Utilization of a Modified Delphi Method for Needs Assessment and Curriculum Revision of a Senior-Level Beef Systems Management Course[1,2]

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Abstract

New instructorship of the senior-level beef systems management course at Iowa State University presented the opportunity for curriculum revision. The objective was to conduct a critical course evaluation and update course objectives and student outcomes. Fifteen industry stakeholders were invited to aid in an assessment of course objectives and student preparation for various beef industry careers. Stakeholders participated in a series of surveys patterned after the Delphi process designed to rank the importance of various beef industry aspects that students need to understand prior to entering the industry. The result was a list of industry-determined student outcomes. During Round I, stakeholders anonymously listed outcomes and objectives considered paramount to the course. Results were compiled, and stakeholders individually ranked outcomes by importance during Round II. Round III involved a group discussion on Round II rankings to develop a stakeholder-ranking of course objectives and outcomes. Rankings were condensed into main categories with a composite mean, median, and standard deviation calculated for each category. Final rankings were used to assess and re-design the curriculum as results recommended an increased emphasis should be placed on business management and financial principles. Surveying stakeholders with this Delphi-style method proved to be an effective protocol for instructors to critically evaluate and update course objectives and outcomes relevant to industry needs.

Introduction

According to the USDA (2015), food security, sustainable energy and environmental quality are current challenges facing the United States that require college graduates with expertise in food, agriculture, renewable natural resources, and environment. These challenges require different skill sets needed by current and future agriculturalists and necessitate an evolved curriculum to keep pace with ever changing industry standards and technologies (Doerfert, 2011). Thoron and Meyers (2008) define sustainable agricultural education as *"the ability to produce agriculturalists indefinitely without causing irreversible damage to our core values".* The goals of sustainable agricultural education are threefold: 1) provide curricula adapted to the need of the student, 2) enhance program delivery through integration of industry concepts, and 3) an assessment that addresses both student and school needs (Thoron and Meyers, 2008).

Sustainable agricultural education begins with up-to-date curriculum created by an instructor who is familiar with recent research and state-of-the-art practices within the industry (Doerfert, 2011). Focus on better utilization of hands-on learning opportunities and effective teaching methods are important to prepare students for a career in which adaptation and critical thinking are vital skills (Thoron and Meyers, 2008; NAS, 2009). Integration of technical agriculture, and formed partnerships with industry professionals, can be helpful assets in developing curricula designed to train new agricultural-

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ists for technologies and challenges facing the industry (Thoron and Meyers, 2008; NAS, 2009).

In order to continue to serve the public and maintain relevancy within the field, land-grant universities must continue to broaden their educational and research agendas to evolve with industry advancements and consumer preferences (Kelsey and Pense, 2001; Trexler et al., 2006). The beef industry is not immune to these advancements, as all phases of the production chain are constantly evolving and incorporating new, more efficient, sustainably-focused management procedures. Industry evolution, coupled with transition in instructorship of the upper-level beef systems management course at Iowa State University, indicated a need to critically evaluate and renovate the curriculum. Because the end goal is to train students that are more competitive in the marketplace, we believed it was paramount to involve stakeholders from the beef industry in the revision process to add validity to the final product. As such, a Delphi survey technique (Hasson et al., 2000; Freeman et al., 2009) was used in this study for its ability to define issues, prioritize discussion topics, and elicit consensus within a group of experts (Trexler et al., 2006; Yousuf, 2007).

Materials and Methods

A modified Delphi process (Reeves and Jauch, 1978; Long and Morgan, 2010) was utilized which involved two rounds of surveys followed by a group discussion. Each round of the process was conducted on a single day with the first two rounds still allowing stakeholder feedback to be anonymous.

Stakeholder Selection

To facilitate the needs assessment and provide pertinent industry insight (Doerfert and Miller, 2006) a panel of 15 industry professionals, stakeholders, and producers were utilized. Participants were strategically selected based on their involvement in cow/calf and/or feedlot sectors and diverse experience in the beef industry ranging from 2–60+ years. The population utilized constitutes a diverse, yet comprehensive, knowledge of the beef industry and have developed credibility within the industry regardless of their years of experience. The stakeholder group consisted of five females and ten males.

Data Collection and Analysis

The objective of the Round I was to determine what individual stakeholders viewed as important student outcomes for the course. Participants were asked to anonymously list all subject objectives of the course that they felt were vital for students to know when entering the industry. Results were then compiled and duplicate objectives were removed. The resultant list contained 102 learning objectives that were then given to each panel member to begin Round II. Panel members were asked to rank each objective from most important to least important using continuous whole numbers. These rankings were then used to group subject matter areas into high, medium, and low priorities. During Round III, panel members were provided the opportunity to participate in a group discussion on the tabulated rankings of individual subject areas from Round II. Once the discussion was complete, the previous semester's curriculum/syllabus was revealed to the panel, and areas that were similar as well as dissimilar to the stakeholder panel's list were highlighted and further discussed.

Following the panel discussion, to add brevity to the learning objectives and better focus the curriculum revision, the 102 learning objectives ranked by the Delphi panel participants were condensed by production emphasis area into 21 categories (Table 1). For each outcome category ranking, a composite mean, median, delta, and standard deviation were calculated from raw

Table 1. Stakeholder Ranking of Important Course Objectives as Determined by a Modified Delphi Survey Process[x]

Category	Mean[y]	Median	Delta[z]	Standard Deviation
Basic economics/risk management	35.2	36.2	-1.08	10.01
Calculating total cost of production (fixed + variable costs)	35.9	33.4	2.60	19.71
Marketing of cattle (culls, replacements, finish cattle, niche/branded programs)	40.7	31.5	9.15	19.62
Acting as an advocate for the beef industry	41.1	38.5	2.64	6.39
Business planning	42.5	43.0	-0.56	17.80
Record keeping	43.7	46.9	-3.26	7.58
Reproductive management	46.7	46.7	0.00	17.35
Facilities (barns/handling facilities, etc.)	47.4	50.7	-3.33	12.57
Nutritional requirements/ration balancing/thumb rules for nutrition	50.4	50.4	0.08	7.18
Environmental issues and relationship with beef production	50.6	50.6	0.00	19.58
Beef quality assurance (BQA)/animal handling procedures	50.9	55.4	-4.48	9.75
Employee management/human relations	51.4	49.3	2.13	11.37
Current status of the industry and major issues	52.5	55.2	-2.64	12.28
Know where to find info on new technologies and management practices	53.5	53.5	0.00	19.58
Herd health/identification of sick or diseased animals	54.4	54.8	-0.42	5.12
Knowledge of companies in industry that provide information and supplies to producers	55.6	53.2	2.40	9.94
Alternative management/business schemes	57.4	57.4	0.00	22.68
Pasture/grazing systems management	57.8	57.8	0.00	13.87
Beef grading systems	62.1	64.6	-2.57	15.63
How to use existing beef-based software	62.4	64.8	-2.38	5.23
Expected progeny differences (EPDs) and breeding systems	63.3	63.3	0.00	0.98

[x] After the Delphi process meeting, 25 final curriculum emphasis categories were derived from summarization and condensation of 102 original learning objectives identified by the panelists. Mean and median values for these categories are larger than 21 due to the data merger.

[y] A lower mean value indicates a higher (more important) ranking among participants.

[z] Delta is defined as the difference between the mean and median.

data collected for Round II rankings, resulting in composite rankings with mean and median values greater than 21. For example, the composite category in Table 1 titled "Record keeping" was a combination of seven of the 102 original learning objectives determined in Round I, with rankings of importance for these 7 objectives spanning from 14 to 90. Compilation of these seven objectives across all panelists' rankings resulted in a weighted composite mean of 43.7. Delta is defined and calculated as the difference between the mean and median of each category (Freeman et al., 2009). Thus, a delta value closer to zero indicates that stakeholders share a more consistent ranking compared to when the delta value is large (either negative or positive) indicating disagreement with the group's average ranking. Rankings were then used to assess and re-design the course structure and curriculum for future semesters.

Results and Discussion

Categories were ranked by composite mean. The top three ranked categories were 1) understanding of basic economics/risk management, 2) ability to calculate total cost of production, and 3) marketing of cattle (Table 1). Current projections from the USDA (2015) show almost half the job opportunities available within agriculture in the next five years will be in management and business capacities, making these categories highly relevant. While basic economics and calculating total cost of production had delta values relatively close to zero, marketing of cattle had a high delta value, indicating that stakeholders' ranking of importance of the marketing category varied amongst stakeholders. Additional categories that were ranked as important course objectives included understanding the importance of serving as an industry advocate, business planning, record keeping, and reproductive management.

Some of the lowest ranked categories included understanding beef carcass grading systems, how to use existing beef-based software programs, as well as expected progeny differences (EPDs) and breeding systems (Table 1). These lower-end categories generally represent more "production-focused" outcomes, which are often covered in pre-requisite courses for this senior level course. This data reinforces the importance of expanding on what students have already learned and not just focusing on topics covered in prior courses, but rather build on those topics. However, while this course has not been structured around these lower-ranked topics, obviously these "production-focused" categories are of significance because stakeholders included them in their ranking of course objectives.

A similar study design by Zekeri (2004) evaluated how former students rated competencies that faculty identified as important to collegiate agricultural education with respect to how much the competencies were needed in their careers. Comparable to the present study, compiled lists showed that knowledge of agricultural economics and efficient production in agriculture were towards the top of the rankings list and knowledge of basic agricultural production and ability to evaluate agricultural investment were found in the middle (Zekeri, 2004). Contrary to the current study, ability to set up farm record systems was second to last in the study by Zekeri (2004).

Data were also ranked by demographics provided by stakeholder based on industry segment involvement (cow/calf or other, defined as stakeholders involved in feedlot or cow/calf and feedlot), gender, and years of experience. When ranked by demographic, stakeholders involved in the feedlot industry ranked the need to be an industry advocate higher than those in the cow/calf industry (Table 2). This could be attributed to the fact that those in the feedlot industry are closer to the consumer and recognize the need to tell our story more than those involved in the cow/calf industry. Other categories that made the top rankings for both segments were calculating total cost of production, marketing of cattle, and basis economics.

When data were sorted based on stakeholder gender (Table 3), females ranked record keeping and understanding costs as higher priorities than males. This could be interpreted as females being more detailed-oriented while males focus more on the big picture. Interestingly, in the female rankings, the variation of delta values is relatively large compared to the low delta values of the male rankings.

In the final sort of course, outcomes based on years of stakeholder experience (Table 4), more experienced stakeholders (≥ 31 years of experience) ranked knowing

Table 2. Top Three Ranked Course Objectives for a Senior Beef Management Course within Stakeholder Industry Segment[w]

Category	Mean	Delta[x]
Cow/calf segment[y]		
Calculating total cost of production	29.2	6.74
Marketing of cattle	38.8	1.88
Basic economics/risk management	39.6	-4.45
Other[z] segment		
Basic economics/risk management	32.3	2.81
Calculating total cost of production	34.8	1.16
Acting as an advocate	37.8	3.27

[w] After the Delphi process meeting, 25 final curriculum emphasis categories were derived from summarization and condensation of 102 original learning objectives identified by the panelists. Mean and median values for these categories are larger than twenty five due to the data merger.

[x] Delta is defined as the difference between the mean and median.

[y] Exclusively involved in the cow-calf sectors, $n = 6$

[z] Any involvement in the feedlot sector, $n = 9$

Table 3. Top Three Ranked Course Objectives for a Senior Beef Management Course within Stakeholder Gender[w]

Category	Mean	Delta[x]
Female[y]		
Calculating total cost of production	23.8	12.19
Basic economics/risk management	39.4	-4.21
Recording keeping	41.3	2.34
Male[z]		
Marketing of cattle	38.6	2.06
Acting as an advocate	40.8	0.32
Business planning	41.2	1.30

[w] After the Delphi process meeting, 25 final curriculum emphasis categories were derived from summarization and condensation of 102 original learning objectives identified by the panelists. Mean and median values for these categories are larger than twenty five due to the data merger.

[x] Delta is defined as the difference between the mean and median.

[y] $n = 5$

[z] $n = 10$

Table 4. Top Three Ranked Course Objectives for a Senior Beef Management Course within Stakeholder Years of Experience[v]

Category	Mean	Delta[w]
2−10 years[x]		
Calculating total cost of production	26.6	9.34
Acting as an advocate	31.2	9.90
Basic economics/risk management	37.0	-1.85
11−30 years[y]		
Basic economics/risk management	28.2	6.95
Record keeping	38.0	5.67
Marketing of cattle	38.1	2.58
31+ years[z]		
Business planning	26.3	-16.19
Calculating total cost of production	37.9	1.95
Know where to find information	39.8	-13.63

[v] After the Delphi process meeting, 25 final curriculum emphasis categories were derived from summarization and condensation of 102 original learning objectives identified by the panelists. Mean and median values for these categories are larger than twenty five due to the data merger.

[w] Delta is defined as the difference between the mean and median.

[x] $n = 6$

[y] $n = 5$

[z] $n = 4$

where to find information on new technologies and management practices high while it was not ranked in the top three categories by younger/less experienced stakeholders. This suggests that recent graduates feel comfortable knowing where to find information. Less experienced stakeholders (2−10 years of experience) ranked acting as an advocate as a high priority. Calculating costs of production, basic economics, and marketing of cattle were commonly ranked across all categories of regardless of experience.

Prior to the structured course revision, curriculum was focused on wide array of basic production management practices; some of which was derived from dated research. Stakeholder input through the Delphi process encouraged a change in curriculum that narrowed the scope of the course to best prepare students for careers within the beef industry. The transformation focused on a systems-management approach to beef production, allowing instructors the opportunity to more explicitly delve into current topics and business principles that are vital to beef industry. This includes an emphasis on business and financial planning which culminates in a course capstone project focusing on partial budgeting and business planning.

Following the course re-design, a formal evaluation is conducted each semester by giving students a pre- and post-course survey. These surveys are identical and students are asked to rank the 21 categories (Table 1) from most to least important and are also asked to indicate their perceived knowledge level of each category. Student responses, or any change in responses, of the category rankings and knowledge levels over the semester is assessed and used to provide insight to the effectiveness of the beef systems management course curriculum. Results are then utilized internally as a continuous improvement process as needed.

Summary

In conclusion, utilizing a modified Delphi process, with carefully selected stakeholders, proved to be an effective protocol that allowed instructors to critically evaluate and update course objectives and student outcomes relevant to the needs of the beef industry. Based on stakeholder feedback, the course has implemented more emphasis on business and financial planning in addition to basic management principals in beef production process.

Literature Cited

Doerfert, D.L. and R.P. Miller. 2006. What are agriculture industry professionals trying to tell us? Implications for university-level agricultural communications curricula. Journal of Applied Communications 90(3): 17-31.

Doerfert, D.L. 2011. National research agenda: American Association for Agricultural Education's research priority areas for 2011-2015. Lubbock, TX: Texas Tech University. Department of Agricultural Education and Communications.

Freeman, S.A., D.W. Field, C.W. Lott and C.V. Schwab. 2009. Evaluation of the safety content in the national association of industrial technology certification exam. Journal of Industrial Technology 25:1.

Hasson, F., S. Keeney and H. McKenna. 2000. Research guidelines for the Delphi survey technique. Journal of Advanced Nursing 32(4): 1008-1015.

Kelsey, K.D. and S.L. Pense. 2001. A model for gathering stakeholder input for setting research priorities at the land-grant university. Journal of Agricultural Education 42(2): 18-27.

R.E. Long and A.C. Morgan. 2010. The elements of two-year equine degree programs in the Mid-western US: A Delphi Study. NACTA Journal 54(2).

NAS. 2009. Transforming agricultural education for a changing world. Washington, DC: The National Academies Press.

Reeves, G. and L.R. Jauch. 1978. Curriculum development through Delphi. Research in Higher Education 8: 157.

USDA. 2015. Employment opportunities for college graduates in the U.S. Food, Agricultural, and Natural Resources System. USDA, National Institute of Food and Agriculture. Retrieved from https://www.purdue.edu/usda/employment/.

Thoron A.C. and B.E. Meyers. 2008. Agriscience: Sustaining the future of our profession. Journal of Agricultural Education 80(4): 9-12.

Trexler, C.J., D.M. Parr and N. Khanna. 2006. A Delphi study of agricultural practitioners' opinions: Necessary experience for inclusion in an undergraduate sustainable agricultural major. Journal of Agricultural Education 47(4): 15-25.

Yousuf, M.I. 2007. Using experts' opinions through Delphi technique. Practical Assessment, Research & Evaluation 12(4): Available online: http://pareonline.net/getvn.asp?v=12&n=4.

Zekeri, A.A. 2004. College curriculum competencies and skills former students found essential to their careers. College Student Journal 38(3): 412-422.