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Assessing Multidisciplinary Team Training for Integrating Horticulture and Nutrition

John S. Caldwell¹ and Marilyn S. Prehm²

Virginia Polytechnic Institute and State University, Blacksburg, VA 24061

Additional index words. farming systems research/extension, informal surveys, interdisciplinary studies, *sondeo*

Abstract. Twenty students from six disciplines in a farming systems course and in a human nutrition course were organized into four interdisciplinary teams during a joint laboratory. Through lectures, videotapes, and actual interviews of farm families, students were trained to work as a team collecting and processing information from informal interviews. Most students (63%) found the joint laboratory "very useful," but 41% considered the overall work load excessive. Students rated achievement of team-related objectives significantly higher than course-related objectives. The actual interviewing of farm families was rated the most useful training technique. Student contributions to the team were more discipline-based than integrative, with 63% of the students contributing knowledge and skills from their own discipline. Students' gains from the team were more integrative, with 94% gaining from the team process, knowledge from other disciplines, and integration of disciplines, but only 31% gaining new knowledge or skills in their own disciplines.

The issues that research and extension professionals must address increasingly cross traditional discipline boundaries. Achieving effective solutions to agricultural develop-

ment problems often requires a systems approach and interdisciplinary teamwork. This is true both in developed and developing countries (Anderson, 1979; Axinn, 1986; Dillon, 1976; Futures Task Force to the Extension Committee on Organization and Policy, 1987; Schuh, 1984). While there is a need for interdisciplinary teams of professionals to analyze and solve complex agricultural development problems, few have experience and/or formal training in interdisciplinary work. There is little information on how to incorporate training for interdisciplinary work into the academic education of future professionals (Chubin et al., 1979),

although beginning the training early in academic programs and extending it beyond the involvement of an outside graduate committee member has been recommended (Mitchell, 1977).

Farming systems research/extension (FSR/E) is one method for organizing interdisciplinary work. FSR/E uses interdisciplinary teams to set priorities for on-farm agricultural production experiments. It is widely used in developing countries and has been applied in several states in the United States (French and Waugh, 1988; Shaner, 1982).

Assessment of food consumption and human nutritional status can provide valuable information to a FSR/E team, both in setting priorities for on-farm experiments and in evaluating the potential nutritional impact of experimental results on farm households. Consideration of food consumption can clarify links between food production and household use. Assessment of human nutrition is especially important when horticultural crops are a part of the farming system (Bittenbender, 1983).

In spite of the need to consider food consumption and nutrition together, examples of this approach in FSR/E are few (Frankenberger, 1985; Frankenberger et al., 1986; Prehm, 1987). There are several possible explanations for this situation. FSR/E makes extensive use of informal survey techniques, derived in part from anthropological methods, in setting priorities for on-farm experiments (Beebe, 1985; Rhoades, 1982). Comparable informal techniques for assessing human nutrition are less developed. Traditional nutrition assessment measures, such as 24-hr dietary recalls and multiple anthropometric measurements, are time consuming. Project resources often are too limited for the team to include nutritionists who could develop simplified methods for assessing human nutrition.

In Fall 1986, students from a farming sys-

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¹Associate professor, Dept. of Horticulture.

²Assistant professor, Dept. of Human Nutrition and Foods.

Table 1. Student self-rating of achievement of individual course and team-related objectives.

Objective	Rating ^a	SD	Significance ^b	n
Nutrition and FSR/E course objectives	3.71	± 0.45	---	18
Contributions of team to discipline	4.35	± 0.68	**	17
Contributions of non-nutritionists to nutrition	4.28	± 0.67	**	18
Contributions of disciplinary skills to team	3.89	± 0.76	NS	18

^aMean of n observations, on a scale of 1–5, where 1 = no achievement and 5 = excellent achievement.

^bStatistical significance of paired *t* tests of each contribution variable vs. course objectives variable, significant at *P* = 0.01 (**), nonsignificant (NS), or not applicable (---).

tems course (Horticulture Dept.) and an international course (Human Nutrition and Foods Dept.) participated in a joint laboratory designed to train them to work in interdisciplinary teams and to integrate horticulture and human nutrition. This report describes an assessment of the usefulness of the laboratory activities in integrating horticulture and nutrition. The assessment was designed specifically to answer the following questions: 1) How useful was combining the two courses? 2) How well did students achieve objectives for the combined activities vs. objectives for each course? 3) How useful were the individual activities in achieving laboratory objectives? 4) What did students contribute to and gain from laboratory activities?

Twenty students from the two courses were organized into four teams for two laboratory projects: 1) analysis of local farm problems and recommendations for on-farm trials based on informal surveys; and 2) project design proposal to improve agricultural development and nutrition in a developing country based on a review of the literature. The team member from the developing country being studied assumed the role of the host country leader for the developing country project proposal, while a U.S. student assumed that role in the informal surveys with local farm families. Following procedures for organizing interdisciplinary teams and methods for conducting informal surveys (also called *sondeos*) developed by Gaye et al. (1988) and Hildebrand (1982), students were assigned so that each four- or five-member team had a balance of disciplines (production, nutrition, and social science), genders, and U.S. and international students. Each team was further subdivided into two interview "pairs" of two or three students, with a pairing of students from nutrition and from either an agricultural production science and/or a social science.

A variety of training activities was included in three 2-hr laboratory sessions. In the first session, informal interview techniques were described, and examples were shown on videotape (Caldwell et al., 1984). The interview pairs did two practice interviews in the second session. The second of the two practice interviews was videotaped and shown to students for self-assessment and feedback from the instructors on the students' interview techniques. Techniques for processing information from informal interviews (organizing field notes into qualitative models, calendars of agricultural activities,

etc.) were presented in the third session (Franzel et al., 1986; McDowell and Hildebrand, 1980; Patton, 1980; Rojas, 1984).

For the first laboratory project, 3 weeks were allocated for each interview pair to interview two local limited-resource farm families and for each team to develop a report based on the information collected by all the team's interview pairs. Each student first prepared a written report describing the system of organization of activities on one of the farms the students had visited. Each team then gave an oral presentation on the results from all their farms, including their groupings of the farms, and their priorities for on-farm experimentation for each grouping (called a "domain" in FSR/E) (Harrington and Tripp, 1984). On each team, one student who was enrolled in both courses and served as team leader also prepared a second written report summarizing the oral conclusions of the team.

For the second laboratory project, each team, focusing on the developing country of one team member, reviewed literature on four topic areas: agricultural production, nutrition, research and extension organizations, and agriculture and food policies. Each student prepared a written paper on one topic area, and each team orally presented a project design proposal for the team's country covering all four topic areas. In the written papers, each team member discussed both their assigned topic area and its linkage with at least one other topic area outside their discipline, to help prevent the problem of single-discipline perspectives dominating due to time constraints (Chubin et al., 1979). In the oral presentation, the team as a whole presented its overall ranking of problems and opportunities across all the topic areas and its consensus on a project design.

At the end of the quarter, 18 students completed a three-part evaluation of one of the individual courses and of the joint laboratory. Where data were missing on a particular item, the analysis used only the actual number of responses for the particular item. Numbers of responses varied from 16 to 18.

Part 1 of the evaluation included close-ended questions (three for the laboratory, eight for the nutrition course, and 16 for the farming systems course) on achievement of objectives, where students chose one response on a 5-point scale with 5 being the highest rating. Part 2 included six close-ended questions on the usefulness of specific laboratory activities, with students choosing one re-

sponse on a 4-point scale with 4 being the highest rating.

Part 3 included three open-ended questions, where the students wrote what they had contributed to and gained from the interdisciplinary team activities and their assessment of the usefulness of combining the laboratory activities. Content analysis (Rojas, 1984) was used to identify key words in the written responses. For the two questions on contributions and gains, key words representing similar concepts were grouped into six categories. The frequency of appearance of key words in a category was determined both on an absolute basis (percentage of respondents using a key word in that category) and on a weighted basis. For the latter, for each respondent, the number of key words in a given category was divided by the total number of key words given by the respondent, yielding the fraction of a single response that key words for that category were used by the respondent. Categories in which a key word did not appear had a value of 0 for that category. The resulting fractions for each category were averaged to obtain the mean weight for each category. Differences in mean weights between categories were compared using paired *t* tests, with correlated response categories (*P* < 0.05) grouped to simplify the analysis.

Content analysis of the open-ended question on the usefulness of combining the two courses indicated that the majority (59%) of 17 students responding to this question considered the combining of the two courses to be "very useful", but 24% considered the combining to be "not useful." However, 41% of the 17 students qualified their "very useful" response with the statement that the overall work load was burdensome. Time required for integration of disciplines through team interaction appears to exceed the expectations of time commitment for traditional courses where an individual works alone in a single discipline.

To evaluate student achievement of team objectives vs. course objectives, the mean achievement of all course objectives was compared with the ratings of achievement of three team-related objectives. Team-related objectives were based on the joint laboratory activities. Course-related objectives included both lecture material specific to each course and lecture material explaining how skills and knowledge from the course the student was enrolled in could be used in the other course. Students rated achievement of two team-related objectives (contributions of the team to the discipline and contributions of non-nutritionists to nutrition) higher than the average achievement of course-related objectives for the two courses (Table 1).

Among the laboratory activities, the *sondeo* (informal interview) farm visits were rated significantly (*P* < 0.01) more useful (mean rating = 4.0) than the presentation of techniques for processing information (mean rating = 2.6). In their suggestions for changes, students indicated that more time was needed to introduce each technique properly.

Content analysis of student responses on

Table 2. Student self-rating of contributions to and gains from an interdisciplinary team.

Response category	Responses ^a (%)	Mean wt ^b	Significance ^c
<i>Contribution to team</i>			
Own discipline	63	0.33	*
Team process	44	0.31	+
Combined own discipline and team process	88	0.63	**
Integration	25	0.09	---
<i>Gains from team</i>			
Team process	50	0.32	*
Other disciplines	50	0.23	*
Integration	50	0.20	+
Combined process, integration, and other disciplines	94	0.74	**
Own discipline	31	0.09	---

^aBased on 16 responses.^bBased on content analysis of student responses, where the mean weight of a response in a category = number of responses in category times total number of responses—1 if number of responses in category is positive, or 0 if number of responses in category = 0.^cStatistical significance of paired *t* tests of each contribution variable vs. integration variable, or each gain variable vs. own discipline variable, significant at *P* = 0.01 (**), 0.05 (*), or 0.10 (+), or not applicable (---).

contributions and gains from working in an interdisciplinary team indicated that contributions were more discipline-based than integrative. The majority (63%) of 16 respondents indicated that they contributed knowledge and skills from their discipline to the team. However, while nearly half (44%) contributed to the team *process* (discussion and other joint activities), only 25% indicated that they contributed directly to integration (in a *content* sense) of disciplines. The mean weight for contributions to integration (0.09) was significantly lower than the mean weight for contributions from each discipline and to the team process (0.63) (Table 2).

In contrast, gains were more integrative than discipline-based. Nearly all of 16 respondents (94%) gained from the team process, knowledge from other disciplines, and integration of disciplines. However, only 31% gained new knowledge or skills in their own discipline from the team, and the mean weight of discipline-based gains (0.09) was significantly less than the mean weight of integrative gains (0.74).

Chubin et al. (1979) described four frameworks for the team operation: common-group learning, modeling, disciplinary negotiation, and leader-as-integrator. The findings here suggest that the teams functioned primarily in the common-group learning and leader-as-integrator modes. Predominance of common-group learning over modeling was evidenced in the low rating given to presentation of modeling techniques. Predominance of the leader-as-integrator modes over the disciplinary negotiation mode was evidenced in lesser integrative contributions and lesser discipline-based gains. The finding that few contributed to integration suggests that the linkage assignments in the reports were not effective in overcoming the tendency of non-team leaders to focus on their discipline and leave integration to the team leader. This also may

be a function of effective team management to allow adequate time for several iterations of report preparation.

Common-group learning tends towards a lowest common denominator (Chubin et al., 1979), rather than maintenance of disciplinary integrity (Mitchell, 1977). The leader-as-integrator becomes ineffective for large-scale team work (Chubin et al., 1979). Although much emphasis in FSR/E has been placed on interdisciplinary tolerance (Hildebrand, 1981), training in constructive disciplinary negotiation may be more effective for increasing contributions to integration for large-scale team work in FSR/E and for maintaining professional integrity necessary for developing effective solutions. To provide a common standard for disciplinary negotiation, all team members might assess whether their discipline can provide the solution that best meets the household's priority problem. More training in modeling techniques could help team members identify the priority problems and the potential contributions of each discipline to solving the problem. More training for team leaders in team management could result in better integration of horticulture, nutrition, and other disciplines.

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Teaching the Principles of Landscape Bidding with an Electronic Spreadsheet

David J. Beattie¹ and Lawrence C. Ragan²
 The Pennsylvania State University, University Park, PA 16802

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Abstract. An interactive spreadsheet program was developed to demonstrate how a landscape bid is estimated. Information from a profit and loss statement, entered periodically, is retained for succeeding bids. Machine and labor costs are determined separately. For an individual bid, inputs include cost of materials, overhead, labor and machine times, contingency, and profit. Labor costs are automatically modified to reflect crew efficiency, and materials costs reflect storage, freight, and other charges. Overhead is based on the relationship between annual direct and indirect costs. The calculations section displays intermediate steps of the final bid estimate. Summaries from calculations include a final bid estimate. A printing option allows the user to selectively print any of the sections, a customer's copy, or the entire bid. The program uses an Apple Macintosh computer, was written for Microsoft Excel software, and uses macro programs. Its concept can be adapted to any electronic spreadsheet and can be protected to allow entry of only certain input data. The program can be used for small landscape businesses, classroom instruction, and/or extension instruction in which higher-order thinking skills are emphasized.

Students today are exposed, particularly outside the classroom, to a wealth of visual stimuli, including movies, television, video tapes, video disks, and computerized video games. These visual stimuli have become such an integral part of students' lives that the traditional lecture format that served classroom instruction for past generations may be dull and ineffective by comparison. Consequently, teachers are using these media, particularly computer-aided instruction, in their classrooms to make instruction challenging, as well as informative. Interactive computer programs can stimulate student interest and reduce rote learning while concentrating on higher-order thinking processes, such as making management decisions (Hannafin and Peck, 1988; McKeachie, 1986).

The primary objective of any landscape business should be to make a satisfactory profit. Most landscape bids are developed by

using the "rule of thumb" method, where the estimate of how much will be charged for landscape services is arrived at by multiplying plant and/or material costs by 2 or 3. While this may be further modified by labor costs, site considerations, or travel time, the estimating process is usually unstructured. For an established business, the rule-

of-thumb method that has been developed and refined with many years of experience may be adequate. However, this bid method may not reflect the actual direct and indirect (overhead) costs, nor can costs be identified with any particular activity. As a result, the desired profit margin is not known. When the actual costs are not known it is also difficult to modify the bid. In addition, the "rule-of-thumb" for one business does not apply to another business.

Computer-aided instruction has been used in teaching agricultural courses (Barbarick, 1985; Danneberger and Rieke, 1985; Dekkers and Donatti, 1981; St. Martin and Skavaril, 1989), for management simulations (Johnson et al., 1984; Russell, 1985), and plant identification (Porkorny, 1988). However, few interactive computerized spreadsheets have been developed for landscape bidding (Smith, 1986); none are for the Macintosh. This spreadsheet bidding program is designed to assist students in understanding how a landscape bid is structured and how costs are allocated so that reasonable profits are ensured and so that management decisions can be made on correct and accurate information.

The objectives of this interactive bidding program are to: 1) Prepare a landscape bid based on actual direct and indirect costs. 2) Ensure a realistic profit margin. 3) Determine annual direct and indirect cost adjustment factors and periodically update overhead costs. 4) Adjust costs based on labor efficiency, unproductive time, and unforeseen contingencies. 5) Allow the user to adjust or update bid factors and costs without tedious

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¹Assistant Professor, Dept. of Horticulture.

²Instructional Designer, Computer Based Education Laboratory.

W-LANDSCAPE BIDDING ESTIMATE 1			
Section A. -- BACKGROUND MATERIAL FROM LAST YEARS PROFIT & LOSS STATEMENT			
The following values are determined from last years Profit and Loss Statement			
Annual Direct Costs	=====	\$412,000	<=====
Freight	=====	\$1,000	<=====
Handling Charges	=====	\$100	<=====
Storage Costs	=====	\$100	<=====
Total Sales Tax	=====	\$1,200	<=====
Indirect Overhead Costs	=====	\$172,000	<=====
Section B. -- LABOR COSTS			
Total for all employees (Info from last years records for all employees)			
Average Direct Labor Charge Per Hour Per Employee			
Annual Wages	=====	\$140,000	<=====
Annual Fringe Benefits	=====	\$14,000	<=====
Annual Payroll Taxes	=====	\$18,000	<=====
Base Hrs Worked/Year	=====	36,500	<=====
Vacation Hours / Year	=====	640	<=====
Holiday Hours / Year	=====	1140	<=====
Sick Hours/Year	=====	400	<=====
Unemploy/Work Comp (%)	=====	13	<===== Enter % as whole number.

Fig. 1. Completed entry path for yearly data from last year's profit and loss statement.