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The impact of an introductory animal handling course on undergraduate students who lack previous livestock handling experience

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Abstract
A majority of animal science undergraduates have limited livestock handling experience when they come to college. To address this issue, a course based on livestock handling, safety and welfare was implemented in the Department of Animal Science at Iowa State University. This study aimed to 1) determine if the course was effective at improving the comfort level of a student while handling livestock and 2) to identify demographic factors that contributed to student performance in the course. The course was delivered as an 8-week, lecture-laboratory format. Each semester, a pre-course survey and pre-course exam were administered during the first class period (N=87). The survey collected self-reported demographic information, prior livestock handling experience, and comfort level by specie. The exam tested the prior knowledge of each student. At the semester conclusion, a post-course survey and post-course exam were given to determine if the course was effective at improving comfort and knowledge levels of each student, respectively (N=75). Students from farm backgrounds outscored urban students by 5.56 ± 2.96% on the pre-course exam (P=0.06). Cumulative grade point average at the time of the course (GPA) had a role in the pre-exam score (P=0.003) while gender, semester, involvement in 4H or FFA, and high school or collegiate judging were not factors in the pre-exam score (P>0.10). Background and student rank did not have an effect on the post-course exam score (P=0.96 and P=0.58, respectively). As expected, GPA was significant when fit as a covariate (P<0.001) in the post-course exam model. Upon course completion, students reported that their comfort level while handling livestock had increased for all livestock species. The largest increases were observed with poultry (37.8 to 66.9%) and dairy (49.3 to 84.3%). Of the 75 students polled, 96% felt that the hands-on approach was beneficial at reinforcing lecture material, and 100% reported that they were more likely to voluntarily interact with livestock inside or outside of the classroom setting after course completion. In conclusion, some demographic attributes play a role in student performance at the beginning of the course, but these factors are no longer significant after completion of the course. In addition, the level of comfort with and knowledge of livestock handling, safety and welfare all improved, which shows that the course was successful at achieving the intended learning outcomes.

Keywords
demographics, learning outcomes, livestock experience, livestock handling, undergraduate

Disciplines
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ABSTRACT:

A majority of animal science undergraduates have limited livestock handling experience when they come to college. To address this issue, a course based on livestock handling, safety and welfare was implemented in the Department of Animal Science at Iowa State University. This study aimed to 1) determine if the course was effective at improving the comfort level of a student while handling livestock and 2) to identify demographic factors that contributed to student performance in the course. The course was delivered as an 8-week, lecture-laboratory format. Each semester, a pre-course survey and pre-course exam were administered during the first class period (N=87). The survey collected self-reported demographic information, prior livestock handling experience, and comfort level by specie. The exam tested the prior knowledge of each student. At the semester conclusion, a post-course survey and post-course exam were given to determine if the course was effective at improving comfort and knowledge levels of each student, respectively (N=75). Students from farm backgrounds outscored urban students by 5.56 ± 2.96% on the pre-course exam (P=0.06). Cumulative grade point average at the time of the course (GPA) had a role in the pre-exam score (P=0.003) while gender, semester, involvement in 4H or FFA, and high school or collegiate judging were not factors in the pre-exam score (P>0.10). Background and student rank did not have an effect on the post-course exam score (P=0.96 and P=0.58, respectively). As expected, GPA was significant when fit as a covariate (P<0.001) in the post-course exam model. Upon course completion, students reported that their comfort level while handling livestock had increased for all livestock species. The largest increases were observed with poultry (37.8 to 66.9%) and dairy (49.3 to 84.3%). Of the 75 students polled, 96% felt that the hands-on approach was beneficial at reinforcing lecture material, and 100% reported that they were more likely to voluntarily interact with livestock

inside or outside of the classroom setting after course completion. In conclusion, some demographic attributes play a role in student performance at the beginning of the course, but these factors are no longer significant after completion of the course. In addition, the level of comfort with and knowledge of livestock handling, safety and welfare all improved, which shows that the course was successful at achieving the intended learning outcomes.

Keywords: demographics, learning outcomes, livestock experience, livestock handling, undergraduate

INTRODUCTION

Each fall, the Department of Animal Science (ANS) at Iowa State University (ISU) welcomes ~340 new students. Approximately 80% of these students come to ISU directly from high school, and 20% are transfer students from two- or four- year institutions (Bundy and Sterle, 2018). The state of Iowa ranks number one for corn, soybeans, swine, and poultry production, yet ISU has experienced a steady decline in student numbers that come from an agriculturally related background. In 2017, 40.4% of first-semester Animal Science students reported that they came from a farm (livestock, crop, or combination), 38.6% came from small towns of less than <100,000 people, and 21.0% classified their background as urban or suburban (>100,000). In addition, student interests tend to focus on companion animals. New, incoming students rank companion animals first (38%), followed by equine (14%), and exotic species (10%). Approximately 17% of new students ranked beef cattle as their first interest, but all other livestock species earned less than 10% of the possible votes (Sterle, 2018).

In 2018, the United States Department of Agriculture (USDA) National Agricultural Statistics Service (NASS) reported that the number of farms in the United States (US) was steadily declining, while the average farm size was increasing. Between 2016 and 2017, the US lost approximately 12,000 farms while the average farm size increased by 0.81 hectares (2 acres). This trend has caused a decline in the number of persons living on farms and in rural populations. Between 1980 and 2010, the population of Iowa increased by 4.5% (2,913,808 in 1980 to 3,046,355 in 2010). However, the number of people living in rural areas within Iowa has declined by almost 10% during this same time period (1,205,576 in 1980 to 1,096,099 in 2010, US Census Bureau, 2010). As the rural population declines, it is hypothesized that the

Department of Animal Science at ISU will continue to see a declining student population with previous agricultural experience. This is extremely problematic when one considers the number of jobs that have been predicted to be available in the agriculture sector in the future. Goecker et al. (2015) estimated that 57,900 jobs will be added to the agriculture sector yearly between 2015 and 2020. It is expected that 26,700 of these positions will be in the management and business sector while over 15,000 jobs will be in the Science and Engineering sector. Jobs in these areas include farm labor specialists, veterinarians, and animal scientists. It is estimated that close to 8,500 positions will be in the Food and Biomaterials sector while 7,200 positions will become available in the Production or Education, Communication, and Governmental Service sector. Occupations in these areas include farmers, ranchers, poultry and swine production managers, high school agriscience teachers, and farm services agents. Across all sectors, knowledge of proper animal handling and animal welfare practices would be extremely beneficial.

In order to produce this critical workforce, Land-Grant Universities will have an important role to train and prepare students that lack livestock experience. Land-Grant Universities will only be successful at completing this task if faculty and staff are able to help new students feel comfortable working with livestock species. If a student is comfortable with a certain specie or multiple species, it is predicted that their employment success will increase favorably in the livestock industries. To address this challenge, the Department of Animal Science, ISU has created a novel eight-week long course that has given students the opportunity to gain extensive livestock handling experience. The course is titled "Animal Science 190: Animal Handling, Safety, and Well-Being" (ANS 190), and is offered in the second half of fall and spring semesters. As described by McNeil et al. (2015), the course includes a weekly lecture

to provide students with background information on biosecurity, livestock movement and perception, while the laboratory session provides livestock interactions.

The overall course aimed to increase the comfort level of students when working with livestock. In order to achieve this, the following course outcomes were identified: (1) students should be able to exhibit an understanding of livestock perceptions, (2) demonstrate factual knowledge of livestock-human interactions, (3) safely handle and move healthy livestock, (4) demonstrate proper methods for recognizing and handling compromised livestock, (5) address livestock well-being, and (6) speak intelligently on the importance of biosecurity (McNeil et al., 2015). Therefore, the objectives of this study were to 1) determine if the comfort level of students improved while handling livestock and 2) to identify demographic factors that contributed to student performance in AN S 190.

MATERIALS AND METHODS

Course description

Animal Science 190 is a two-credit course that is taught in the second-half of the spring and fall semesters. Up to 24 students per semester were allowed to enroll each semester and required instructor permission. Students were allowed to enroll even if they had extensive handling experience with only one livestock specie, but lacked experience working with five livestock species. Livestock species were defined as dairy, beef, swine, sheep, horses and poultry that included laying hens, turkeys and broilers. Once enrolled into the eight-wk course, students had two-h/wk of lecture and three-h/wk in hands-on laboratory sessions. A complete description of the course can be found in the ISU course catalog: http://catalog.iastate.edu/azcourses/an_s/

Data collection

Following approval from the ISU Institutional Review Board (IRB 14-410), four semesters of survey data were collected from the students enrolled in ANS 190. During the first class period, students completed a pre-course demographics survey. The pre-course demographics survey allowed students to report on their sex, entry type (transfer or direct from high school), residency, and whether they were previously involved in agriculture-related activities (4-H, FFA, livestock judging). Students identified their background as livestock farm, crop farm, combination farm, small town, urban/suburban, but definitions of each category were not provided. For data analysis, the livestock, crop, and combination farm categories were combined into one 'farm' category due to possible confounding. In addition, livestock handling experience and comfort level were determined. Livestock handling experience was defined as "more than just touching or petting" the animal. Students ranked their livestock handling experience and comfort level on a six-point scale. For livestock handling experience a zero indicated no prior experience and a five indicated that the student was proficient at handling the given specie. For livestock comfort level, zero indicated that the individual had never touched that specie of livestock, while a five indicated that the student was perfectly comfortable interacting with the given specie. For the purposes of summarizing these results, we combined the low-level ranks (0 through 2) into one category and the high level ranks (4 and 5) into one category. A rank of 3 was considered neutral, and was left in its own category.

Upon completion of the course, students completed a post-course survey. In the survey they were asked to re-rank their comfort level with each specie, and to answer questions related to the course effectiveness as it related to course outcomes. The post-course survey was modified

in 2016 by adding additional questions that would address the long-term impacts of the course. One of the added questions assessed the ability of the individual to handle and recognize compromised animals. In addition, a second added question determined the likelihood of the individual to interact with livestock after completion of the course. Comparisons of the pre- and post-course comfort levels helped to determine if the course was effective at improving the comfort level of a student while working with livestock species (Research Objective 1).

A pre-course, 50- multiple choice question exam was administered on the first class day of each semester. This exam assessed the knowledge of livestock perception, behavior, biosecurity, and best care practices. At the course conclusion, students completed a post-course exam. The post-course exam were the same 50 multiple-choice question exam. During both exams, students were denied access to their notes or other resources. Pre- and post-course exam scores were used to create a new variable called "overall improvement". Overall improvement was calculated as follows:

(Post-course exam score) – (Pre-course exam score) = Overall improvement.

Statistical analysis

The dependent variables of pre-course exam score, post-course exam score, and overall improvement were analyzed using an F-test in PROC MIXED of SAS in order to determine if demographic factors had a role in a performance of a student in the course (Research Objective 2). Demographic factors were divided into two statistical models. The first statistical model included factors from the background of each student:

Model 1 – Effects of student background on scores and improvement

Dependent Variable = μ + *Gender* + *Semester* + *Background* + *Rank* + *Cov(GPA)* + *e*

where:

Dependent Variable = Pre-course exam score, Post-course exam score, or Overall improvement

μ = Population mean of the dependent variable

Gender = Male, or Female

Semester = Fall 2015, Spring 2016, Fall 2016, or Spring 2017

Background = Farm, Small town, Urban, or Other

Rank = Freshman, Sophomore, Transfer sophomore, Junior, Transfer junior, Senior, or Transfer senior

Cov(GPA) = Cumulative grade point average at the time the student was enrolled in the course – fit as a continuous covariate

e = error

If a fixed effect was found to be significant ($P < 0.05$) or approached significance ($P < 0.10$), appropriate contrasts were performed using the CONTRAST statement in PROC MIXED of SAS. The second model tested factors that indicated the previous agricultural related experience of a student:

Model 2 – Effects of agricultural-related experience on a scores and improvement

Dependent Variable = μ + *4H or FFA* + *High School Judging* + *Collegiate Judging* + *e*

where:

Dependent Variable = Pre-course exam score, Post-course exam score, Overall improvement

μ = Population mean of the dependent variable

4H or FFA = Yes (involvement in one or both) or No (was not involved in either)

High School Judging = Yes (involvement in livestock judging in high school) or No

Collegiate Judging = Yes (involvement in livestock judging in college) or No

e = error

As with Model 1, if a fixed effect was significant, appropriate contrasts were performed using the CONTRAST statement in PROC MIXED of SAS. Lastly, a final model was created that contained significant effects from the background and involvement models. In some cases, an effect that tended towards significance ($P < 0.10$) remained in the model if it improved the overall fit of the model as indicated by the Akaike's Information Criterion (AIC).

RESULTS AND DISCUSSION

Student demographics and prior experience

Out of the 87 students enrolled, 77% were female and 23% were transfer students. This percentage is consistent with the departmental estimates in 2017, at 20% transfer classification (Bundy and Sterle, 2018). Interestingly, students were evenly distributed between farm, small town, and urban backgrounds (Table 1). These numbers are in alignment with a previous report by Sterle (2016). Therefore, the student sub-population that have enrolled in ANS 190 are representative of the undergraduate population in the Department of Animal Science at ISU. The trends that we observe at ISU are reflected across Animal Science degree granting programs nationwide. Enrollment numbers are continuously increasing and consist of females that want to work with animals (Daigle, 2016).

There is limited published work that has investigated the livestock handling experiences of undergraduate students. One study by Reese et al., (1987) reported 92.5% of animal science majors had experience with livestock or poultry prior to starting college. The students in the 1987 study were predominantly from a rural background (86.0%) and were involved in 4H and FFA. In contrast, our student population consisted of only 59.8% from farm or small towns

(Table 1), whereby on average, 42.9 ± 16.8% reported that they had experience with livestock species. In addition, livestock experience was heavily weighted to horses (Table 2). As the American rural population continues to decline we could hypothesize that the student numbers with livestock handling experience prior to college will also decline.

In addition to a binary yes/no question related to experience, we also asked students to rank their livestock handling. It is interesting to compare the student percentage that reported having prior livestock handling experience (yes/no) with the level of experience that was reported. For example, 26.4% of students indicated that they had prior poultry handling experience (Table 2), but only 11.76% reported their experience as moderate and high (Fig. 1). Likewise, 70.1% reported prior equine handling experience (Table 2), but 40.2% reported their experience level as moderate to high (Fig. 1). Interestingly, the 25.3% of students reported dairy livestock experience (Table 2) tended to rank their experience level as moderate to high (21.9%; Fig. 1).

Student comfortability while handling livestock species

A total of 87 students completed the demographics survey on the first day of the course (N = 87) and 75 completed the post-course survey on the last day of class. The lower number of post-course survey participants was due to student absences on the day of the survey, and due to students dropping the course prior to completion. Nevertheless, there was a reduction in the proportion of students that reported being uncomfortable during the post-course survey when compared to the pre-course survey (Fig. 2). These differences were significant across all livestock species ($P < 0.001$). Around 43% reported being uncomfortable handling poultry prior to taking the course but this decreased by 32.8% during the post-survey. Armstrong (2015)

reported that agricultural students are less interested in poultry due to lack of exposure and prior experience and that 48% of county 4H leaders in Georgia felt that their poultry curriculum training and implementation was inadequate. In this study, there was an improvement in dairy cattle comfortability with a 27.5% decrease in the number of students that were uncomfortable handling dairy cattle from the pre- to post-course surveys. Again, this lack of comfort with dairy maybe due to the limited number of students that are exposed to dairy cattle. At ISU there has been a steady decrease in students declaring Dairy Science as their major. Kenealy (2010), reported that 66 students were Dairy Science majors during 2009-10 school year, but by 2015 Dairy Science majors had declined to 43 students (Sterle, 2016), and is now at 31 students in the 2017-18 school year (Sterle, 2018). Even though we saw the largest improvements in comfort level with poultry and dairy cattle, we still observed improvements in all other livestock species that were included in the course (Fig. 2).

Assessment of course outcomes through student feedback

A total of 96% agreed that the hands-on approach was beneficial in reinforcing the material learned in lecture. This learning style is in agreement with previous studies across plant and animal disciplines have shown that experiential learning benefits retention of material (Bauerle and Davis, 2012), problem solving skills (Millenbah and Millspaugh, 2003), and overall interest in the subject at hand (Reiling et al., 2003). A total of 99% agreed that the course has made them aware of why proper livestock handling is important, while 98% agreed that the course had taught them how to handle livestock properly (Fig. 3). These data show that we are achieving the course outcomes of teaching students to be able to exhibit an understanding of livestock perceptions, to demonstrate factual knowledge of livestock-human interactions, and to

safely handle and move healthy livestock. These findings are not unique to the course offered at ISU. Reilling et al. (2003), reported that their hands-on large animal practicum at the University of Florida earned a 4.63 out of 5.00 student rating (1.00 = poor, 5.00 = excellent) for the course ability to facilitate animal science concept learning.

Additional survey questions addressed the efficacy of the remaining course outcomes. Out of 52 respondents, 96% agreed that the course has prepared them to correctly handle and recognize compromised livestock (Fig. 3). Underwood (2002) discussed in her Animal Welfare Forum paper that one of the top three methods in reducing stress and pain in sick or injured animals is to ensure that animal handlers understand the basic concepts of animal handling. Hands-on training, like the training offered in this class, is a key component of effective animal welfare management. One of the most exciting results from the student feedback data was that 100% agreed that they were more likely to voluntarily interact with livestock inside or outside of the classroom after course completion. These future interactions are likely to include livestock-based internships and part or full-time jobs.

Demographic effects on pre-course exam scores

The average pre-course exam score was 62.96 ± 10.18% (N = 87). Gender (P = 0.83) and semester (P = 0.99) had no role in how a student performed. Surprisingly, when we fit background as a fixed effect we found that it was not significantly related to the pre-course exam score (P = 0.30). However, analysis of the pair-wise differences between least-square means of ‘farm’, ‘urban’, ‘small town’, and ‘other’ showed that the difference between the pre-course exam scores of farm and urban students approached significance (P = 0.06). Students from farm

backgrounds tended to outperform urban students by an average of 5.56 ± 2.96% on the pre-course exam.

The combination of student rank and admission type tended towards significance (P = 0.08). Contrasts between rank/admission type combinations showed that seniors, regardless of admission type, scored higher on the pre-course exam than all other students (P < 0.001). In addition, freshmen scored less than all other students (P = 0.02). These differences were expected since seniors would have had many more opportunities to learn about livestock perception, biosecurity, best care practices, and livestock movement in their previous collegiate animal science courses. There were no differences observed between transfer students and direct-from-high-school counterparts of the same rank (P > 0.56). Cumulative grade point averages (GPA) were fit as a continuous covariate to account for differences in academic ability. As expected, the covariate was significant (P = 0.003) as students who tend to have a higher GPA performed better on the pre-course exam.

Additional modelling tested whether agricultural-related experiences had an effect on pre-course exam scores. Interestingly, involvement in 4H or FFA (P = 0.62), high school livestock judging (P = 0.12), and collegiate livestock judging (P=0.58) did not have any effect on the pre-course exam score. It was predicted that students who were involved in these activities would score higher compared to students who were not involved in these agriculturally focused programs. However, participation in 4H or FFA does not always guarantee that students get hands-on livestock experience. It is possible for a student to participate in these programs and focus on other scientific disciplines, leadership, or education. Students did not provide a

description of their involvement in 4H or FFA but merely provided a yes/no answer. This information will be collected on future pre-course surveys.

Demographic effects on post-course exam scores

The average post-course exam score was 83.26 ± 6.74% (N = 82). The effects of gender (P = 0.58), semester (P = 0.16), background (P = 0.20), and rank (P = 0.58) were not significant. The cumulative GPA covariate was highly significant (P < 0.001), and similar to what was observed on the pre-course exam with higher achieving students performing better. Although background was not significant, background contrasts against all categories. We found that there were no longer differences in post-course exam scores between the urban students and all others (P = 0.96). Frick et al. (1995) showed that urban students typically come to college with the smallest amount of livestock knowledge and exposure. Therefore, the finding that this contrast was not different is incredibly important from the standpoint of the course outcomes. Therefore, this course was effective in helping these students "catch up" to their more experienced counterparts. Contrasts of farm background versus all groups (P = 0.27) and other versus all groups (P = 0.54) were not significant. However, the contrast of small town versus all groups was significant (P = 0.05) as students from small towns performed, on average, 3.26% higher on the post-course exam than other students in the course. Further investigation showed that students from small towns had higher GPAs, on average, when compared to the rest of the group (2.84 versus 2.56).

An important finding was that the combination of student rank and admission type did not play a role in the post-course exam scores (P = 0.58). Contrasts of all seniors versus all academic ranks (P = 0.43) and freshman versus all others were not significant (P = 0.20). It is

hypothesized that the lack of difference is because the course provides the opportunity for students with less classroom-based experience to "catch up" to students who are more advanced within the animal science curriculum. In addition, high school and collegiate judging had no role in the post-exam score (P = 0.53 and 0.46, respectively). However, participation in 4H or FFA approached significance (P = 0.06). Surprisingly, students that did not participate in 4H or FFA actually performed better on the post-course exam by an average of 3.34% than the students who participated in these programs.

In conclusion, this study has demonstrated that Animal Science 190: Animal Handling, Safety, and Well-Being improves the comfort level of a student when they are handling livestock, and the course was of particular importance for students will little livestock handling experience and students that came from a urban background prior to coming to Iowa State University. The eight-wk course provided an opportunity for those students to catch up to students who have prior experience working with livestock species. Students who feel comfortable working with and around livestock are more likely to recognize compromised animals and voluntarily interact with food animal species. This course is a useful tool to enable all students to feel confident in pursuing a career in livestock sector.

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Table 1. Self-reported demographic data from the pre-course survey (N = 87)

Gender	n	%
Males	20	23.0

Females	67	77.0
Entry type		
Direct from high school	67	77.0
Transfer students	20	23.0
Student-reported background		
Farm	26	29.9
Small town	26	29.9
Urban	24	27.6
Other	11	12.6
Residency		
Iowa resident	54	62.1
Out-of-state	33	37.9
Agricultural involvement (Yes)		
[1]4H or [2]FFA	44	49.4
High school livestock judging	20	23.0
Collegiate livestock judging	4	4.6

[1]4H is a cooperative extension program that specializes in youth development

[2]FFA (Future Farmers of America) is an intracurricular student organization for those interested in agriculture and leadership

Table 2. Student percentage that reported livestock handling experience by species on the first day of class each semester from fall 2015 through spring 2017 (N = 87).

Specie	**[1]Yes, %**	**No, %**
Beef cattle	43.7	56.3
Dairy cattle	25.3	74.7
Equine	70.1	29.9
[2]Poultry	26.4	73.6
Sheep	40.2	59.8
Swine	51.7	48.3

[1]Experience is defined as more than merely touching or petting an animal

[2]Poultry includes laying hens, broilers, and turkeys

Figure 1.Self-reported level of livestock handling experience (none, low, moderate and high) by species on the pre-course survey, fall 2015 through spring 2017 (N=87)

Figure 2. ANS 190 students that reported being uncomfortable with a species before (N=87) and after completing the course, fall 2015 through spring 2017 (N=75). All differences are significant ($P < 0.001$).

Figure 3. Percentage of students that strongly agreed, agreed, were neutral, disagreed, or strongly disagreed with each statement from the post-course survey in the fall of 2015 (N = 75) and from spring 2016 through spring 2017 (N = 52).