An Interdisciplinary Capstone Course In Agricultural Production Systems

A. Wright

Agricultural Production Systems is a compulsory capstone course taken in the final year of a three year degree program at Massey University. The course objective is to develop skills in integrating and applying information and principles to problems of improving situations on farms. Interdisciplinary team teaching is a feature of the course which is based around a series of major projects, most involving class visits to case study farms. The course is highly rated by students and graduates. Some features of a successful interdisciplinary capstone course are discussed.

Introduction

Employers of agricultural graduates often value problem solving skills, including communication and interpersonal skills, more highly than the depth of disciplinary knowledge. Yet teaching in degree programs is commonly organized along disciplinary lines and emphasizes content rather than process. To be an effective and efficient problem solver requires that graduates can obtain and integrate knowledge across a wide range of disciplines. Agriculture is particularly suited to teaching integrative skills because of the multi-disciplinary nature of most real problems (Spedding, 1982).

Although not common, capstone courses based on problem solving case studies are recognized to have a particular value for integrating knowledge (Howell et al., 1982; Schweitzer, 1986; Ward and Waller, 1988; Zimmerman, 1991). Kranz (1991) has summarized a capstone learning experience as one that (1) cultivates problem-solving skills; (2) utilizes a multi-disciplinary approach; (3) builds teamwork and interpersonal skills; (4) develops information sources for the professional solution of the problem; (5) considers societal, economic, ethical, and professional aspects in problem solving, and; (6) requires written and oral reports. The Agricultural Production Systems course described in this paper was designed as a capstone course for a new degree and it has involved team teaching from its inception. Feedback from students and graduates indicates that the course has evolved into a very successful learning experience since it was first taught in 1981.

The Bachelor of Agriculture Degree

The B.Agr is a three-year program designed as an alternative to a traditional four-year agricultural science degree, for students who may not have a strong background in science and mathematics (Gregg, et al., 1985). Teaching is organized so that the supporting physical, biological and social science material necessary to study agriculture can be learned by students from a variety of backgrounds. Core courses make up two thirds of the program, and students can major in Production and Management or Rural Valuation. The structure of the degree is illustrated in Figure 1. Graduates compete strongly with four-year agricultural science graduates for employment in the production and servicing sectors of agriculture.

Agricultural Production Systems

Agricultural Production Systems (APS) is the capstone course in the degree. It is taken by all students and as it is equivalent to three normal courses, represents half the workload for students in their final year. The course objectives shown in Figure 2 are closely related to the overall degree objectives, and emphasize learning and problem solving processes rather than disciplinary content.

Prior to enrolling in APS students will have taken at least two courses in each of agronomy, animal production, farm economics and management, and soils. In addition, each student must have completed 30 weeks farm practical work (internship). Between 1986 and 1991, class size has ranged between 31 and 48.

Evolution of APS since the degree was first taught has been strongly influenced by formal and informal feedback from students, graduates and employers (e.g. Anderson et al., 1989). In turn, APS has an important role in guiding content and performance criteria for pre-requisite core papers.

Course Structure

Agricultural Production Systems runs over a 26-week teaching year and comprises a series of major projects (12 in 1991) most of which run for two or three weeks. The projects are chosen to cover the range of important farming systems (arable, beef, dairy, deer, sheep), to deal with topical issues in production agriculture, and to provide a coverage of the course objectives. Most projects are based on actual farms and farmers, and include the phases of problem definition, information collection and analysis, and communication of results or recommendations to a "client". A typical project will involve a brief introductory session, a visit to one or more farms, substantial time for individual or group work, an

Wright is an associate professor in the Department of Agricultural and Horticultural Systems Management, Massey University, Palmerston North, New Zealand.

Figure 1. Structure of the B.Agr Degree with options in Rural Valuation, and Production and Management (Prod. & Mgmt).

Year	Core Courses	Option Courses	
	Pre-entry Farm Practical (Desirable)		
1	Agr. Economics Agr. Engineering Animal Production Soil Properties and Processes Agr. Engineering	No electives	
	Vacation Farm Practical (15 Weeks)		
2	Animal Production Pasture and Crop Production Soil Productivity Farm Business Management	Law Planning Valuation	) Rural) Valuation) Option
		Mechanisation Engineering Agribusiness	) Prod. & Mgmt) Option)
	Vacation Farm Practical (15 Weeks)		
3	Agricultural Production (3) Systems	Bldg. Technology Rural Valuation Farm Management 3 electives	) Rural) Valuation) Option) Prod. & Mgmt) Option

oral presentation of results, and a written report. Resource lectures, particularly by persons from industry, may be provided but students are expected to use knowledge and skills learned in discipline courses. Considerable emphasis is placed on independent work by the individual or by discussion groups of 6-10 students. APS is timetabled for 12 hours per week, including a complete day free of other lectures, so that concentrated blocks of time can be devoted to specific tasks including field trips. Visits to farms are an important part of the course and in 1991, 18 farms were used.

Figure 2. General and Specific Objectives for Agricultural Production Systems

General Objective

To develop skills in integrating and applying information and principles to problems of improving situations on farms.

Specific Objectives

1. Analyse a specific production system with respect to:
   a. Obtaining information on resources, technology and management necessary to describe the production system, its purpose, and its environment.
   b. Analysing the relevant information in order to explain the production system and its relationship with its physical and socio-economic environment.
   c. Identifying the components of the system which most contribute to its existing level of performance and the extent to which these can be controlled by the farmer.
   d. Identifying the sources and level of risk and uncertainty associated with the system, and the means of reducing production and income variability.
   e. Evaluating alternative technology and/or management strategies that may increase productivity and/or reduce risk and uncertainty.
2. Construct a short and/or medium term plan for the management of a specific production system.
3. Monitor a production system over time.
4. Compare and contrast production systems and derive general principles which might be used to improve other production systems.
5. a. Write to a farmer or employer a report which describes a production system and which makes recommendations as requested by the farmer or employer.
   b. To communicate verbally and in writing, principles, concepts or technology about specific production systems.
6. Describe and use the appropriate problem solving methodologies.

The project which students consistently rate the most valuable involves small groups visiting the same farm at intervals of 6-8 weeks. During the first visit they get an initial understanding of the farm resources, production system, and the farmer's production objectives. On subsequent visits they become involved in monitoring feed and animal production and assessing productivity of the farm. Students usually develop a very good understanding of the farmer/farm family's objectives and of the relationship between planning, implementation and control. At the end of the course, each group hosts a two-hour field day on "their" farm for the rest of the class.

A recent innovation has been the requirement for students to maintain a portfolio about their learning experiences during the course. This concludes with a written summary of what the student now considers to be important knowledge and skills for identifying and solving management problems on farms.

The Teaching Team

Agricultural Production Systems is taught by a team of 8 to 9 staff drawn from five departments of the Faculty of Agricultural and Horticultural Sciences. Most are relatively senior staff and have some input into teaching pre-requisite disciplinary courses. Hence weaknesses in the knowledge and skills of students entering APS tend to be noticed and rectified very quickly. One staff member is designated coordinator with responsibility for planning and implementation of the course. Maintaining good communication between members of the team and the class is an important function of the coordinator.

At the start of each year the team reviews course objectives and assessment procedures, and makes decisions about the number and type of projects. Detailed planning and operation of each project is normally the responsibility of two staff from different departments. Additional team members may contribute from time to time as facilitators for discussion groups, or to allow rapid assessment of completed projects. The team meets every two or three weeks to monitor student progress and to discuss details of proposed projects. An important team function is to ensure that objectives of individual projects are consistent with the overall course objectives.

Assessment

A variety of forms of student assessment are used. Project assessment involves written reports (several in the form of a consultant's report), oral presentations by groups, and individual oral defense of written presentations. A significant part of the final examination for the course is an oral examination of the student's portfolio. The mix of oral and written assessment is important as some students who perform well in the traditional written examination have poor oral communication skills and vice versa.

Student Evaluation

The APS course is evaluated by students each year. The 1991 class of 45 students were asked to rate how well

participation in the course had improved their ability to meet each of the specific objectives listed in Figure 2. The response rate was 100% and the results are summarized in Table 1. Given that APS is a compulsory course, the results are very encouraging. However, the result for objective 6 indicates that we have some work to do in developing students' understanding of problem solving methodologies, the most recent addition to the course objectives and content.

The majority of students find the discussion group approach useful for learning but it is clear that formal group management procedures are needed if numbers exceed 10. Students are very positive about the value of visiting farms in small groups, and of repeat visits to the same farm. Typical comments are; "easier to become involved in discussion", "much more in-depth understanding of the farm is obtained", "best learning exercise of the course". Changes to the course suggested by the 1991 class include greater opportunities to develop "arguing, debating and negotiating" skills, and increased use of oral assessment of project work.

In the 1988 review of the B.Agr (Anderson et al., 1989) graduates were asked to evaluate aspects of the APS course. Using a scale of 1 to 5 as in Table 1, 69% of respondents gave APS a rating of 1 or 2 for its usefulness in integrating earlier course material, and 83% rated it 1 or 2 for the usefulness of the skills learned to them in the workplace.

Lessons from a Decade of Teaching Agricultural Production Systems

If a course is to be integrative, students must have something to integrate and the skills to acquire additional information as required. The knowledge and skills expected of students entering a capstone course like APS need to be clearly stated, and entry restricted to qualified students. The first two years of the B.Agr. degree are designed to provide much of the knowledge and skills base for the APS course.

While "learning by doing" is an important part of skill acquisition, a course must do more than simply provide opportunities in the form of case studies. Students need guidance to develop their own problem solving procedures which are likely to be unique to the individual. They need to reflect on how they tackled particular problem solving tasks and the results achieved in relation to the time and effort expended. The individual portfolio offers a means of doing this and of arousing students' interest in studying alternative problem solving methodologies. The portfolio also offers teachers an opportunity to monitor the learning processes of their students. For example, portfolios have shown us that many students begin to acquire integrative/problem solving skills some weeks before these become evident in their written project work.

Real-life case studies help give students a sense of purpose, in that there is a client who "owns" the problem and is interested in their solutions. Real situations are often complex but students should not be protected from these in their final year of study. While it is sometimes difficult to find cooperative farmers willing to have their financial problems examined by classes, the course can be based around identifying and evaluating opportunities. From a teaching viewpoint there is little difference between problems and opportunities.

To be an effective problem solver it is necessary for the student or new graduate, to establish credibility in the eyes of the farmer or problem owner. This is helped by the confidence that comes from a good knowledge base about agricultural production, a "library" of problem solving experiences, and good communication skills. The practical work or internship component of the B.Agr degree (a minimum of 30 weeks prior to taking APS), is a very important part of the program.

Members of the teaching team need to have a commitment to the objectives of the course, and a respect for the disciplines of the other team members. The key to successful team teaching lies in the initial planning, and in maintaining good communication between team members. If this is well done, the actual teaching need not tie up a lot of staff resources.

The timetable is very important. Large blocks of time are needed for field trips to case study farms, and to allow students to concentrate on acquiring the knowledge and skills to complete a task without the distraction of other lectures and assignments. The B.Agr program was designed around the timetable requirements of APS.

Table 1. Student evaluation of how well specific course objectives had been achieved (% of student responses).

Objective*	1 (immensely)	2 (a large amount)	3 (moderately)	4 (not much)	5 (not at all)
1 (a)	18	69	11	2	0
1 (b)	11	64	20	4	0
1 (c)	24	44	29	2	0
1 (d)	15	38	31	15	0
1 (e)	9	33	53	4	0
2	22	47	29	2	0
3	38	49	11	2	0
4	9	53	36	2	0
5 (a)	49	33	11	7	0
5 (b)	27	51	20	2	0
6	7	22	44	27	0

*See Figure 2.

Conclusion

Agricultural Production Systems has proved to be a very successful capstone course for the B.Agr degree. It is highly rated by students and graduates and it has allowed staff to extend their knowledge of the processes of learning and problem solving. Many of the innovations in course content and style of teaching first tried in APS have had a marked influence on teaching in other degree programs in the Faculty.

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A Profile of Women Faculty Members In Agricultural Teacher Education

Cathy A. Baxter and Tracy S. Hoover

Women have been a part of the university setting, teaching both traditional and nontraditional subject areas, since the nineteenth century. No specific date could be identified as to when women officially began teaching post-secondary agricultural education. However, state teacher colleges added agriculture and nature studies to their curricula around the turn of the century (True, 1929) and women soon became an important part of the instruction.

Currently, the percentage of women faculty in the colleges of agriculture is small, but increasing (Kuehl, Collins & Pesek, 1987). This finding seems to parallel the situation for women in many colleges and universities. In 1984-85, Kuehl, Collins & Pesek (1987) found that women made up 6% of full professors, 16% of associate professors and 27% of assistant professors at selected universities that have colleges of agriculture. Russell (1991) found that women made up 25% of full-time regular faculty in four-year institutions during the fall of 1987.

In general, the number of women in higher education has been growing. More women are graduating from colleges and universities in the USA than ever before. This trend is supported by an increasing number of women completing doctoral programs. The number of women receiving doctoral degrees in agriculture and natural resources increased sixteen percent between 1971 and 1988 (U.S. Bureau of Census, 1991). In 1971, women earned 14.3% of the 32,107 doctoral degrees granted in the United States. By 1988, 35.2% of 34,039 doctoral degrees were conferred to women (U.S. Bureau of Census, 1991).

Perhaps more women would consider entering a doctoral program with encouragement from faculty members and evidence of women faculty members to serve as role models (Kuehl, Collins & Pesek, 1987). University faculty appear to be an important factor in women deciding to continue their education and academic career. Christiansen, Macagno-Shang, Stanley, Stamler, and Johnson.(1989) found that 35.2% of the women faculty at a large midwestern university decided to pursue an academic career in their field during their graduate study. When Cooper and Henderson (1989) surveyed women agricultural faculty at land-grant universities, they found that university faculty members were often cited as individuals who frequently encouraged the women to consider a doctoral program. They also found that most of the women surveyed would do nothing or very little differently if they began their careers again. Murphy (1990) found that the majority of the successful women surveyed in vocational education were satisfied with their educational preparation and would make the same career choice again.

However, the women Murphy (1990) interviewed still believe that it is more difficult for women to succeed in vocational education. Over half of the respondents reported that they had been treated differently than men in similar positions. The women also expressed a concern over the lack of women mentors and role models during their careers. Parson (1991) found that many of the tenured and tenure track faculty at a public research-oriented university in the midwest believed senior faculty have a responsibility to mentor assistant professors. Unfortunately, 15% of the women respondents reported that there were no senior faculty women to serve as mentors and that men found serving in such a role in relation to women problematic. Fifty-nine percent of the women felt that their work was undervalued because of their gender. When Johnsrud & Wunsch (1991) surveyed pairs of junior and senior women faculty, they found that the junior women faculty did not feel as isolated as the senior counterparts had thought. Both junior and senior women perceived the barriers surrounding work priorities, a sense of belonging and scholarship very similarly. However, Christiansen et al. (1989) found that overall, the women faculty interviewed reported positive perceptions about their work environment and felt supported within their departments by both men and women.

Although information was available on women faculty in general, little data exists on the academic backgrounds, employment, career choices and barriers of women faculty

Baxter is a graduate assistant and Hoover is an assistant professor in the Department of Agricultural & Extension Education, 323 Ag Administration Building, The Pennsylvania State University, University Park, PA 16802, but in 1993 will join the Department of Ag. Ed. and Comm., 305 Rolfs Hall, University of Florida, Gainesville, FL 32611

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