

Quantifying Attitudes and Knowledge Change About the Meat-Animal Industry via a Massive Open Online Course

Abstract

Massive open online courses (MOOCs) offer a unique platform through which Extension can provide valuable education. We explored The Meat We Eat, a MOOC designed to create a more informed meat consumer and increase perceptions of transparency surrounding meat production. Compared to pretest respondents ($n = 490$), students who completed the posttest ($n = 226$) had an improved attitude toward meat and slaughter, an improved perception of the meat industry's transparency, and increased knowledge. These findings suggest the relevance and value of MOOCs as Extension activities for improving knowledge and attitudes toward animal agriculture and other topics.

Keywords: [massive open online course](#), [Coursera](#), [meat](#), [animal](#), [attitude](#)

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Introduction

Only 2% of Americans are involved in production agriculture, and the average American is now at least three generations removed from production agriculture (American Farm Bureau Federation, 2019). This scenario leads to the disconnection that exists between how the public views agriculture and how scientists and producers view it and results in consumer distrust of the science of commercial food production. This lack of trust can cause consumer confusion and the urge to grasp at multiple solutions. However, a growing number of consumers in developed countries are aspiring to "know where their food comes from." Those involved with animal agriculture need to explain the technology that will be used to sustainably feed 9 billion people by 2050 (Godfray et al., 2010). Extension programming in animal agriculture has traditionally served other Extension professionals, producers, and industry. Extension programming in animal agriculture and many other disciplines likely will need to be more consumer focused going forward.

During the summers of 2014 and 2015, the undergraduate consumer education course *The Meat We Eat*, which has been taught on campus at the University of Florida for more than 40 consecutive spring and fall semesters, was taught as a massive open online course (MOOC) to more than 20,700 people from 169 countries enrolled via the Coursera platform (<https://www.coursera.org/course/meatweeat>). Literature has been published supporting the viability of MOOCs as vehicles of Extension education in India (Devakumar, Balaji, & Yaduraju, 2014), but no known literature has formally recognized MOOCs as potential platforms for Extension education in the United States.

The purpose of the MOOC *The Meat We Eat* was to empower consumers to be more informed about the quality, safety, healthfulness, and sustainability of meat and to address current issues in animal agriculture in developed and developing countries. A secondary purpose was to improve the transparency of meat animal agriculture in the United States and internationally. Lectures covered all aspects of meat-animal and meat production, processing, preparation, storage, and cooking. Additionally, the role of meat in a balanced diet was addressed as well as factors that contribute to consumers' limiting or eliminating meat from their diets. The class included more than 7.5 hr of video lectures and demonstrations.

Methods

Survey

Students were asked to complete an online inquiry via Qualtrics before beginning and after completing the class. The survey included four questions assessing attitude toward the meat industry, five assessing attitude toward slaughter, six addressing need for slaughter transparency, six addressing perceptions of the U.S. meat industry's transparency, and nine assessing knowledge gained. The survey was based on a previously developed instrument that was deployed with traditional undergraduate students for the same course offered on the University of Florida campus (Abrams, Zimbres, & Carr, 2015).

Statistics and Data Presentation

We analyzed question responses applying ordinary least squares (PROC GLM, SAS Inst., Inc., Cary, NC), using program completion (preclass or postclass) as the only fixed effects for the dependent variables of attitude toward meat, attitude toward slaughter, need for slaughter transparency, perception of livestock and meat industry transparency, and knowledge gained. We calculated the percentages reported by using the total number of respondents for each question as the denominator and the number of respondents having a given answer as the numerator multiplied by 100. We analyzed the binary data generated when respondents answered "0, don't know" with the GENMOD procedure of SAS, using program completion as the only fixed effect. We reported the arithmetic means and standard deviations for descriptive statistics, and we separated least squares means statistically using pair-wise *t* tests (P-DIFF option of SAS) when a significant ($p < .05$) *F* test was detected. Additionally, we reported the largest standard error for each main effect mean. The survey was submitted for human subjects review at Colorado State University and the University of Florida and was granted exemption status.

Results and Discussion

Data regarding preclass and postclass survey completion and demographics of respondents are shown in Table 1. Approximately 3% of the more than 20,700 individuals who enrolled in The Meat We Eat on Coursera completed the preclass survey, and 1% completed the postclass survey. The percentage of enrollees who completed the postclass survey is markedly lower than the median completion rate of 12.6% identified by Jordan (2015) in a survey of 221 MOOCs. Many respondents who completed the posttest also had completed the pretest; however, it was not possible to confidently pair the preclass and postclass surveys for all respondents to assess a repeated measure or change rather than treatment means. Surprisingly, a greater proportion of respondents in our study were female, differing from data reported by Christensen et al. (2013) in their review of MOOCs. The greatest proportion of respondents were from the United States, complementing the findings of Christensen et al. (2013). Canada was the only other country of origin for which respondents exceeded 5% of the total in our study.

Table 1.
Demographics of Respondents

Time	n	Avg.	% female	% male	Weekly servings of meat consumed \pm SD	# of countries represented	% U.S. respondents
		age \pm SD					
Preclass	630	45.0 \pm 0.6	65.2	34.8	5.5 \pm 0.2	63	65.8%
Postclass	292	47.3 \pm 0.9	53.7	46.2	6.2 \pm 0.3	54	55.5%

The results shown in Table 2 suggest that completing the online course improved ($p \leq .05$) all indexes of attitude toward meat. However, it should be noted that the average respondent "agreed" that meat production is critical to feeding a growing world population when surveyed prior to beginning the course. Similarly, of the topics addressed, the importance of meat in the diet had the fewest number of respondents answering "don't know" before the class and had the least change after course completion. Respondents who already have a favorable attitude are more likely to engage and have greater attitude improvement than individuals with less favorable initial attitudes of a subject. Barnes-Holmes, Murtagh, Barnes-Holmes, and Stewart (2010) suggested that vegetarians had a much more favorable attitude about vegetables than omnivores had about meat. The authors of the same study found that omnivores' attitude about meat was more favorable than, but not that different from, vegetarians' attitude about meat (Barnes-Holmes et al., 2010). Collectively, these results support our findings that many consumers have favorable general attitudes about meat.

As shown in Table 2, the lowest numerical means for the construct of attitude toward meat related to environmental concerns with livestock farming, with the average respondent "disagreeing" with the statement "livestock production is NOT harmful to the environment." Of course, everything affects the environment. Animal agriculture imparts due diligence to improve efficiency and minimize environmental impact; however, livestock production does account for approximately 4.2% of U.S. greenhouse gas emissions (Mitloehner, 2016).

Also indicated by the data presented in Table 2, the second greatest numerical improvement in attitude toward meat occurred relative to attitudes surrounding humaneness of livestock farming. Additionally, of the

topics addressed, attitude toward livestock humaneness had the greatest percentage reduction ($p < .001$) of "don't know" responses from the preclass survey to the postclass survey. These changes are potentially rationalized by the fact that almost 1 hr of the 450 min of lecture addressed how livestock are raised on commercial U.S. farms. Miele and Evans (2010) reported that ethical concerns about eating animals are predominantly linked with the conditions of animals during their lives in commercial production systems.

Table 2.
Impact of Program Completion on Attitudes Toward Meat

Item	Preclass	Postclass	<i>p</i> value	Preclass	Postclass	<i>p</i> value
	(<i>n</i> = 630)	(<i>n</i> = 292)		"Don't know" ^a	"Don't know" ^a	
Meat production is critical to feeding a growing world population.	3.13 ± 0.04	3.25 ± 0.05	.05	15 / 2.4%	5 / 1.7%	.52
Meat is necessary to provide an adequate amount of protein and nutrients in the human diet.	2.85 ± 0.04	3.09 ± 0.05	<.001	6 / 0.2%	3 / 1.0%	.91
Livestock farming is NOT harmful to the environment.	2.21 ± 0.03	2.52 ± 0.05	<.001	60 / 9.5%	10 / 3.4%	.002
Livestock farming is humane.	2.54 ± 0.04	2.79 ± 0.05	<.001	93 / 14.8%	18 / 6.2%	<.001
Total attitude toward meat ^b	10.06 ± 0.12	11.31 ± 0.18	<.001			

Note. Scale: 0, *Don't know*; 1, *Strongly disagree*; 2, *Disagree*; 3, *Agree*; 4, *Strongly agree*. Greater values indicate improved attitudes toward meat industry or improved knowledge about industry.

^aFrequency / percentage who responded "Don't know." ^bAttitude toward meat range = 4 to 16.

The results shown in Table 3 suggest that completing the course improved ($p < .001$) all indexes of attitude toward livestock slaughter. The average respondent had comparable numerical attitude improvements relative to humaneness during the slaughter process and livestock feeling pain during the slaughter process, with the greatest improvements in attitude occurring for these items. This is despite the fact that the videoed lecture addressing slaughter accounted for less than 4% of the total online recorded video time. Abrams et al. (2015) reported that after watching a slaughter video, students became more positive toward or accepting of livestock slaughter. Perhaps this was because the video revealed the process to be more humane than expected, even among people with high animal affinity.

Data presented in Table 3 also indicate that improvement in respondent attitude about sanitation and food

safety was almost as great as improvement in their attitude toward humane slaughter. Brewer and Rojas (2008) reported that half of 400 consumers surveyed considered their food "very safe" and that 70% of consumers surveyed believed foods approved for commercial sale by the U.S. Food and Drug Administration are safe to eat. Additionally, in our study the number of responses of "don't know" declined ($p \leq .06$) after individuals completed the online course.

Table 3.
Impact of Program Completion on Attitudes Toward Slaughter

Item	Preclass	Postclass	p value	Preclass	Postclass	p value
	(n = 630)	(n = 292)		"Don't know" ^a	"Don't know" ^a	
I am disgusted and/or emotionally disturbed by the slaughtering and processing of livestock.	2.78 ± 0.04	3.03 ± 0.05	<.001	38 / 6%	9 / 3%	.06
The slaughtering process is inhumane for livestock.	2.68 ± 0.04	2.99 ± 0.05	<.001	102 / 16.2%	17 / 5.8%	<.001
Livestock suffer and feel pain before dying in the slaughter process.	2.42 ± 0.04	2.81 ± 0.05	<.001	128 / 20.3%	29 / 10%	<.001
Livestock are slaughtered and processed in unsanitary conditions/facilities.	2.87 ± 0.04	3.14 ± 0.05	<.001	107 / 17%	19 / 6.5%	<.001
Knowing about livestock slaughter and processing makes me less likely to want to eat meat.	2.87 ± 0.04	3.11 ± 0.06	<.001	59 / 9.3%	9 / 3%	.001
Total attitude toward slaughter ^b	11.78 ± 0.18	14.22 ± 0.27	<.001			

Note. Scale: 0, Don't know; 1, Strongly agree; 2, Agree; 3, Disagree; 4, Strongly disagree. Greater values indicate improved attitudes toward slaughter. ^aFrequency / percentage who responded "Don't know." ^bAttitude toward slaughter range = 5 to 25.

Data regarding respondent perceptions of the need for slaughter transparency are shown in Table 4. The average respondent "agreed" that people should know more about livestock slaughter and processing and that the meat industry should actively communicate about slaughter and processing using pictures and explanations. Generally, respondents "disagreed" that the livestock industry should share an online video showing slaughter and processing. However, completing the course did not affect ($p \geq .18$) respondents' need

for the livestock industry to be transparent about slaughter. Also, interestingly, respondents who completed the online course had lower or contrary responses concerning wanting to know ($p < .001$) and seeking out more information ($p = .002$) about livestock slaughter and processing. If respondents felt they learned an extensive amount from their time commitment with the online The Meat We Eat course, it stands to reason that they might not seek out additional information. These findings align with previous research in that more information about a science topic may not always translate into attitude change; however, openness and transparency are indeed expected (Abrams et al., 2015; Beulens, Broens, Folstar, & Hofstede, 2005).

Table 4.

Impact of Program Completion on Perception of Need for Slaughter Transparency

Item	Preclass (n = 630)	Postclass (n = 292)	p value
People should know more about livestock slaughter and processing.	3.40 ± 0.04	3.37 ± 0.04	.40
The livestock industry should be actively communicating about slaughter and processing.	3.20 ± 0.04	3.18 ± 0.04	.59
The livestock industry should share a video online showing slaughter and processing.	2.90 ± 0.05	2.97 ± 0.05	.18
The livestock industry should provide a website that shows pictures and an explanation of slaughter and processing.	3.13 ± 0.4	3.15 ± 0.4	.58
I want to know more about livestock slaughter and processing.	3.29 ± 0.4	3.07 ± 0.4	<.001
I am willing to seek out more information about livestock slaughter and processing.	3.25 ± 0.4	3.10 ± 0.4	.002
Total need for slaughter transparency ^a	19.17 ± 0.18	18.83 ± 0.18	.12

Note. Scale: 0, *Don't know*; 1, *Strongly disagree*; 2, *Disagree*; 3, *Agree*; 4, *Strongly agree*. Greater values indicate greater need for slaughter transparency.

^aNeed for slaughter transparency range = 6 to 24.

The results shown in Table 5 suggest that completing the online course improved ($p < .001$) respondents' perceptions of livestock and meat industry transparency. Completing the course resulted in the greatest numerical improvement for truthfulness (+0.44), commitment to do good (+0.39), openness (+0.37), and sincerity (+0.36). As stated earlier, the average respondent "agreed" that it is important to know more and communicate about the livestock and meat industry (see Table 4), regardless of when the survey was completed. Consumers with positive perceptions of an industry will only become more supportive of its transparency when they gather more information about that industry (Abrams et al., 2015).

Table 5.
Impact of Program Completion on Perceptions of U.S. Livestock and Meat Industry Transparency

Perception description and range (1–4)	Preclass	Postclass	p value
	(n = 630)	(n = 292)	
Not committed to do good (1) vs. committed to do good (4)	2.83 ± 0.05	3.22 ± 0.05	<.001
Unethical (1) vs. ethical (4)	2.72 ± 0.05	3.08 ± 0.05	<.001
Unreliable (1) vs. reliable (4)	2.95 ± 0.05	3.22 ± 0.05	<.001
Closed (1) vs. open (4)	2.37 ± 0.06	2.75 ± 0.06	<.001
Insincere (1) vs. sincere (4)	2.61 ± 0.05	2.97 ± 0.05	<.001
Deceptive (1) vs. truthful (4)	2.52 ± 0.05	2.96 ± 0.05	<.001
Total perception of transparency ^a	16.01 ± 0.27	18.21 ± 0.27	<.001

^aPerception of livestock and meat industry transparency range = 6 to 24.

Data regarding course participants' knowledge gain are presented in Table 6. Respondents who completed the online course scored 8.2% greater ($p < .001$) on the nine-item knowledge-based posttest compared to those who completed the pretest. The only three topics for which respondents initially scored over 80% correct addressed the role of the U.S. Department of Agriculture Food Safety and Inspection Service, factors affecting meat flavor, and thawing of meat products. The greatest score improvement from pretest to posttest related to understanding of what raw materials are used during the manufacturing of ground beef commercially (+17.7%), why ground beef should be cooked to higher degree of doneness than a steak (+14.5%), and the value of lean fresh meat in the diet (+13.6%).

Table 6.
Impact of Program Completion on Knowledge Gained

Item	Preclass	Postclass	p value
	(n = 630)	(n = 292)	
Why is it safe to cook a steak or roast to medium rare, but a ground beef patty should be cooked to 70°C/160°F?	64.6	79.1	
a) A roast has a larger surface area			
b) The inside of a muscle is naïve to pathogens			
c) Pathogens are killed at medium-rare			
d) Pathogens are killed by grinding			
Which of the following is a true statement about US animal agriculture?	54.6	56.5	
a) All chickens are given hormones			

b) Hot dogs are made of inedible offal items		
c) All pigs eat forage		
d) Gestating cows eat forage		
The main role of the United States' Department of Agriculture FSIS is _____.	81.4	88.4
a) Inspection		
b) Grading		
c) Pricing		
d) Marketing		
Which food is E. coli O157:H7 commonly associated with?	61.3	69.9
a) Chicken breast		
b) Ham		
c) Ground beef		
d) Intact ribeye steak		
The flavor of unmarinated, unseasoned pork and poultry is most driven by which of the following traits?	92.9	91.1
a) The position of the sun		
b) The animal's diet and its influence on fatty acid profile		
c) What country it was raised in		
d) Food safety		
Commercially manufactured ground beef in the US is made up of what?	51.7	69.5
a) Brain, tongue, liver, hooves and fat trimmings from a young beef carcass		
b) Organ meats and fat trimmings from a cow carcass		
c) Fat trimmings from young beef carcasses and lean trimmings from cow carcasses		
d) An even ratio of fat and lean trimmings is removed from each animal and packaged individually		
Which of the following statements about meat in the diet is false ?	49.4	63.0
a) Meat is an excellent carbohydrate source		
b) Iron in meat is more available to your body than iron from plants		
c) Multiple fresh beef, pork, and poultry products have been identified as lean and heart healthy		
d) Animal products are the only source of cholesterol in the diet		

Marbling, or taste fat, is also known as _____?	61.1	72.6	
a) Intermuscular fat			
b) Subcutaneous fat			
c) Perinephric fat			
d) Intramuscular fat			
Which of the following is the safest way to defrost meat?	88.1	90.4	
a) Don't thaw, cook frozen			
b) On the countertop			
c) In hot water			
d) In the refrigerator			
Total test score ^a	67.2 ± 1.1	75.5 ± 1.1	<.001
^a Nine-item test score range = 0 to 100.			

Implications

During the last few years, MOOCs have been offered through various platforms such as Coursera, EdX, and Udacity as a way to educate extended audiences. These classes provide top-quality education while avoiding the barriers faced in traditional higher education institutions, such as cost, admission requirements, and academic background (Jordan, 2014). With the given infrastructure, MOOCs have the potential to be used to offer education to the masses.

There is an associated opportunity to improve the perception of the average consumer regarding a given industry through transparency and education. Our results show that MOOCs directly serve the overarching objectives of Cooperative Extension programs by providing knowledge to the public in an effort to elicit positive change. Similar to Extension, the animal agriculture industry strives to be open and accessible and to serve the public. MOOCs are a practical way for an industry to disseminate factual information to a broad consumer base. In addition to educating the general public, it is just as important to offer professional development opportunities for Cooperative Extension agents, especially those with little previous exposure to the subject matter. MOOCs are dual purpose in this regard as they can be used for consumers and professionals alike (Garst, Baughman, & Franz, 2014).

Conclusions

Students who completed the posttest for The Meat We Eat via the Coursera platform had an improved attitude toward meat and slaughter, an improved perception of the meat industry's transparency, and increased knowledge compared to those who completed the pretest. These findings illustrate the value of this kind of Extension education relative to improving attitudes toward animal agriculture and, potentially, other industries as well.

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