand knowledge does not always equate lack of opinion, as evidenced by Ochs and others. In a survey focused on laying hen housing systems, members of the U.S. public failed to recognize challenges in different housing systems and in transitioning between systems, yet still believed alternatives to conventional cages were superior and equally beneficial ([2018](#)). Therefore, we speculate that it is possible that students with no livestock background have a different perception of livestock breeding based on resources like social media or product marketing, while those with a livestock background may have formed opinions based on farm experience.

The effect of sex alone affected agreeability with the statement “chickens have innate worth and value”; females agreed with this statement more strongly, an outcome that agrees with previous work reporting that women faculty in animal science are more concerned about animal welfare

(Heleski et al., 2004), female veterinary students report feeling more empathy toward animals (Devine et al., 2015), females in the United Kingdom report greater general concern for animals (Bradley et al., 2020), and female undergraduates are less agreeable that agricultural practices are humane than males (Bobeck et al., 2014). The intrinsic or inherent value of animals is not a topic that was covered in the course; this statement was rather included in the survey to determine if a semester of hands-on experience with various breeds, ages, and purposes of chickens influenced students' attitudes on chicken value. We did not observe altered agreeability post-education as might have been expected in students with little/no previous experience, but the authors acknowledge that the moral standing of animals is a complex topic, and previously held beliefs are unlikely to be influenced in one semester of education.

Remaining poultry issue statements were affected by multiple demographic, year, or education effects. The statement on the ethics of culling male layer chicks was affected by livestock experience, sex, and career goals, with greatest agreeability among students who grew up on a livestock farm compared to other backgrounds, males compared to females, and students planning to enter the livestock industry (other than poultry) compared to other categories of career goals. A survey conducted on veterinary students showed that those planning to work with large animal species agreed that medical procedures (hot branding, castration, surgical procedures, etc.) were more humane than students planning to work with companion animals, regardless of livestock species (Devine et al., 2015). It is possible that culling male layer-type chicks on day of hatch, a byproduct of egg production, may thus be considered more humane by those planning to enter the livestock industry, even though they are not planning to work with poultry. It is likely that some students were altogether unaware of the industry practice: a Dutch survey of over 250 people showed that only half of respondents were aware of the culling of male chicks, although 84%–90% of respondents agreed that an alternative is needed (de Haas et al., 2021). However, as responses to this statement in our survey were in the agree range rather than neutral, students could have had some familiarity with the subject of culling; otherwise, a neutral response due to lack of knowledge may be expected (Walter and Reisner, 1994). As this topic was affected by all three demographic variables but not the year or semester of instruction, it is possible that student opinions on this topic were more strongly affected by their individual characteristics than by the semester of poultry science instruction.

Laying hen housing is a key topic of conversation in terms of animal welfare concerns in the poultry industry, but as the egg industry transitions from conventional cages to alternative systems, consumers find it difficult to differentiate between housing system labels (Ochs et al., 2018). The previously described survey conducted by Ochs and others showed that the American public perceives cage-free and free-range housing benefits similarly in comparison to battery cages. In the current survey, students enrolled in the same animal science course at the same university are not unified in their opinions on hen housing. Conventional cages were perceived more positively by males after taking the course than by females before, and by students entering the poultry industry before and after instruction compared to other career groups. Meanwhile, students who grew up on a livestock farm agreed more strongly that cage-free laying hen housing is ideal than

students with no or other livestock experience, and females agreed more strongly that enriched colony housing is ideal after the semester than males did before. The increased agreeability with conventional cage housing by males after the course is likely due to discussion and observations of pros and cons of various systems in class, including welfare benefits associated with conventional cages such as reduced keel bone deformities and cleaner feathers compared to aviary-housed hens (Blatchford et al., 2016). Similarly, increased agreeability that enriched colony housing is ideal by females after taking the course is a potential outcome of education on the topic of enriched colony systems, which are associated with welfare improvements compared to conventional cages (Blatchford et al., 2016), and environmental benefits like improved air quality compared to cage-free systems (Zhao et al., 2015). Education of consumers on the enriched colony/furnished cage style of housing has been shown to improve support for novel systems where consumers may initially feel like “a cage is a cage” (Nolan et al., 2022), a positive effect observed in the current study following a semester of instruction including this topic.

Commercial stocking density is another topic where exposure and education through an introductory poultry science course clearly affected student attitudes. Agreeability with the statement “stocking density in commercial poultry houses is acceptable” was increased after taking the class in students with little/no livestock experience (responses went from neutral to agreeing with this statement), both female and male students, students entering the poultry and non-poultry livestock industries, and students taking Animal Science 223 in 2020. The effect of instruction shifting the opinions of students without a livestock background closer toward the responses of students with a farm background was likewise observed in animal science students surveyed by Bobeck et al. (2014), further strengthening the theory that the increased baseline knowledge of students with a livestock background guided their stronger opinions. Commercial stocking density regulations are aimed at maintaining both animal welfare and production efficiency in poultry (Bergeron et al., 2020), and as part of the lab section of the course, students learned guidelines, measured cages, counted birds, and assured proper stocking density on-farm, likely driving the overall increased acceptability in our survey.

This same effect was observed in responses to the statement regarding acceptability of leg lameness prevalence in the broiler industry: after taking the course, percent agreeability was increased in students with significant livestock experience, male and female students, students with career goals in both the non-poultry livestock and non-animal industries, and students after taking the poultry science course in 2020 vs. before taking the course. As reported by previous authors, animal science undergraduate students are less aware of issues and practices in animal agriculture coming into animal science classes than might be assumed (Heleski and Zanella, 2006). Leg disorders are a primary welfare concern in commercial broilers, affecting anywhere from 5% to 49% of birds (reviewed by Karcher and Lum, 2019), yet students with significant personal livestock experience, such as working with a large animal vet shifted from a neutral to an agree position on this statement. This possibly represents the shift from lack of understanding to a position backed by knowledge, as has been previously discussed (Walter and Reisner, 1994), and highlights the necessity for animal welfare-focused education for veterinary or animal science students (Broom, 2005).

In the case of environmental enrichment availability, education did not strictly increase agreeability, although likely increased knowledge. Students from a livestock farm agreed with the statement “environmental enrichment options available to poultry producers are adequate” more after taking the course than those with little/no livestock experience did before, but within each group of student experience agreeability was either unchanged or numerically decreased after instruction. Similarly, students with career goals in the non-animal industry agreed with this statement more after taking the course than poultry industry-focused students did before taking the class, but within each career group opinions did not change. By year the course was taken, agreeability increased only between years (students in 2020 agreed more after taking the course than students in 2018–2019), but opinions either remained unchanged or decreased in agreeability within the same year. It is worth noting that course instruction, although not content, was altered in 2020 due to the coronavirus pandemic to include virtual delivery of lectures and labs to affected students when necessary. Overall, course enrollment was small enough to maintain in-person, socially distanced instruction, however, changes in student agreeability in 2020 should be considered in the context of potentially altered modality of instruction, with increased virtual education to a number of students at different times throughout the semester. Environmental enrichment is a timely topic of discussion: while public demand for enrichment and mental stimulation in poultry rearing systems has increased, there is no requirement for enrichment in the National Chicken Council Animal Welfare Guidelines and Audit Checklist for Broilers (NCC, 2020) nor in the United Egg Producers Animal Husbandry Guidelines for U.S. Egg-Laying Flocks (UEP, 2017).

While environmental enrichment lacking biological relevance such as string provision by Bailie et al. (2018) or barrier perches by Bench et al. (2016) does not always improve welfare or behavioral outcomes, due to documented benefits to broiler and layer welfare associated with an enriched environment and positive public perception (Riber et al., 2018; Campbell et al., 2019), individual companies and welfare certifications such as American Humane Certified (2019), the Better Chicken Commitment (2022), and Global Animal Partnership Animal Welfare Certified Laying Hen Standards (GAP, 2022) require multiple forms of enrichment in barns. Previous surveys conducted with animal science students have not measured student opinions on environmental enrichment specifically as we have done in the current study. However, based on our survey data considered as a whole and established course content with a focus on rearing environments of commercial birds, we believe that the instruction throughout the semester of Animal Science 223 did not fail to provide knowledge on environmental enrichment to students, but rather failed to provide evidence that current environmental enrichment options industry-wide are adequate.

Student agreeability with two statements regarding their purchasing decisions were unaffected by education, though they were impacted by student demographics. Students with little/no livestock background agreed with the statement “I purchase poultry products based on advertised welfare standards” more than students with other significant livestock experience, but all groups fell into the disagree category with this statement. Similarly, students planning to go into a non-animal career agreed with the statement “I purchase poultry products based on marketing on the package” more than students going into the livestock industry, but all

responses were in the strongly disagree to disagree categories. This evidence that students surveyed do not make poultry or egg product purchases based on animal welfare standards or marketing adds up when considered with responses to the statement “I purchase poultry products or eggs based on price”, which all fell into the agree category. These results therefore agree with the unwillingness of consumers to pay premiums for meat products raised in higher welfare environments, despite the supposed value placed on welfare (de Jonge and van Trijp, 2013a). As our survey was conducted on students currently living in the midwestern United States, the value placed on prices agrees with previous survey results showing that Midwest residents are “more likely to agree that low meat prices take precedence over farm animal welfare” (Prickett, 2007).

Further, this purchasing statement was the only one where responses changed significantly before and after taking the course, with students planning to enter the livestock industry (other than poultry) agreeing with this statement more after taking the course than they did before. This agrees with data from the 2014 survey conducted by Bobeck and others, where both farm and urban background students agreed more with buying food based on price after a semester-long science-based course. Additionally, responses from all career groups of students became remarkably similar after taking the course; this is likely in part due to the course’s focus on understanding marketing and pricing of poultry products, as well as to being presented scientific information on alternative rearing systems.

In summary, these data have shown that over 4 yr of surveying undergraduates, responses to unchanging poultry issue statements were affected differently by student experience, sex, career plans, a semester-long course, and year the survey was taken, although the previous experience of the individual students appeared to affect opinions the most strongly. The topics of commercial stocking density, leg lameness in broilers, and environmental enrichment availability were most varied in student responses when analyzed by demographic variables as well as a semester of poultry science. Overall, this poultry-specific survey highlights the importance to the poultry industry and to university instructors not only of understanding individual background and interests but also in using science-based instruction as a crucial tool to educate students and consumers.

Supplementary Data

Supplementary data are available at *Journal of Animal Science* online.

Conflict of Interest

The authors declare no conflict of interest.

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