Quantifying the Critical Thinking Skills of Students Who Receive Instruction in Meat-Animal or Meat Product Evaluation

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Abstract

Meat-animal and meat product evaluation and participation on intercollegiate judging teams have long been reported to instill critical thinking and decision making skills in students, but no known work has quantified this objectively. Students within the Department of Animal Sciences at the University of Florida were given the EMI instrument to measure the Engagement, Cognitive Maturity, and Innovativeness of students at the start (Preintro; n = 110) and end (Postintro; n = 78) of the Introduction to Animal Sciences class, at the start (Preeval; n = 21) and end (Posteval; n = 21) of the meat-animal or meat product evaluation classes, and at the end (Postteam; n = 10) of participation on the intercollegiate meat or livestock evaluation team. Responses from Postteam students displayed greater ($P \leq 0.03$) Engagement than students the other test groups and greater ($P \leq 0.03$) Innovation than students from the Preintro, Postintro, and Preeval test groups. The results from this research objectively show participation on intercollegiate evaluation meat-animal or meat product teams improves students' critical thinking. The findings from this research further validate the efficacy of intercollegiate judging team participation to university administrators, program donors and sponsors, and prospective employers.

Introduction

The National Research Council (NRC) has stated that today's college graduates in the agricultural sciences are expected to have the ability to solve problems and critically evaluate complex situations (NRC, 2009). However, the NRC noted that many academic programs have not evolved to provide opportunities for students to develop these skills. They specifically suggested that students should be given opportunities to use a variety of data to make decisions and then be asked to defend their decisions. An existing activity that seems to meet all of these criteria is evaluating and assessing animals and animal products.

Animal science programs within land-grant universities and agricultural colleges have fielded animal or product evaluation teams for over a century, with a national contest for livestock and meat evaluation first held in 1900 and 1926, respectively (Davis et al., 1991; Mello et al., 1973). Most students involved in these activities take a background course at their home institution focused on proper terminology, understanding traits which influence the value of meat animals and the products they produce, and defending their decisions via written or oral communication (Heleski et al., 2003). Intercollegiate competitions serve as a method to gauge mastery of the skills acquired through coursework and add incentive for practicing evaluation and communication skills (Kauffman et al., 1984; McCann and McCann, 1992).

Employers in animal agriculture expect recent college graduates to have a strong knowledge base within their field of study and the ability for independent and critical thought (Berg, 2002; Field et al., 1998; Shann et al., 2006). Testimonies of former students, academicians, and meat-animal industry professionals document the value of participation on intercollegiate judging teams to instill critical thinking, communication skills and leadership in students (Field et al., 1998; Guthrie and Majeskie, 1996; Smith, 1989). Results from over 2,700 judging team alumni cited improved decision making skills as one of the primary skills gained from program participation (Davis et al., 1991; McCann and McCann, 1992). Other reports document judging team participants to have greater grade point averages (Berg, 2002) and post-graduation incomes (Morgan, 2003) than non-judging animal science alumni.

The only research known to objectively measure the critical thinking skills of students receiving instruction in livestock or meat evaluation reported students participating in a meat-animal evaluation course to have an increase in post-class Watson-Glaser objective critical thinking scores, compared to pre-class scores (Shann et al., 2006). The authors are not aware of any research which objectively quantifies the critical thinking of meat animal or meat product judging team participation.

Objective

The purpose of this study was to objectively assess the critical thinking skills of students within the Department of Animal Sciences at the University

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of Florida (UF) at the start and conclusion of the Introduction to Animal Sciences class and the meat-animal or meat product evaluation classes and at the conclusion of competing on the intercollegiate meat or livestock evaluation teams.

Materials and Methods

Evaluations were made during the 2009-2010 academic year. Students were given the EMI instrument at the start (Preintro; n = 110) and end (Postintro; n = 78) of the Introduction to Animal Sciences class, at the start (Preeval; n = 21) and end (Posteval; n = 21) of the meat-animal or meat product evaluation classes, and at the end (Postteam; n = 10) of participation on the intercollegiate meat or livestock evaluation team. The critical thinking disposition test known as the EMI is similar to the Watson-Glaser test and measures the Engagement, Cognitive Maturity, and Innovativeness of students (Ricketts and Rudd, 2005). This test has been reported as having Cronbach's alpha coefficients of 0.89, 0.75, and 0.79 for Engagement, Cognitive Maturity, and Innovativeness constructs, respectively, suggesting the value of the test to assess differences in critical thinking (Norris and Ennis, 1989).

The 26 question EMI test contains 11 questions which measure Engagement, eight questions measuring Cognitive Maturity, and seven measuring Innovativeness. Each question was answered on a one to five summated rating scale, with one representing a low level of critical thinking and five representing extensive critical thinking, thus the possible per student totals for Engagement, Cognitive Maturity, and Innovativeness were, 11 to 55, 8 to 40, and 7 to 35, respectively. The Engagement questions measure a students' predisposition to use confident reasoning. The Innovativeness questions measure a students' predisposition to be intellectually curious and seek the truth. The Cognitive Maturity questions measure a students' awareness of real problems and openness to other points of view, while being aware of their own biases (Ricketts and Rudd, 2005).

The three formal meat-animal or meat product evaluation classes assessed along with the Introduction to Animal Sciences class were Live Animal and Carcass Evaluation, Meat Selection and Grading, and Live Animal Evaluation. Students within these classes were given the EMI instrument on the first and last day of instruction, whereas students participating on the intercollegiate meat or livestock evaluation teams were only given the EMI instrument at the conclusion of program participation.

Introduction to Animal Sciences is a four credit hour lecture and supplemental laboratory course which emphasizes the role of beef cattle, dairy cattle, swine, sheep, poultry, and horses in serving humans. The course introduces the anatomy and physiology of digestion, growth, and reproduction and the application of genetics to livestock improvement. The course also introduces animal health and management systems, livestock marketing, and animal products.

Live Animal and Carcass Evaluation is a hands-on two credit hour lecture/laboratory course which provides instruction on the evaluation, grading, and economic value of fed-beef, market hogs, and slaughter cows and the carcasses they produce. Laboratory activities include estimating carcass merit of live animals, and subsequent evaluation of their carcasses.

Meat Selection and Grading is a hands-on two credit hour lecture/laboratory course which provides instruction on grading, determining value, and ranking carcasses, wholesale cuts, and assessing the fabrication acceptability of subprimal cuts of beef, pork, and lamb. Laboratory activities include grading and ranking carcasses and cuts, defending their rankings via written reasons, and evaluating the acceptability of subprimal cuts.

Live Animal Evaluation is a hands-on two credit hour lecture/laboratory course which provides instruction on the science and art of live animal evaluation addressing all aspects of improving the selection of meat animals and the efficiency of meat animal production. Laboratory activities include evaluating and ranking market animals and breeding animals of all meat animal species using phenotype and performance records, and defending their rankings via oral reasons.

Members of the intercollegiate meat or livestock evaluation teams at UF receive extensive hands-on experience as they meet approximately 45 times during a 15-week semester to practice their evaluation and communication skills. Students take one of the three background courses prior to participation on one of the intercollegiate evaluation teams for consecutive spring and fall semesters. Students are given up to 15 minutes to evaluate the animals, carcasses or cuts, and to note differences, and then are given time to prepare oral or written reasons defending their placing. Students travel outside the state and practice at various operations including: livestock breeders, feeding operations and commercial slaughter facilities, as they travel to compete in up to three intercollegiate contests in the fall and spring semesters.

Question responses from the EMI were analyzed using ordinary least squares (PROC GLM, SAS Inst., Inc., Cary, NC) using test group (Preintro, Postintro, Preeval, Posteval, and Postteam) as the only fixed effects for the dependent variables of Engagement, Cognitive Maturity, and Innovativeness. The arithmetic mean and SD were reported for descriptive statistics and least squares means were separated statistically using pair-wise t-tests (P-DIFF option of SAS) when a significant ($P < 0.05$) F-test was detected. Additionally, the SE for each main effect mean was reported.

Results and Discussion

Demographics of students within Introduction to Animal Sciences (Intro) are indicative of the Animal Sciences majors at UF with the majority being pre-professional or science option (Prepro) and female (Table 1). This complements Buchanan (2008) who reported an increase in the percentage of both female students and students who intend to apply to a college of veterinary medicine, from departments of animal science across the country. Also, Intro is a required class for admittance into the College of Veterinary Medicine at UF, thus many non-animal sciences majors (NAS) in Intro are pre-professional students as a Biology, Microbiology and Cell Science, Food Science, or Wildlife Ecology and Conservation major. The average age of undergraduate students has increased over the past 20 years (Buchanan, 2008; Tsapogas, 2004). Approximately 40% of students are admitted into the College of Agricultural and Life Sciences at UF as juniors, rather than freshman.

Demographics of students within the three meat-animal or meat product evaluation classes (Eval) and those who participated on the intercollegiate meat or livestock evaluation team (Team) were collectively similar (Table 1), but those percentage demographics were different than Intro. A majority of Eval and Team students were female, but both groups had a greater percentage of male students than Intro. The majority of Eval and Team students were animal sciences majors with a food animal or equine option (FAE). The percentage of NAS students is similar between classes (Table 1), but a different group of NAS students comprise the percentage in Eval and Team than in Intro. Most Eval and Team students which are NAS are either Agricultural Education and Communication majors who aspire to gain greater evaluation experience prior to becoming a secondary agricultural teacher or are students with an agricultural background who are either Food and Resource Economics majors or not a student within the College of Agricultural and Life Sciences at UF.

The responses for the EMI constructs of Innovation and Engagement in this study (Table 2) are similar to the findings by Ricketts and Rudd (2005) for a comparable sample size of secondary and post-secondary agricultural education students. The values for Cognitive Maturity were almost 10 units greater for students from the current study at 31.4, than those reported by Ricketts and Rudd (2005) at 21.7. Students from the current study were almost three years older (20.7 vs. 17.8) than those sampled by Ricketts and Rudd (2005), likely affecting measurements of maturity.

Student responses for Cognitive Maturity were similar ($P = 0.21$) across test groups (Table 3). The findings for Cognitive Maturity by this and other reports (Ricketts and Rudd, 2005) suggest this EMI construct is more easily affected by chronological age than educational enrichment. The questions used to develop the Cognitive Maturity construct by Ricketts

Table 1. Descriptive Statistics for the Sample of Students within the Department of Animal Sciences at the University of Florida Measured by the EMI Test

			Gender, %		Undergraduate option[a], %		
Classes[b]	No. of Students	Avg. Age ± SD	Male	Female	FAE	Prepro	NAS
Intro	118	20.4 ± 1.5	29.66	70.34	8.47	53.39	38.14
Eval	26	20.9 ± 1.2	42.31	57.69	42.31	30.77	26.92
Team	10	22.9 ± 2.1	40.0	60.0	50.0	20.0	30.0
Total	154	20.7 ± 1.6	32.5	67.5	16.88	46.10	37.02

[a]FAE; Animal Sciences major with a food animal or equine option. Prepro; Animal Sciences major with a pre-professional/science option. NAS; Non-Animal Sciences major.
[b]Intro; Introduction to Animal Sciences class. Eval; Meat-animal or meat product evaluation classes. Team; Participation on the intercollegiate meat or livestock evaluation team.

Table 2. Descriptive Statistics for the Cognitive Maturity, Engagement, and Innovativeness of Students as Measured by the EMI test[a]

EMI Construct[b]	No. of Observations	Mean	SD	Minimum	Maximum
Cognitive Maturity	240	31.40	3.53	21	40
Engagement	240	44.60	5.05	27	55
Innovation	240	28.39	3.68	12	35

[a]Greater values indicate more extensive critical thinking.
[b]Cognitive Maturity: a students' awareness of real problems and openness to other points of view, while being aware of their own biases; range- 8 to 40. Engagement: a students' predisposition to use confident reasoning; range- 11 to 55. Innovativeness: a students' predisposition to be intellectually curious and seek the truth; range- 7 to 35.

Table 3. Comparison of Students' Critical Thinking at the University of Florida at the Start and End of the Introduction to Animal Sciences and the Meat-Animal or Meat Product Evaluation Classes and at the End of Participation on the Intercollegiate Meat or Livestock Evaluation Teams, as Measured by the EMI test[a]

	Least squares means ± SE for test group[b]					
EMI Construct[c]	Preintro (n = 110)	Postintro (n = 78)	Preeval (n = 21)	Posteval (n = 21)	Posteam (n = 10)	*P*-value
Cognitive Maturity	31.03 ± 0.34	32.10 ± 0.40	30.57 ± 0.77	31.83 ± 0.77	31.00± 1.12	0.21
Engagement	43.82[e] ± 0.48	45.23[e] ± 0.56	44.14[e] ± 1.09	44.64[e] ± 1.09	49.00[d] ± 1.57	0.02
Innovation	27.87[e] ± 0.35	28.65[e] ± 0.41	27.91[e] ± 0.79	28.98[de] ± 0.79	31.40[d] ± 1.15	0.04

[a]Greater values indicate more extensive critical thinking.
[b]Preintro: start of the Introduction to Animal Sciences class. Postintro: end of the Introduction to Animal Sciences class. Preeval: start of the meat-animal or meat product evaluation classes. Posteval: end of the meat-animal or meat product evaluation classes. Postteam: end of participation on the intercollegiate meat or livestock evaluation team.
[c]Cognitive Maturity: a students' awareness of real problems and openness to other points of view, while being aware of their own biases; range- 8 to 40. Engagement: a students' predisposition to use confident reasoning; range- 11 to 55. Innovativeness: a students' predisposition to be intellectually curious and seek the truth; range- 7 to 35.
[d,e]Values within a row lacking a common superscript letter differ (*P* ? 0.03)

and Rudd (2005) were reported to explain less of the critical thinking skill scores than Engagement and Innovativeness and was also reported to have a slightly inverse relationship with measurements of critical analysis and inference.

Responses from Postteam students displayed greater ($P \leq 0.03$) Engagement than students the other test groups and greater ($P \leq 0.03$) Innovation than students from the Preintro, Postintro, and Preeval test groups (Table 3). Student responses for Engagement and Innovation were similar ($P \geq 0.20$) across the four classroom test groups (Table 3). The material and curriculum of the Eval classes are similar to those for Team students, suggesting the extensive hands-on experiential learning opportunities improved the critical thinking of Team students.

Intercollegiate judging team participation has long been promoted to instill confident reasoning (Engagement) and intellectual curiosity (Innovation) in animal science students (Field et al., 1998; Guthrie and Majeskie, 1996; Helieski et al., 2003; Mello et al., 1973). Engagement is developed in judging team members in preparation for and during intercollegiate contests. Students are required to make independent decisions under pressure, and then defend those decisions via either oral or written communication to an industry expert. Engagement is also instilled by teammates interacting as competitors. Innovation is instilled in judging team members by being exposed to experiential learning in a real-world setting, much different than a classroom, where students are prompted to question, explore, synthesize, make and defend judgments (Schillo, 1997; Smith, 1989). These skills have been identified repeatedly by employers as those needed for success in many different careers (Berg, 2002; Coorts, 1987; Guthrie and Majeskie, 1997; Smith, 1989; Taylor, 1990).

Summary

Meat-animal and meat product evaluation and participation on intercollegiate judging teams have long been reported to instill critical thinking and decision making skills in students. The results from this research objectively show participation on intercollegiate evaluation meat-animal or meat product teams improves students' critical thinking. The findings from this research further validate the efficacy of intercollegiate judging team participation to university administrators, program donors and sponsors, and prospective employers. These activities develop skills that employers seek and align with the NRC's (2009) vision for undergraduate education in the agricultural sciences.

The data presented in this study represent one point in time in one academic program at one university. This research should be replicated at other universities to determine these same results would hold true with animal and animal product evaluation classes and activities. This research should also be replicated in the future to determine if the results of the current study are stable over time. Finally, this research should be replicated by examining similar activities and courses in other agricultural disciplines.

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