A Capstone Problem Solving/Systems Course at a Two-Year Technical College

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Abstract

The course described in this article is based on the National Agricultural and Natural Resources Curriculum Project, Food and Agricultural Systems Task Group. However the course content was modified to meet the needs of students and curricula at a two-year technical college. Course topics include the hierarchy of four problem solving approaches, creative and critical thinking, communication skills, learning styles, personality types, and decision making. Development of the course, its content and structure, and results based on its initial offering are discussed.

Introduction

The importance of and techniques for incorporating systems approaches to problem solving in baccalaureate curricula have received considerable attention in recent years. A major contributor to implementation of successful problem solving/ systems courses has been the workshop/manual combination entitled "Systems Approaches to Food & Agricultural Problems" developed by members of the Food & Agricultural Systems Task Group of the National Agricultural & Natural Resources Curriculum Project (1986). Soft systems techniques in particular are emphasized. Several faculty training workshops have been conducted throughout the USA. I attended the 1987 workshop held at North Carolina State University.

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Incorporation of these problem solving/systems concepts in baccalaureate coursework, curricula, and programs have been discussed by several authors including Hoshmand (1988), Merritt and Wilson (1990), and Murphy et al. (1990). An excellent textbook for an upper level course based on the workshop/manual has also been published (Wilson and Morren, 1990).

After moving from a teaching position at a four-year college to a division chair position (Engineering Technologies) at a two-year technical college, I was confronted with the challenge of adapting the problem solving/systems concept to students and curricula at the associate degree level. Clearly the rationale for the need to incorporate this material into the learning process in baccalaureate programs (Merritt, 1984; Wilson, 1986) applies to technical college students as well. However, given the applied nature and short time frame of two-year technical curricula; modifications in course content and orientation are required to make the topics appropriate at the technical college level.

Course Development

A basic concept incorporated in the systems model for problem solving is that there is a hierarchy of four major problem solving approaches (Bawden, 1986; Wilson and Morren, 1990). Listed from the most reductionistic to the most holistic, these techniques are identified as 1. the scientific method, 2. application of technology, 3. hard systems, and 4. soft systems. Given the course content and selection in technical curricula, students' interests and orientation, and the career opportunities for graduates; I decided that only the application of technology and certain aspects of the soft systems approaches should be emphasized (although all would be discussed) in a problem solving/systems course designed for associate degree programs. However for all other topics typically incorporated in problems solving/ systems courses taught at the baccalaureate level, such as creative and critical thinking, communication skills, learning styles, personality types, and decision making; there would be no difference between the courses.

I recommended to Engineering Technologies Division faculty that the proposed problem solving/systems course be required for all Division students and scheduled as a capstone course in the curricula. This recommendation was incorporated as part of the overall Division curriculum revision proposal which was approved by the faculty. Official approval of the course, Engineering Technologies T292, "Problem Solving Using Systems Approaches", was obtained via the standard University Academic Affairs process. The course was offered for the first time during Spring Quarter, 1990.

Course

Students

Twelve students representing all four Division programs (Power Equipment, Fluid Power, Construction, Forest Products) were enrolled in the new course. Two were older nontraditional students who were employed full-time and completing graduation requirements on a part-time basis. All twelve students were male and all but one were graduating or within one quarter of graduation.

Organization

The course is a three credit (quarter basis) offering which requires three hours of class sessions per week for ten weeks. In order to accommodate the employed students, avoid conflicts due to students from several different majors, and allow time for extended discussions and activities; the course was scheduled on Monday evenings from 6-9. Due to a Monday holiday only nine formal class sessions were held, students were directed to use the tenth session time allotment working independently on their final project. The course was concluded with a two hour group oral final/project report session.

All meetings were held in a classroom with moveable tables and chairs which allowed for a flexible seating arrangement. Students were typically clustered in three groups of four in a semicircular arrangement around the instructor's desk. The classroom environment was informal/discussion oriented.

The instructor occasionally presented some background material with the use of overheads; however, most of the information and activities were based on handouts provided during the class period. (A suitable text is not available for the course.) Typically students were asked to read the handouts and then engage in follow up discussion; or to complete the exercises/activities individually, within their subgroup, and/or with the class as a whole.

Content

A detailed syllabus was provided to students at the first class session. An expanded description/rationale was included in the syllabus in an effort to help students prepare for the unconventional nature of the material and structure of this new course and to explain the need for such a course. These concepts were reinforced during the first class session using material from various educational and industry sources.

Students were introduced to journal (free) writing and provided a handout on this subject. Some journal entries were incorporated into class activities throughout the quarter; however, each student also had to make a minimum of four out-of- class entries per week relating class material to school, work or personal situations. Individual entries were collected randomly and returned with written feedback. Journals were graded at the end of the quarter using appropriate journal evaluation techniques.

As part of the planned activities during class sessions for the first half of the course, various creative/critical thinking exercises were completed. Sources include Adams (1986), Ecker (1987), and Rubinstein (1975). Many exercises were gleaned from my files, gathered over the years from unknown or miscellaneous sources. The students thoroughly enjoyed these activities and clearly "improved" their performance as a result of the repeated practice.

The concept of a hierarchy consisting of four problem solving approaches and the need to match the problem with the appropriate method were discussed at the first class session and reinforced throughout the quarter. Because of its familiarity and appropriateness to the students, application of technology was the method first introduced in detail and included as a topic in the first three sessions. Various techniques for using this method were provided to students based on the material from several sources (Ewens et al., 1988; Hindhede et al., 1983; Jackson, 1975; Johnson, 1987; Savage, 1989). Students were given problems to solve in class as a group activity using this method. Also each had to complete a case study/report describing a problem actually encountered and solved using the application of technology at work, school or home.

The scientific method was briefly discussed during the third session using material from two biology texts (Brum and McKane, 1989; Ward and Hetzel, 1984). Each student was required to complete a simple seed germination experiment/report using this method.

Learning styles and personality types and their relationships to problem solving were topics of discussion in the third and fourth sessions. The class was introduced to the work of Kolb (1984, 1976) concerning experiential learning and learning style inventories and their application to problem solving (Bawden, 1986; Wilson and Morren, 1990). Right/left brain learning patterns (Buzan, 1983) and other aspects of learning styles versus educational methods were also discussed.

Fortunately due to campus and community resources, I was able to have the students participate in the well known Myers-Briggs Type Inventory (Briggs-Myers, 1980; Keirsey and Bates, 1978; Sorenson and Hartung, 1987). Campus personnel in the University's Office of Residence Halls are authorized to administer and score the test which they volunteered to do for the class. Likewise, a clinical psychologist associated with the student health center at a private college in the community and who uses the Myers-Briggs in her practice agreed to conduct the follow up class session concerning interpretation and applications to learning/problem solving.

Hard and soft systems approaches (Bawden, 1986; Carter et al., 1984; Checkland, 1981; Wilson and Morren, 1990) were introduced and compared during the fifth class session. A simple linear programming exercise was presented by a colleague in business technology as an example of the hard systems method.

As previously discussed, I had concluded that although the topic of soft systems was to be an important part of the course, the entire detailed, multistage process as presented by the Food and Agricultural Systems Task Group (1986) and Wilson and Morren (1990) was not appropriate for technical college students. Therefore, I prepared a handout for class discussion which defined and explained the soft systems approach and its application. I then concentrated

class activities on Stage 1: Inquire into the Situation and Stage 2: Describe the Situation. Divergence, obtaining a rich picture, and techniques such as mindmapping and cartooning (Buzan, 1983; Buzan, 1984) were emphasized. The later stages of the soft systems process were not presented as such, instead the discussion was limited to models for effecting change and strategies for achieving consensus. Students were assigned the project of using this procedure in completing an individual case study of an actual real world situation with a report due at the end of the quarter.

As a class project, students were given background reading material from several sources concerning the controversy surrounding enforced use of turtle excluder devices by shrimp fishermen. During the sixth class session students role played as members of different groups involved in the situation and as facilitators. Other example problem situations were also discussed. Time was spent during each remaining class session assisting students with their individual projects.

The topics of interpersonal relationships, group dynamics, leadership and management styles were presented in the seventh session. A colleague from social sciences conducted most of this class using various handouts and a video. Students participated in several interactive group activities which were obtained from Pfeiffer and Goodstein (1982) and Pfeiffer and Jones (1974).

Decision making and strategy, risk taking, and planning were discussed in the eighth class session. Adams (1986) has background information and sample exercises on these topics at a level appropriate for the course. One class activity which proved to be very effective and popular with the students was to have them play a board game during which they observed and recorded the strategy, risk taking, and decision making characteristics of their opponents.

The direct application of the topics presented in the seventh and eighth classes to business management was a major topic during the ninth class session. The formal process of strategic planning was also a class activity during this last session. Handouts for the topics presented in the last three class sessions were based on a variety of miscellaneous materials in my files collected from an assortment of trade, educational, and popular publications.

Grades were assigned for the course based on several weekly reports (including the application of technology and scientific method projects previously mentioned) (25%), class participation (15%), soft systems case study/report (25%), journal (25%), and the oral final (10%). The grading system did not include any written quizzes or tests.

Evaluation

As expected, initial student reaction to this unique required course was mixed. Some students were enthusiastic, eagerly joining in class discussions and activities; whereas others responded only when called upon. The effects of individual learning styles, personality types, and work experience on class participation were apparent. Constant attempts were made throughout the quarter to involve all students and to relate the material to the "real world" of business and industry.

The standard University Student Evaluation of Teaching (SET) course evaluation was provided to students at the beginning of the seventh session. Mean values for the student responses were in the 1.0 to 1.5 range (scale: -2 to 2) and consistent with overall College and University mean values. None of the students chose to provide any written comments on the SET forms. At the conclusion of the group oral final/project report session, I again requested anonymous written feedback to assist me in improving the course. All students responded and the comments were overwhelmingly positive and supportive. It is my feeling based on differences between the SET and written responses that the concept and usefulness of the course "jelled" for many of the students only during the last few sessions.

Suggestions for improvement included: fewer handouts, industry speakers, more specific details for some topics/assignments, and reduction in quantity of assigned work. The first three are valid suggestions which I will incorporate in future classes, the last is typical for my classes and reflects my high expectations of students. I was pleased with the overall performance of the students. The class GPA was 2.87 (scale: 0 - 4), which is higher than usual for my courses.

Conclusion

Based on my experiences with this course, I have concluded that the stated course objectives and learning outcomes were achieved. In addition to problem solving, the course integrates material from a number of non-technical subject areas to provide students with reinforced skills and abilities needed to be successful in the current business and industry environment. Given the brief, narrow, specialized nature of two-year technical curricula, the need for such a course may be more critical than in a baccalaureate program. As a capstone course it also plays an important role in the students' transition from college to the "real world".

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