The Capstone Experience Course in Agricultural Curriculum

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Capstone courses are being developed in colleges of agriculture in response to demands from agribusiness firms, students, and other university stakeholders. With data from a faculty survey, the factors affecting the success of capstone courses in agricultural economics as well as other agricultural disciplines are identified.

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Introduction

Agricultural faculty involved in undergraduate curricula design and delivery are currently being challenged from industry, enrolled university students and alumni, and various other stakeholders involved in university education. The agribusiness firms, which constitute a significant portion of the employers of graduates from agricultural programs, are dealing with the challenges of a rapidly changing industry. These firms need individuals who, in addition to being technically competent, are able to identify problems, effectively solve problems by developing alternative solutions and communicate results, are effective team players while providing leadership as needed, and have a high level of integrity (Litzenberg, Gorman and Schneider, 1983; Litzenberg, Schneider, 1987).

The undergraduate students of today are also more demanding than in the past. The current cohort of students has grown up with computers and electronic games (e.g. Nintendo) in addition to television and is not stimulated by the traditional lectures that long served universities. These students are also demanding that their curricula be relevant and that they understand why they are studying what they are studying (American Association of Colleges, 1985).

Capstone courses have been introduced into undergraduate curricula in response to the above challenges. A review of the literature revealed that capstone courses have been developed across the country in many different disciplines, including sociology, nursing, engineering and different departments in colleges of agriculture. While the definition of a capstone course differs from one department and university to another there are some core concepts including having students engaged in: problem identification; integrating accumulated knowledge and technical

skills into finding a solution; critical thinking; and communicating conclusions. In other words, a capstone course is *the crowning course* of the baccalaureate program.

The objective of this study is to determine the factors that have the greatest influence on the success of capstone courses. The following two sections of this paper contain a summary of the literature. First, a discussion of how agricultural curricula are changing in response to changing conditions in agriculture and agribusiness is presented. Then, the alternative definitions of what constitutes capstone courses are presented. A description of the data for this study, which was collected via a survey of agricultural faculty that teach capstone courses, is found in the fourth section. A summary of the survey results as well as the results of the statistical analysis is then presented. The final section of the paper contains conclusions and suggestions for further study.

Changing Focus of Agriculture Curricula

Several authors have documented the importance of and rapid pace at which the industrialization of agriculture is occurring (Urban, 1991; Drabenstott, 1994; Boehlje, Akridge and Downey, 1995; Boehlje, 1996; Boehlje and Schrader, 1998). This industrialization is influencing university faculty and the agriculture curricula they develop. Surveys of potential employers indicate that the agricultural discipline must keep its students up to speed by strengthening the technical as well as the social aspects of the school curricula (Litzenberg, Gorman and Schneider 1983; Litzenberg and Schneider, 1987). In the first study, Litzenberg, Gorman and Schneider found from the survey of Texas cooperatives, that departments must train students to function well in the social environment by building up skills in human relations, problem solving and ethics. However, in addition the authors argue for enhancing the technical

aspects of the education program, such as quantitative analysis, technical aspects of agriculture, finance, marketing and selling (Litzenberg, Gorman and Schneider 1983:p.1063-1064).

In the follow-up AGRIMASS survey Litzenberg and Schneider targeted a broader agribusiness group to identify what employers are looking for from university graduates. In addition to confirming the findings from the first study, the authors argue in favor of network building between educators and potential employers to enhance the graduates' competitive advantage (Litzenberg and Schneider, p.1036).

In addition, reports on higher education emphasize the importance of shifting the learning focus among the Baccalaureate and Master of Science programs towards an integrated learning experience. The 1985 American Association of Colleges (AAC) report, *"Integrity in the College Curriculum: a Report to the Academic Community"*, served as a "wakeup call" for faculty who develop curricula (Erven, 1987; Siegfried et.al., 1991; Wagenaar, 1993). The report discusses the need to redefine the meaning and purpose of a university baccalaureate degree, by focusing on nine experiences including: inquiry, literacy, historical consciousness, science, values, art, international, multicultural experiences, and study in depth (AAC, p.15-24). Essentially, the AAC argued that curricula need to incorporate a more holistic focus (AAC, p.2). The AAC is not the sole source of criticism. Erven quotes numerous critical sources that all challenge the traditional university curricula, and argues that faculty need to rethink learning objectives. It is interesting to note that recent studies, such as those in the book edited by Palomba and Banta indicate that important changes have occurred in university curricula, specifically noting a number of examples that represent important interaction among university faculty, industry, and other stakeholders.

The importance of adapting curricula and in particular the development of capstone courses has been highlighted in the literature. Troyer notes that "…many departments have accepted the essential idea that to culminate their undergraduate career, students need an experience different from merely taking another course" (Troyer, p. 246). Rhodus and Hoskins argue that the capstone experience course conceptualizes on the last item in the AAC list of study experiences, study in depth.

The demands to change curricula are not limited to B.S. programs in agriculture in the United States, but are found in other disciplines and on other continents. In the field of sociology, for example, Steele (p.242) states that the curricular objectives have to focus on "… the development of personal and social awareness as the student cultivates a number of traits, including (among others) honesty, objectivity, clarity of values, development of skills, logical consistency and discipline" (Steele, p. 242). Steele is careful to note both the limitations and potential of capstone courses. "The capstone course, with its possibilities for use in evaluation, is no panacea for curricular weaknesses, but it provides excellent opportunities for actions that will improve both the major and the graduates" (Steele, p. 242).

A similar pattern is observed beyond North America. Collins and Dunne discuss the successful implementation of capstone courses in a three-year curriculum that intertwines industry with faculty at the University of Queensland, Gatton College, Australia. Dunne and Collins and Collins and Dunne argue that the institutionalized courses endanger the students' opportunities to fully succeed in the job market. The changing dynamics in the job market spurred the university to evaluate and develop its curriculum, including the development of a capstone course (Collins and Dunne). At Massey University in New Zealand, Wright offers a

team-taught course in agricultural production systems with positive feedback from both students and faculty.

What is a Capstone Course?

As noted previously, faculty differ in their definition and interpretation of what a capstone course is. Wagenaar and Troyer, both in sociology, refer to the capstone course as an opportunity for the student to "demonstrate mastery of the area's complexity" (Troyer, p.246). Durel, also a sociologist, defines the capstone course as:

> . . . a crowning course or experience coming at the end of a sequence of courses with the specific objective of integrating a body of relatively fragmented knowledge into a unified whole. As a rite of passage, this course provides an experience through which undergraduate curriculum in an effort to make sense of that experience and look forward to a life by building on that experience (Durel, p.223).

Westgren and Litzenberg implemented a capstone course with overt and covert learning objectives. Overt objectives are pronounced learning goals, usually stated in the syllabus, whereas covert objectives are "behavioral learning objectives, but they do not focus on the material in the course itself" (Westgren and Litzenberg, p.362). Crunkilton, Cepica and Fluker develop a handbook for implementing capstone courses in agricultural colleges, based on a national survey of agricultural faculty. They define the capstone course as "…a planned learning experience requiring students to synthesize previously learned subject matter content and to integrate new information into their knowledge base for solving simulated or real world problems", which is incorporated in a set of "required learning activities", e.g. projects, case studies, issue analyses, small group work, oral communication, and intensive writing (Crunkilton, Cepica and Fluker , p.3-6). Table 1 provides a summary of alternative approaches for implementing capstone courses and represents ideas from additional authors.

Table 1: Capstone Course Learning Goals, Educational Outcome and Format

Discipline/ Subject	Authors	Required course?	Learning Goals/ Educational Outcomes	Recommended Format, Resources, Class Size
Agriculture	Crunkilton, Cepica, Fluker (1997)		Problem solving, decision making, critical thinking, collaborative/ professional relationships, oral and written communication	Projects, case studies etc., small group work, oral communication, writing, industry involvement. "…a capstone course should be offered in the last year of the students' program and ease transition of students between their academic experiences and entry into a career of further study" (p.4)
Agricultural Communications	Sitton (2001)	Yes	"Offer the students the opportunity to enhance the knowledge and skills they have acquired in previous classes." (p.2)	Focus on problem solving, written and oral communication, synthesis of curriculum, decision making and critical thinking
Agricultural Economics	Erven (1987)	Yes	"Provide the students with a clear sense of advancing sophistication." (p.1040)	Should include a term paper, drawing from different courses and experiences
Agricultural Economics	Westgren and Litzenberg (1989)		Two goals 1. Overt objectives: "… integrate the various functional agribusiness courses and present material in strategic management; 2. Covert: building interpersonal and communication skills…" (p.362)	Groups in 3-4, oral and written reports in 2 case studies, lectures and discussions. Students report how much time they spend. Lacking prerequisites and work experience hindering elements
Agricultural Economics	Dunne and Collins (1995); Collins and Dunne (1996)		"…student learning… progress from concrete experiences, through reflective observation to abstract conceptualization… Kolb's (1984) learning cycle" (p.108)	"…three-way commercial partnership between a client agribusiness firm, a group of students and the university" (1995, p.108)

Agricultural economics	Fulton (1998)		Problem identification, problem solving, application of economic theory, quantitative analysis, and business strategy, industry interaction, written and oral communication.	Term project presented in both written and poster presentation format. Keys to success included having minimum standards, intermediate deadlines, and working with industry as a reality check.
Agriculture Education, Studies and other majors	Andreasen & Trede (2000)		Provide a culminating learning experience, allowing to apply knowledge from previous courses	Solve "real world" farm problems, problem solving, decision-making, critical thinking; and goal setting.
Electrical Engineering	Bond (1995)		Project management skills; Design selection and optimization; Communication and personal skills	The students produce a finished product (hardware, software). External audience important; students sign contracts; instructor must have regular meetings
Nursing	Boland and Laidig (in Palomba and Banta (2001))	Yes	"Provide students with an opportunity to synthesize knowledge and skills learned throughout the program" (p.90-91)	Intensive clinical practice course
Sociology	Wagenaar (1993)	Yes	"Conceptualized as an advanced introductory course" (p. 211-214)	Seminar format; it is not a replacement for internship or an individual course; fewer than 15 students. A team taught course is ideal since multiple instructors bring different theoretical and methodological approaches so students can experiences these differences first hand.
Sociology (professional major)	Wattendorf (1993)	Yes	"…requires the student to demonstrate such cognitive skills as analysis, synthesis and evaluation,…, indented to provide an assessment of the program" (p.230)	Seminar, research project and class discussion.
Visual Arts	Nelson (in Palomba and Banta(2001))	Yes	"Preparation of a portfolio that integrates studio skills and critical thinking skills in a group setting; and writing and speaking abilities essential to real work.." (p.192-193)	Assignments, projects and discussions; senior capstone paper.

Another common theme in the literature is that the capstone course is more than just changing the name of a traditional course that students take in their final year of an undergraduate program. Crunkilton, Cepica and Fluker envision that the capstone experience course represents more than a "culminating educational experience for students" (p.2-3). In a similar vein, Erven argues that the curricular changes that are currently being demanded of faculty require more than a "Band-Aid" approach with a need to "shift from the narrowness of courses to the expansiveness of the educated person" (p. 1042).

While the definition of a capstone course differs from one department and university to another, the some core concepts including having students engaged in: problem identification, integrating accumulated knowledge and technical skills into finding a solution, critical thinking, and communicating conclusions are fairly universal.

Data

Data for this study were gathered from an internet-based survey of faculty, teaching capstone courses, in various departments in colleges of agriculture across the United States, Australia, and New Zealand. Faculty were asked for background information on the course including: the title, number of credit hours, whether the course was required or an elective, the level of the course (e.g. only open to seniors), the faculty/student ratio, grading procedures, whether the class was specific to a department or interdisciplinary, the use of industry contacts by the students and the instructor, the extent that students were involved in group work, assessment of student communication skills, and the format of the course (e.g. % lecture, % case studies, % student initiated projects, other). The faculty were also asked to rate the success of their capstone course from different perspectives (e.g. how effective the course was in improving

student communication skills, improving student problem solving skills, and in making the students more competitive in their job searches).

The data for this paper were collected from faculty that showed a particular interest in the design of capstone courses in agriculture and are teaching such courses. These faculty were selected because they had recently presented or published an article on capstone courses or made their syllabi available on the internet. Of the twenty-five faculty members who were invited to complete the on-line questionnaire 80 percent responded. Three of the respondents declined the invitation to participate. The data used in this study is taken from 14 usable observations[1].

Results

The courses represented in the on-line survey span a number of departments from colleges of agriculture. Although there is particular emphasis on agricultural economics and agribusiness, courses from food science, agricultural and biological engineering, natural resources, conservation and management, and zoology, were all represented. Two of the courses are inter-departmental: Natural Resources Conservation and Management; and Economics, Finance, Decision Science, Zoology and Geography Departments. Nine respondents indicated that the course is only open to students from the department, whereas five respondents indicated that his/her course is open. However, in the latter group, one respondent wrote that the course is "open to all, but only Agricultural Economics students take the course". Four capstone courses utilize more than one faculty, varying from three to five. An inter-departmental course instructor noted, however, that it is "difficult to support team teaching, financially".

[1] Two of the respondents were teaching a graduate level (strategic management) capstone course. Since this analysis focuses on undergraduate curricula those observations were not included. Future study may expand to include graduate level courses and make use of the data form these two observations.

Five of the courses represented in the survey have 40 or more students. The average class size in the sample is 37 students, ranging from 16 to 80 students. In all but one course, 75 percent or more of the students are seniors or graduate students. It is interesting to note that the capstone courses are a well-established component of the curricula. Seven of the courses have been offered for more than 10 years. The courses range in age from two years to 40 years with an average of 11 years. The instructors are also experienced. Six of the respondents had been instructing the course for more than 10 years.

Methods of Instruction

Respondents reported that a variety of methods of instruction is used in the capstone courses that they teach (Figure 1). While lectures have the highest percentage (31%) of all of the categories, there is wide diversity. In nine of the courses, more than 50 percent of the course-time is devoted to team projects, case studies, class discussions, and presentations. In a Fisheries and Wildlife Sciences course, 80 percent of the class-time is devoted to literature discussions. In an agribusiness management course, students devote 90 percent of class time to working with industry. Group projects are also an important part of capstone courses. Seven instructors report that they utilize group projects most of the time, with group sizes ranging from two to five students. Given the time allocation to different methods of instruction, it appears that, for the most part, faculty have embraced the idea of a truly capstone course and not just renamed traditional courses that students take in their senior year.

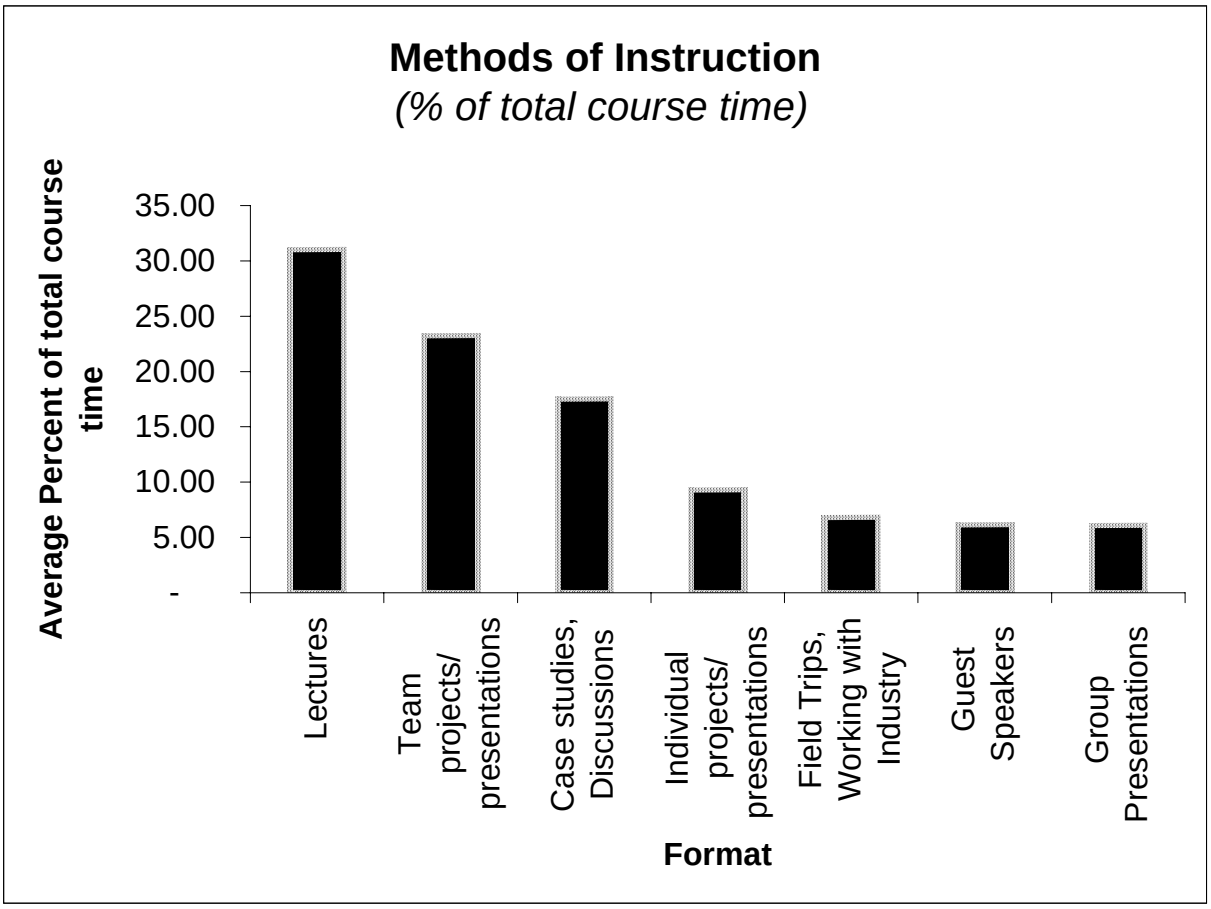

Figure 1. Methods of Instruction by Percentage of Class Time Devoted

Methods of Evaluation

In order to determine how students are being evaluating in capstone courses, respondents were asked to identify the percentage of the final grade that is assigned to each of several methods. The results are presented in Figure 2 with the top of each bar indicating the maximum value that a respondent indicated, the bottom of the bar indicating the minimum value and the average (mean) shown by the black dot. The most widely used method of evaluation is reports and presentations, which determined more than 75 percent of the final grade in four of the courses. Traditional methods of evaluation are also used. Four instructors use midterm and final

examinations. Four respondents take attendance, whereas 12 of the 14 respondents utilize class participation. Two instructors reported that they use peer evaluation, accounting for 5 and 20 percent of the final grade.

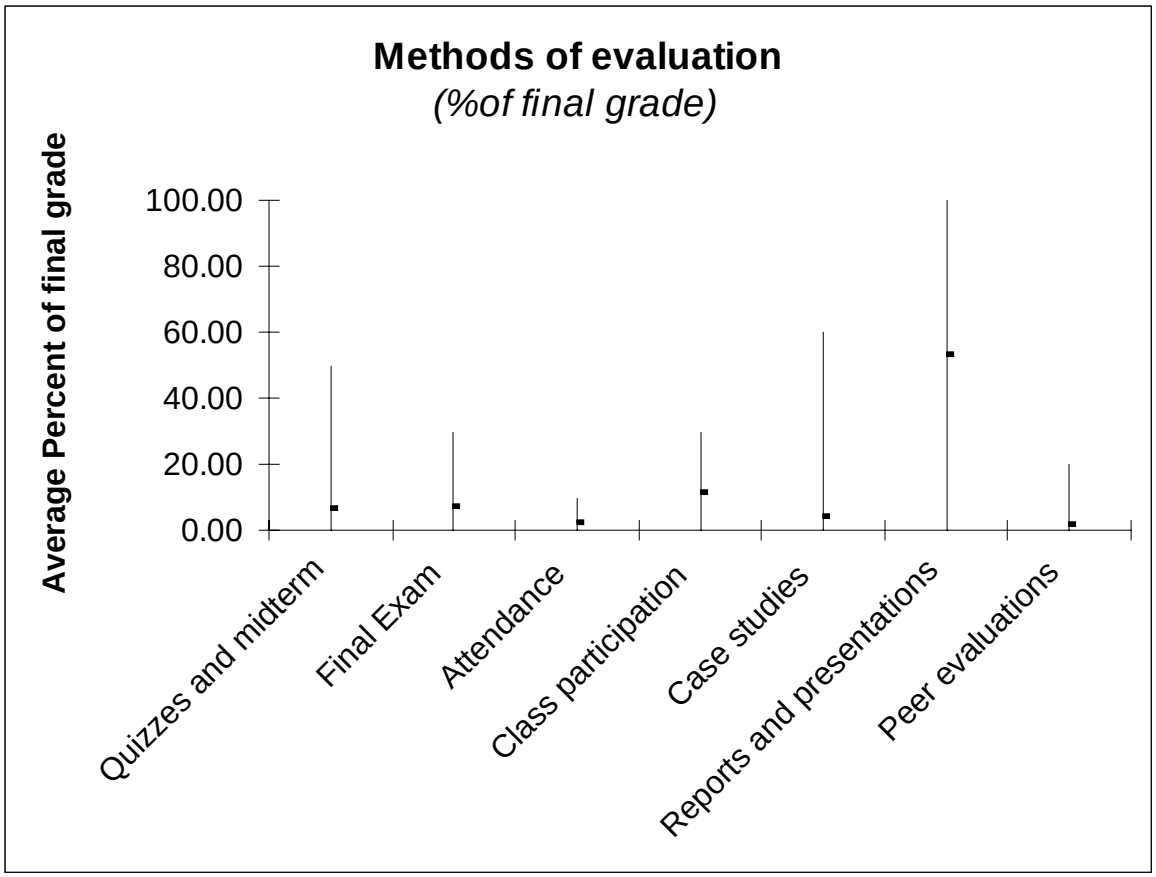

Figure 2. Methods of Evaluation: Percentage of Final Grade

Educational Outcomes – Summary Statistics

Eleven educational outcome measures were identified and used in this analysis. Respondents were asked to evaluate each outcome measure from two perspectives (Table 2). First, each respondent was asked to rate (on a 5-point Likert scale, where 1 is not important and 5 is extremely important) the importance of each outcome with respect to the objectives of the capstone course (reported under "Course" in Table 2). Second he/she was asked to rate how

effective (on a 5-point Likert scale, where 1 is ineffective and 5 is extremely effective) he/she felt the capstone course was for students with respect to each of the outcome measures (reported under "Student" in Table 2). The values reported in Table 2 are the average of the respondents' ratings, with the rank columns provided for ease of interpretation. The average rating is above 3.3 for all categories except job search. This suggests that respondents have not only structured their courses to meet these learning objectives but also feel that they are achieving success with respect to student outcomes. The responses to another general question support this conclusion. When asked to rate the overall effectiveness of the course (on a five point scale) all but one of the respondents reported a 5 with the other respondent reporting a 4.

The top rated outcome measures, both with respect to course objectives and student outcomes are: communication skills, problem solving, knowledge and skill utilization, and problem identification, all with average ratings above 4.3. It is interesting to note that knowledge and skill utilization is rated as one of the four most important learning objectives, even though discussion of capstone courses often focuses on other learning objectives. One respondent noted in the area for additional comments, the importance of students learning "new subject matter" and that "strategic management [is] very important". These results are consistent with Andreasen and Trede who found from an alumni survey that former graduates reported capstone courses to enhance their knowledge and skill utilization as well as communication skills.

It does not appear that the order that the outcome measures appeared on the survey influenced respondents' ratings. For example while communication skills was rated the most important for both course objectives and student outcomes, it was the fifth question on the survey.

Although job search was rated low with an average rating below 3, four instructors believe their students' job search skills improved as a result of the capstone course. In the open-ended comments, one respondent noted that "this course should make our students 'a little' bit better than students from peer institutions". Collins and Dunne and Fulton both identified that a real value of capstone courses is improved job opportunities for the students. As Fulton notes "representatives from industry, as well as the students, were particularly pleased with the way that this course helped to 'link up' students and businesses for jobs as well as internships" (p. 474).

Table 2. Ranking of Course Learning Objectives and Student Outcomes

Learning Objective/ Student Outcome	Course (average rating)	Rank	Student (average rating)	Rank
Communication skills:	4.77	1	4.57	1
Problem solving:	4.71	2	4.36	3
Knowledge and skill utilization:	4.54	3	4.31	4
Problem identification:	4.50	4	4.50	2
Integrity	4.00	5	3.86	6
Interdisciplinary focus:	3.92	6	4.14	5
Professionalism	3.86	7	3.57	7
Life long learning:	3.54	8	3.36	9
Leadership	3.50	9	3.36	10
Professional contacts:	3.36	10	3.38	8
Job search:	2.73	11	2.83	11

Educational Outcomes: Binary Logit Analysis

Next, a set of binary choice logit models is developed to determine the factors that influence the success of capstone courses (Table 3). Endogenous variables of interest are the student outcome variables from Table 1 and include: PROBLEMSOLVING,

PROFESSIONALISM, LIFELONGLEARNING, and LEADERSHIP [2]. Although the data for these variables were collected via the response to a 5-point Likert scale, binary logit is used in this analysis. Given the relatively small number of observations (14) it was not possible to obtain meaningful results from ordered probit analysis. Therefore, for each of the four student outcome measures, a binary choice endogenous variable was created. If the respondent assigned a value of 4 or 5 the binary choice variable took on a value of 1, and 0 otherwise.

Three explanatory variables were considered. The variable GROUPWORK, entered the models as a dummy variable taking on a value of 1 if the respondent answered a 4 or 5 (on a 5-point Likert scale) to the question of "Please indicate the extent to which students work in groups in your course" and 0 otherwise. A positive relationship between GROUPWORK and student outcomes is expected.

CLASSSIZE is a continuous variable equal to the average number of students the respondent indicated are enrolled in the course. Since these student outcomes are easier to attain with smaller groups, a negative relationship is expected. The variable REPORTSGRADE is also a continuous variable equal to the proportion of students' final grade that is determined by case study analyses, written and oral presentations, and peer evaluations. A positive relationship is expected.

The explanatory variables in the first model are CLASSSIZE and REPORTSGRADE, with PROBLEMSOLVING as the endogenous variable. The variable CLASSSIZE is negative and statistically significant. Although not significant, REPORTSGRADE has a positive coefficient. The variables CLASSSIZE and REPORTSGRADE correctly predict 92 percent of

[2] It is useful to note that these endogenous variables are not the four that respondents rated as highest. There was not enough variation in the responses for the other outcome effectiveness variables to be able to perform logit analysis. For example, all but one of the respondents rated communication skills a 4 or 5.

the time. Two respondents, who thought that large class sizes pose a major threat in capstone courses, reinforce these results. In the open-ended comments one instructor wrote "let the students solve problems and teach themselves. Don't over-lecture or over-teach. Peer pressure works well as a motivational tool."

Table 3. Results of Logit analysis

	Endogenous variables			
Exogenous variables	PROBLEM SOLVING	PROFESSIONALISM	LIFE LONG LEARNING	LEADERSHIP
CONSTANT	-0.464 (2.695)	-1.278 (2.181)	-0.7702 (1.5131)	1.6728 (1.6912)
GROUPWORK			1.8488 (1.1942)	3.9800* (2.1087)
CLASSSIZE	-0.026* (0.054)	-0.017 (0.040)	-0.0042 (0.0362)	-0.0813* (0.0491)
REPORTSGRADE	0.073 (0.059)	0.054 (0.0.34)		
Chi-Squared	2.949	3.641	2.6698	8.6115**
% Correctly predicted	92%	69%	71%	93%

The number below the coefficients in parentheses are Standard Errors;
*Statistically Significant at the 5% level;
**Statistically Significant at the 10% level

None of the coefficients in the models with PROFESSIONALISM and LIFELONGLEARNING as dependent variables are statistically significant. It is nevertheless interesting to note that the coefficients have the expected signs (positive for GROUPWORK and REPORTSGRADE and negative for CLASSSIZE). In contrast to the first and fourth models, 69 percent and 71 percent of the variation is explained.

In the LEADERSHIP model both exogenous variables are statistically significant with the expected signs. Students' improvements in leadership skills are significant and positively related to the intensity of group work but negatively related to class size. Ninety-three percent of the variation in LEADERSHIP is explained by the exogenous variables.

Opportunities and Threats

The respondents were asked to rate the importance of various opportunities and threats their capstone course faces, on a 5-point Likert scale where 1 is not important (not a threat) and 5 is a very important factor (a major threat). The first part of the question, concerning opportunities, yielded diverse yet interesting responses. In each case, the respondents were identifying the importance of various factors that lead to the development of the course. Three respondents gave "new requirement in the core curriculum" a 4 or 5, whereas four respondents rated "We seized the moment: The department(s) had accessible resources, such as good instructional facilities, contacts with alumni, business etc," a 4 or 5. Workshops or conferences on instructional methods were noted as important or very important (4 or 5) by four respondents. Finally, one respondent thought that "complying with accreditation criteria" was very important (rating equal to 5).

The second part of the question, dealing with threats, yielded slightly more consistent results. Eight respondents perceived that "students lack communication skills" poses a major threat (rating of 4 or 5). Five instructors responded that "time constraint for faculty" is a significant threat (rating of 4 or 5). For each of the threats, "time constraint for students," "students lack motivation," and "poor participation" three respondents assigned a rating of 4 or 5. Four instructors perceived that "students lack appropriate background" is a major threat (4 or

5). In the open-ended comments, five respondents note that faculty time constraints are a real obstacle as follows:

- may require more preparation time than traditional courses;
- there is a personal cost to the faculty member;
- colleagues may view it as too soft. It takes a lot of energy to do it correctly. It is much easier to just lecture and give exams;
- lazy faculty; and
- it takes more than the usual dedication to the job for the faculty member to champion it.

Conclusions

The agricultural faculty in undergraduate curricula design and delivery have adapted to the challenges from industry and university stakeholders to design curricula that ensures students are: technically competent, able to identify problems, effective problem-solvers who can develop alternative solutions and communicate results, effective team players who can provide leadership as needed, and have a high level of integrity. The results of this research are interesting given the challenges put forth by Erven and Crunkilton, Cepica and Fluker. These authors challenged faculty to not just use a "Band-Aid" approach to curricula revision or generate capstone courses that are simply a "culminating educational experience for students" (Crunkilton, Cepica and Fluker, p.2-3). Agricultural faculty who responded to the survey in this research have clearly met these challenges.

A number of important patterns were observed from the results of the on-line survey of faculty who teach capstone courses. The faculty have created "active learning environments," where students are challenged through class discussions, case study analysis and group presentations. Lectures were found to represent, on average, just over 30 percent of course time, while projects, presentations, and case studies, represent over 50 percent of course time. Faculty

utilized evaluation methods that are consistent with this interactive course structure. The most widely used method of evaluation that also on average made up the highest percentage of the final grade was "reports and presentations."

The four most important learning objectives and student outcomes, as reported by the faculty, are: communication skills, problem solving, knowledge and skill utilization, and problem identification. On a 5-point Likert scale each of these outcomes had an average of greater than 4.3. These results are consistent with the literature. Andreasen and Trede found from an alumni survey that former graduates reported capstone courses to enhance their knowledge and skill utilization as well as communication skills. Students in Fulton's class reported that the experience was positive, and enhanced their skills and ability to draw conclusions (p. 474). It is interesting to note that although job search was, on average, rated below 3, some faculty found this factor to be important. This result is consistent with that of Collins and Dunne and Fulton.

Binary logit analysis was performed to determine the factors that influence the success of capstone courses. Class size was found to have a negative and statistically significant impact on students' problem solving and leadership abilities. In addition, the intensity of group work has a positive and statistically significant impact on leadership abilities. The faculty responses to the open-ended questions support these conclusions.

The results of the analysis reported here suggest important conclusions for faculty who are adapting existing courses or developing new courses that are capstone experiences. Courses that have a smaller number of students, utilize group discussion, case studies and reports, and evaluate via reports and presentations are more likely to meet important learning outcomes.

References

Association of American Colleges. *Integrity in the College Curriculum: A Report to the Academic Community*. Washington: Association of American Colleges, 1985.

Andreasen, R. J. and L.D. Trede. "Perceived Benefits of an Agricultural Capstone Course at Iowa State University." *NACTA Journal*, 44(March 2000): 51-56.

Boehlje, M.D. "The Industrialization of Agriculture: What are the Implications?" *Choices*, (First Quarter 1996): 30-33.

Boehlje, M. D. and L. Schrader. "The Industrialization of Agriculture: questions of Coordination." In *The Industrialization of Agriculture: Vertical Coordination in the U.S. Food System*, edited by Jeffrey S. Royer and Richard T. Rogers, 3-26. Aldershot: Ashgate Publishing Ltd, 1998.

Boehlje, M. D., Akridge J. T. and D. W. Downey. "Restructuring Agribusiness for the 21st Century." *Agribusiness*, 11(November/December 1995): 493-500.

Boland, D. L. and J. Laidig. "Assessment of Student Learning in the Discipline of Nursing." In *Assessing Student Competence in Accredited Disciplines Pioneering Approaches to Assessement in Higher Education*, edited by Catherine A. Palomba and Trudy W. Banta, 71-94. Sterling: Stylus Publishing LLC, 2001.

Bond, B. "The Difficult Part of Capstone Design Courses." New Mexico Tech. HTML: http://fie.engrng.pitt.edu/fie95/2c3/2c31/2c31.htm (accessed on May 13, 2002).

Collins, R. J. and A. J. Dunne. "Utilizing Multilevel Capstone Courses in an Integrated Agribusiness Curriculum." *Agribusiness: an International Journal*, 12(January/February 1996): 105-12.

Crunkilton, J. R., M. J. Cepica and P. L. Fluker. *Handbook on Implementing Capstone Courses in Colleges of Agriculture.* (USDA award # 94-38411-016). Washington, DC: U.S. Department of Agriculture, 1997.

Drabenstott, M. "Industrialization: Steady Current or Tidal Wave?" *Choices*, (Fourth Quarter 1994): 4-8.

Dunne, A. J., and R. J. Collins. "Quality and Links with Industry: The Agribusiness Education Experience." *Assessment & Evaluation in Higher Education*, 20(April 1995): 105-14.

Durel, R. J. "The Capstone Course: A Rite of Passage." *Teaching Sociology*, 21(July 1993): 223-25.

Erven, B. "Reforming Curricula–Challenges and Change for Agricultural Economists," *American Journal of Agricultural Economics*, 69(December 1987): 1037-42.

Fulton, J. "Bringing Industry into an Undergraduate Agribusiness Course." *The International Food and Agribusiness Management Review*, 1(Issue 4 1998): 465-75.

Litzenberg, K. K., W. D. Gorman and V. E. Schneider. "Academic and Professional Programs in Agribusiness." *American Journal of Agricultural Economics*, 65(December 1983):1060-1064.

Litzenberg, K. K. and V. E. Schneider. "Competencies and Qualities of Agricultural Economics Graduates Sought by Agribusiness Employers." *American Journal of Agricultural Economics*, 69(December 1987): 1031-1036.

Nelson, K. "Assessing Student Competence in Visual Arts." In *Assessing Student Competence in Accredited Disciplines Pioneering Approaches to Assessement in Higher Education*, edited by Catherine A. Palomba and Trudy W. Banta, 177-198. Sterling: Stylus Publishing LLC, 2001.

Palomba, C. A. and T. W. Banta. *Assessing Student Competence in Accredited Disciples: Pioneering Approaches to Assessment in Higher Education*. Sterling: Stylus Publishing LLC, 2001.

Rhodus, T. and J. Hoskins. "Toward a Philosophy for Capstone Courses in Horticulture." *HortTechnology*, 5(April/June 1995): 175-8.

Siegfried, J. J., R. Bartlett, W. L. Hansen, A. C. Kelley, D. N. McCloskey, and T. H. Tietenberg. "The Status and Prospects of the Economics Major." *Journal of Economics Education*, 22(Summer 1991): 197-224.

Sitton, P. S. "Capstone Experience: The Key to a Successful Agricultural Communications Program." *Journal of Southern Agricultural Education Research*, 51(2001): 1-3.

Steele, J. J. 1993. "The Laden Cart; the Senior Capstone Course." *Teaching Sociology*, 21(July 1993): 242-45.

Troyer, R. L. "Comments on the Capstone Course." *Teaching Sociology*, 21(July 1993): 246-49.

Urban, T. "Agricultural Industrialization: It's Inevitable." *Choices*, 6(Fourth Quarter 1991): 4-6.

Wagenaar, T. C. "The Capstone Course." *Teaching Sociology*, 21(July 1993): 209-14.

Wattendorf, J. M. "The Sociology Capstone Course in a Professional School." *Teaching Sociology*, 21(July 1993): 229-32.

Westgren, R. E. and K. K. Litzenberg. "Designing Agribusiness Capstone Courses: Overt and Covert Teaching Strategies." *Agribusiness*, (July 1989): 361-66.