Modifying a Technical Course to Meet Baccalaureate Objectives

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THE CRITICISM: MANY TECHNICAL COURSES LACK RIGOR

Several recent reports have been critical of the quality of general education in the United States (Assn. of American Colleges, 1985; Geiger, 1980; Schwerin, 1983). Baccalaureate education has not been spared from negative evaluation (Boyer, 1987). A report of the Assn. of American Colleges (1985) stated that the bachelor's degree had lost its intrinsic value: undergraduate education was being dominated by a marketplace philosophy and universities were not promoting rigorous thinking.

Many traditional courses in 4-year agriculture programs are technically or vocationally oriented. In fact, support for practical education in agriculture and mechanic arts has been mandated in the United States since the enactment of the Morrill Act of 1862. Many of these courses seem prone to the criticisms of being overly responsive to the marketplace and of not fostering critical thinking and intellectual growth.

The Assn. of American Colleges report (1985) asserts that there are major areas where the training of students with either a "liberal" or "vocational" emphasis should overlap. The report noted that "... graduates with professional baccalaureate degrees as well as graduates with degrees in traditional liberal arts fields should share essential intellectual characteristics and attributes" (Assn. of American Colleges, 1985). The report listed the following as essential experiences in baccalaureate programs: inquiry, abstract logical thinking, and critical analysis; literacy in writing, reading, speaking, and listening; understanding numerical data; historical consciousness; science; values; art; international and multicultural experiences; and study in depth (Assn. of American Colleges, 1985).

By addressing some of these points in every baccalaureate course, we can ensure that students graduated by these programs will have practiced the critical thinking skills that provide a sound foundation for long-term professional growth.

A RESPONSE: MODIFYING A FLORAL DESIGN COURSE

An introductory floral design course at Washington State Univ. was reviewed with the above criteria in mind. The course was revised, and modifications are presented below as an example of what can be done to address the broad goals of baccalaureate education while accomplishing the needed technical training.

The course traditionally had consisted of laboratory exercises, in which students practiced flower arranging, and lectures, in which the principles of design, history of flower arranging, and techniques for extending cut-flower life were presented. The course had been effective in conveying technical information, but did not emphasize complex cognitive skills (Bloom, 1956).

To incorporate more of the intellectual experiences that are considered essential to baccalaureate education into a traditional floral design course, I chose to expand the students' understanding of horticultural principles and to enhance their appreciation for the scientific means of acquiring new information. It would have been possible to enhance the course by expanding the examination of artistic design, for example, by studying the psychological response to color and the influence of light quality on color rendition. Because this course attracted potential horticultural science majors, the emphasis on the science and principles of horticulture was selected.

In the modified course, the lecture subjects are largely unchanged, but an emphasis is placed on promoting conceptual rather than factual knowledge. Lohr and Cotter (1984) demonstrated that this method is effective in teaching students both concepts and facts. Thus, time spent on strictly factual information can be reduced to allow more time for discussing conceptual issues. The laboratory exercises continue to focus on flower arranging, but the principles of extending cut-flower life are demonstrated inaddition to design principles. This is accomplished by adding scientific experiments to the design laboratories each week. Students make floral arrangements and they conduct experiments with these same arrangements.

The laboratory experiments for the course are designed in response to general findings in the educational literature and to recommendations in various task force reports (Assn. of American Colleges, 1985; Babi-
mational factors. Finally, the laboratory exercises need to be arranged so that students progress from simple to more advanced concepts in both floral design and experimentation. An example of a progression for a fall-term class is presented in Table 1. Students do not perform experiments during the weeks before vacations or exams, because they cannot make observations during those weeks; those periods are reserved for less-structured activities, allowing the students to choose different materials and designs. The planning of individual experiments also involves several considerations. Students are involved in choosing some experimental treatments. For example, students are asked what they have heard about making cut flowers last. They respond with such notions as adding aspirin to the holding water. These ideas are incorporated as treatments (see Table 2). This approach stimulates curiosity, interest, and active participation. Finding quantitative measures to detect treatment differences is sometimes difficult. Each arrangement contains different flower types and often different quantities of flowers. For simple arrangements, as in bud vases, it is possible to determine the fresh weight of each major flower. For larger arrangements, students need to tag representative flowers for subsequent measurements. The responses of the floral material to the experimental treatments is used as the basis for discussion of some advanced topics. In the first laboratory exercises, the students expect all flowers to respond exactly as described in class. This provides an opportunity to present such concepts as variability and the need for replication in biological studies. The problem of confounding treatment effects can be discussed after Expt. 6 on light (Table 1), where temperature, light quality, or humidity could influence the results. Experiments that involve different actions by the floral designer, such as Expt. 7 on asymmetrical triangle flower arrangements, can be used to consider economics and ergonomics as well as flower responses. This can lead into discussions on values, ethics, and the choice of "best" treatment.

THE ASSESSMENT

Students filled out evaluation forms after taking the modified course. Generally, both floriculture majors and non-horticulture majors supported the changes in the floral design course. Most of the students (64%) believed that the laboratory projects were "excellent" or "very good", and the remaining 36% believed they were "good". Almost all of the students (92%) agreed that the objectives had been met. All stated that they would recommend the course to friends; for example, one student wrote "I would recommend this course as not just a fun, creative course, but as an art and a science mixed." Almost 80% of the students believed that the course strongly encouraged independent thinking and emphasized principles; the remaining 21% agreed that the course did not rely on rote memorization.

The students' evaluations lend support to the premise that the broader objectives of higher education can be successfully incorporated within technically and vocationally oriented courses. Students are exposed to increased conceptual thinking and to challenges to their ideas of how information is acquired. The incorporation of these important learning experiences can be accomplished with simple modifications that can be made in any technically or vocationally oriented course.

### Table 1. Progression of experiments to be conducted with floral designs in the laboratory of a fall-term introductory floral design course. Designs and experimental topics generally progress from simple to more complex.

<table>
<thead>
<tr>
<th>Expt.</th>
<th>Design</th>
<th>Flower</th>
<th>Experimental treatments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Bud vase</td>
<td>Carnation</td>
<td>Preservative solutions (see Table 2)</td>
</tr>
<tr>
<td>2</td>
<td>Vertical</td>
<td>Rose</td>
<td>Cutting technique: Stems cut in air, Stems cut under water</td>
</tr>
<tr>
<td>3</td>
<td>Horizontal</td>
<td>Gerbera</td>
<td>Temperature: Room temperature (20°C), Refrigerated (2°C), Incubated (30°C)</td>
</tr>
<tr>
<td>4</td>
<td>Round</td>
<td>Mixed greens</td>
<td>Anti-transpiants: No spray, Foliar spray sold by floral industry, Foliar spray sold by nursery industry</td>
</tr>
<tr>
<td>5</td>
<td>Right-angle</td>
<td>Rose</td>
<td>Water quality: Tap water, Tap water + 4 mg fluoride/liter, Deionized water</td>
</tr>
<tr>
<td>6</td>
<td>Inverted &quot;T&quot;</td>
<td>Chrysanthemum</td>
<td>Light: In darkness, Under fluorescent light</td>
</tr>
<tr>
<td>7</td>
<td>Crescent</td>
<td>Carnation</td>
<td>Ethylene: Control without preservatives, With C2H4 scrubber, such as Purafil</td>
</tr>
<tr>
<td>8</td>
<td>Asymmetrical triangle</td>
<td>Chrysanthemum</td>
<td>Flower holders: Held with pin holders, Water-absorbent foam block, Shredded styrofoam</td>
</tr>
<tr>
<td>9</td>
<td>Hogarth curve</td>
<td>Poinsettia</td>
<td>Latex excretion: Control in preservative, Dipped in boiling water (1 sec)</td>
</tr>
</tbody>
</table>

In 90% isopropyl alcohol (10 min)

### WILL ASPIRIN MAKE MY FLOWERS FEEL BETTER?

- Effects of Preservatives Solutions on Cut Flower Longevity

**Introduction:**
You know that flowers should be placed in water after they are cut, but do you know if something should be added to the water? Floral shops often sell packets of preservatives that claim to prolong the life of cut flowers. Preservative solutions can also be prepared from common household chemicals. How effective are these and how do they work?

Commercial preservatives and homemade solutions often contain acidifying agents and simple sugars. Acidified water reduces the growth of microorganisms. This is important because rapidly multiplying bacteria could clog the xylem elements in the stem and reduce water uptake. Sugar added to the water may replenish or enhance the sugar reserves in the flower and foliage; these reserves are necessary for energy release via respiration.

**Treatments:**
1. Tap water (the control).
2. One aspirin tablet (500 mg), ground, per 250 ml tap water.
3. 100 ml soft drink, 400 ml tap water, 5 drops bleach.
4. Commercial preservative prepared according to label.

**Procedures:**
Prepare the above holding solutions and place them in separate bud vases. Make floral arrangements in the vases according to the design principles discussed. Place the arrangements under simulated home conditions. At least twice each week, record the following: general appearance, degree of opening, fresh weight, and percent of petal damage on the main flower. Record the number of days of vase life. Prepare a lab write-up and bring results for class discussion.

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The current problems centering upon profitability in agriculture have generated increased pressure for production diversification and management efficiency (USDA, 1987). Expanding market opportunities and relatively high gross economic returns have made horticultural enterprises a primary focus of farm production diversification initiatives nationwide. However, the economic success of such diversification initiatives often has been jeopardized by failure of producers to comprehensively evaluate the integrated requirements for capital, equipment, labor, and management resources in the decision-making process (Sullivan et al., 1988b).

Advanced computer-based techniques offer a unique opportunity for assuring that management support systems commensurate with the quantitative decisionmaking needs of producers will be available (Baldwin and Dayton, 1986; Bender, 1984). Although management software programs have proliferated in the marketplace, acceptance and application has not been widespread among agricultural producers. It is estimated that <10% of all farms in the United States currently use personal computers for management decisions (Agricultural Scientific Associates, unpublished data). Findings indicate that this low level of use is related to several factors, including the fact that existing technology: a) requires knowledge of computers and application software, b) lacks natural language capability, and c) does not provide needed interactive reasoning capabilities.

Advances in artificial intelligence (AI) technology and expert system (ES) knowledge engineering have created opportunities for the development and commercial implementation of a new generation of computer applications in enterprise management. Artificial intelligence technology enables researchers to make machines, such as computers, perform functions that historically were limited to human reasoning powers. Expert systems knowledge engineering techniques are used to acquire knowledge from domain expertise and then use this knowledge to create rule sets for solving problems in a dynamic decisionmaking environment.

Expert systems

Expert systems represent a relatively new development in the field of AI and are designed to duplicate the thought processes of a human expert, generate advice and develop solutions in a particular problem area through an interactive management support program (Andriole, 1985; Bonczek et al., 1981; Holzapfel and Whinston, 1987). The advice is comparable to that which would be offered by a human expert. No previous computer knowledge is required by the user, and natural language is employed in the user consultation process. The technical problems impeding the acceptance of computers among agricultural producers are largely resolved through expert systems. The development of ES management programs, therefore, represents a significant new concept in risk management, multiple resource allocation, and profit maximization for agricultural producers. Expert systems are being used in many business situations to enhance productivity and reduce costs (Holzapfel and Whinston, 1987). Examples of ES currently available to agricultural producers include the Grain Marketing Advisory and the Muskemelon Production Management System (Uhrig et al., 1988; Sullivan et al., 1988b).

Expert systems development software is composed of a user interface, an inference engine, and stored expertise. The user interface performs the interaction between the user and the computer. It accepts requests from the user and comprises the channel through which the responses are given. The inference engine is a generalized problem solver designed to perform the reasoning process through the rule sets created by the knowledge engineer. The inference engine is able to accept a problem statement from the user, use reasoning knowledge about the problem area in attempting to derive a solution, gather needed problem-specific information in the course of reasoning, explain why it needs this added information, present the solution to the user, and explain the line of reasoning used in reaching the solution. The stored expertise consists of a set of rules developed by the domain experts. Each rule is a fragment of reasoning knowledge consisting of a premise (IF: condition) and a conclusion (THEN: action). The rules govern the parameters of each production management function and dictate the final recommendation to the user.

Expert system shells

Agriculturally related research and development initiatives in AI to date have centered primarily upon the use of expert system shells in the development of production management software programs (Gaultney et al., 1987; Jones and Hoelscher, 1987; Jones and Strickland, 1987; Nagarajan et al., 1987; Rettinger, 1987). Several expert system shells for building operational expert systems are available commercially. The shell Personal Consultant Plus (PC PLUS) (Texas Instruments, 1986) and LISP programming languages have been used most extensively. However, none of the expert system shells...