problems applicable to their degree programs and more commercial software. All of the suggestions were reasonable and as the course continues to change and evolve, they may be integrated into the course curriculum.

Some of the results that were predicted were not realized. We thought that more students would have graduated, be in computer related jobs, and own computers. On the other hand, since the students were exposed to word processing in the beginning of the semester, we were surprised and pleased to find that many of them used the computer to do term papers and resumes.

Bibliography

Foster, R M., University of Nebraska, C.E. Walker, University of Nebraska, "Microcomputer Instruction in Agriculture a Report of a Cooperative Approach," *NACTA Journal*, December, 1984.

Reber, E.S., "Copyright Dilemma" given at NCCI computers in Workshop, October, 1984.

Tinsley, W.A., Clemson University. "Teaching with the Microcomputer: Adoption of a New Technology," Southern Journal of Agricultural Economics, July, 1983.

Williams, W.S., Michigan University, J. Shrage, Wayne County Michigan Intermediate School District "Microcomputers and Education: An Overview of Popular Hardware and Software," *Educational Technology*, February, 1983.

CLASSROOM REPORT

Microcomputers Aid Instruction in "Livestock Management"

William C. Russell

Introduction

Over the last few years, developments in microcomputer technology and more importantly, the increased availability of agricultural software have enabled students to benefit from the speed and accuracy with which relatively low-cost modern computers can perform complicated tasks. While computers have been used in the classroom for many years (Brackelsberg, 1978), most early programs were written for large mainframe computers with the primary goal of demonstrating or applying some technique. Presently, with the advent of the microcomputer and development of agricultural software, the computer has become a tool available to anyone.

Many instructors are incorporating computers into existing courses (McGlone and Russell, 1983; Menkhaus et al., 1984) while colleges and departments are developing new courses designed solely to instruct the student in the use of computers in agriculture (Coffey et al., 1983; Foster and Walker, 1984; Menkhaus et al., 1984). The former generally parallels the introduction of the hand-held calculator into courses to speed up calculations so that more time can be spent learning pertinent material. Recently, development of innovative software has allowed the instructor to get ideas across that would be difficult or extremely time consuming without the aid of the computer.

The purpose of this paper is to discuss the development of a decision making course in Animal Science and the incorporation of microcomputers as a major instructional tool. Also considered are the rationale leading to the inception of the course, as well as the perceived benefits to the student.

Course Implementation and Structure

In 1982 a new course was developed and is now taught at the University of Wyoming titled "Livestock Management Decisions." The objectives of this course are: (1) to provide senior Animal Science students with a course that integrates the various disciplines in livestock management (Table 1) in such a way that management decisions reflect those disciplines; and (2) to incorporate computers in the class as a tool to aid in evaluating alternative decisions.

The basic content of the course is presented in Table 1. The first section is designed to evaluate each discipline in light of possible alternative decisions that may be made while stressing the interrelationships between biological and economic efficiency. This part is not intended as a review but as a thought provoking session in which students must consider alternatives. Many students who are capable of absorbing facts have difficulty in using these facts to arrive at a decision. As an example, a student may be very familiar with the characteristics of a number of breeds of cattle, however, difficulty arises when the student is required to choose breeds to go into a crossbreeding system in a specific environment. The justification for this course is based predominantly on this concept. Exit interviews with graduating seniors and discussions with recent graduates have continually identified decision making as an area not adequately covered in many curricula. Students are taught the facts and current practices but little time is spent on tying facts together to develop a logical and workable plan.

Table 1. "Livestock Management Decisions"

A.	Introduction	
	1.	Importance of management decisions in agriculture.
	2.	Application of mathematics to the biological sciences and decision making.
B.	Decisions and Alternatives	
	1.	Economics
	2.	General management
	3.	Nutrition
	4.	Genetics
	5.	Physiology
	6.	Range management
C.	Computer Applications to Decision Making	
	1.	Review of programming and computer use
	2.	Models and model building
	3.	Linear programming
	4.	Simulation
D.	Development of Management Systems Using Computer Techniques	

Russell is assistant professor of Animal Science, University of Wyoming, Laramie, Wyoming 82071.

Table 2. Example Problems Selected by Students

Non-traditional methods of marketing feeder calves to increase return
The use of supplements in a feeding program — how do you determine what you need
Preconditioning — advantages and disadvantages
Cow/calf vs. stockers
Importance of heifer development
Importance of poisonous plants and management to avoid problems
Mud in feedlots — situations and solutions
Maximizing lamb survival

In an attempt to stimulate logical thinking, a number of assignments have been developed that stress problem solving. These have been both computer related exercises and more traditional assignments where the student must evaluate a number of alternatives in order to make a final choice. In addition, a paper has been required that addresses some problem in Animal Science. The student is expected to identify the importance of the problem, its nature and to discuss possible solutions. Students generally select a problem from several suggested by his or her County Extension Agent. Wyoming has a diverse agricultural base and, as such, agents provide a variety of problems from which the student may choose. (Non-resident students are able to select certain unique problems from their home state.) Those students from urban or non-livestock areas are allowed to choose a problem from lists received by others. A partial list of selected problems is presented in Table 2.

The second section of the course is designed to familiarize the student with computers and to utilize computer software designed for Animal Science in order to evaluate alternatives. This section includes discussions of how a computer works, its applications (e.g. word processing, graphics, etc.) and an introduction to BASIC. The first time the course was taught all students were on relatively equal footing in that none had experience with computers or computer languages. The College of Agriculture now offers an elective course in "Microcomputers in Agriculture" which many students take. As a result, we now have students proficient with a computer while others are still beginners. The solution to this problem will likely be to require the introductory computer course as a prerequisite.

The design of "Microcomputers in Agriculture" is very similar to a course described by Foster and Walker (1984) although the rationale for our course is somewhat different. Faculty, with the support of college administration, felt the need for an introductory course that would teach basic computer skills with examples and assignments drawn from agriculture. These skills would then be used in more advanced application courses, such as "Livestock Management Decisions," permitting that instructor more time for subject matter coverage (Menkhaus et al., 1984).

Initially, an Apple microcomputer and several terminals connected to the campus mainframe were used in teaching; however, in 1983 a computer classroom was devloped in the College of Agriculture providing excellent facilities for the course. This classroom is equipped with 10 IBM-PC microcomputers, six mainframe terminals as well as several printers and a plotter. The IBM's are networked to a 20 mByte hard disk providing easy student access to copyable programs and instructor access to students' computer assignments for evaluation and grading.

Other topics covered under the computer section include introductory linear programming, simulation and the use of spreadsheets and other existing software. The student is not expected to become an expert in these areas but to gain an appreciation for how these tools work and can be used in an Animal Science environment. Neither senior students nor ranchers normally develop simulation programs but they may have access to them through the Extension Service or commercial software sources. An understanding of these techniques could prove useful in providing inputs and interpreting results from programs developed by others.

Grading is based on class participation, term paper, problems and two tests. Test materials have been difficult to develop and it is likely, in the future, the problem assignments will be expanded and the tests deemphasized. Currently, the term paper, problems and tests have equal weighting while participation has been used to decide borderline cases.

Discussion

The primary objective of "Livestock Management Decisions" is to encourage students to use the facts at hand to arrive at a defensible decision. Use of computers as a tool that will likely be available to them after graduation is also considered important. The emphasis in this last statement is on the word "tool." Considerable class time and discussion is spent on evaluating why the particular computer solution was obtained. Occasionally in the course, incomplete linear programming models and spreadsheets are provided so incorrect or no solutions are obtained. The student is then given time to evaluate the model, hopefully discovering what is incorrect or missing. This technique is useful in determining whether the student has full grasp of the concepts. A special effort is made to insure that the student does not rely on a "black box," i.e. being capable of using the tool but not understanding how a solution is achieved.

Student acceptance of this new course has been good. Students seem to enjoy the challenge of putting together the facts, as well as being able to use computers. The single most prominent criticism voiced by each class has been the amount of time spent (4 to 6 wk) on the first part of the course which covers the alternatives in each discipline. While many of the students believe they are knowledgeable about the information covered, they are many times unable to recall pertinent information in the disciplines. As a result, some time must be spent in this area and the amount of time has varied with each class.

Conclusions

College students have frequently been criticized for their lack of ability to think. A senior level course in Animal Science has been developed to motivate students to evaluate pertinent facts as they choose livestock management alternatives which consider both biological and economic efficiency. Although the computer is utilized as a tool, concepts that must be considered before a decision is made are stressed. Student reaction to this course has been good in part due to the availability of microcomputers for their use. Additional benefits to the student are:

— training on computers which they may have access to after graduation.

— exposure to selected agricultural and general software.

— an appreciation of how computers can be integrated into the decision making process of a farm or ranch.

One of the objectives of education should be to provide students with the opportunity to develop skills in decision making. While facts may always be obtained by one method or another, the ability to utilize these facts to make logical, useful decisions is an ability that must be learned and developed. This course attempts to achieve this objective.

Literature Cited

Brackelsberg, P.O. 1978. The computer in Animal Science teaching experiences with a beef genetic simulation. Symposium on use of the computer in Animal Science teaching, research and extension. American Society of Animal Science. Annual meeting, July 9-13, Michigan State University.

Coffey, M.T., M.D. Harrison, R.A. Levins, W.G. Boggess and W.E. Kunkle. 1983. Developing a new course "Microcomputers and Their Applications to Agriculture." *J. Anim. Sci.* 57:835 Supp 1.

Foster, R.M. and C.E. Walker. 1984. Microcomputer instruction in Agriculture: A report of a cooperative approach. *NACTA J.* Vol. XXVIII No. 4:7.

McGlone, J.J. and W.C. Russell. 1983. A computerized analysis of heating and ventilation for livestock buildings. *J. Anim. Sci.* 57:841 Supp 1.

Menkhaus, D., W.C. Russell and H. Hughes. 1984. Classroom use of computers — some observations. *NACTA J.* Vol. XXVIII No. 1:7.

A CLASSROOM SYSTEM REPORT

A Computer-Assisted Classroom Feedback System

J. S. Quick and H. A. Talley

Abstract

A computer-assisted rapid evaluation/feedback (CARE) system has been developed to provide instant feedback to the instructor and students. The system includes a portable microcomputer, feedback terminals and a printer (optional). Following display of the question by the instructor, the students choose the correct numbered answer on the terminal. The computer simultaneously polls all students, provides an instantaneous summary of results by question or student, and can store or print the results at any time. The equipment cost is reasonably low, class size is not limited, and paper use and grading time are essentially eliminated. A survey of 30 students in an introductory plant breeding class during March-May 1985 indirectly indicated that the system reduced student intimidation and improved overall instruction and learning.

Introduction

Feedback has been defined by Milton (1978) as "authoritative information students receive that will reinforce or modify responses to instruction and guide them more efficiently in attaining the goals of the course."

The benefits of continuous feedback from students to the instructor have been well documented (Bloom, 1976; Milton and Edgerly, 1977; Milton, 1978; McKeachie, 1976 and 1978; Lowman, 1984). Improved motivation, interest, and performance have been cited as benefits of feedback. McKeachie (1976) concluded that "the more feedback given, the more learning results." Bloom (1976) stressed the need for a system of feedback to the teacher and the students that "can reveal errors in learning shortly after they occur... a self-correcting system so that errors made at one time can be corrected before they are compounded with later errors."

Feedback can be considered part of teaching rather than an assessment process. To be effective as a teaching method it must be separated from the grading process as much as possible. If used correctly, feedback will provide the student with direction and a sense of achievement. There are several types of feedback in use: written tests, written assignments, group discussion, and group problem solving assignments. Limitations to feedback are class time, equipment, teacher training, threat of intimidation associated with evaluation, and class size.

The key to overcoming several limitations to the use of feedback is the application of computer technology. The major uses of computers as teaching aids have been in drill and practice routines, learning devices (games, etc.), dialogue or tutorial responses, and in management of instruction (record keeping and diagnostics). Direct computer polling or testing has been limited because of high cost and lack of computer portability. If testing could be done by the computer, the advantage would be **immediate** feedback. Immediate effective feedback would allow "active" learning through practice because the students would "see the results" (McKeachie, 1978).

The objective of this paper is to describe a unique teaching method, computer-assisted rapid evaluation/feedback (CARE), for classroom instruction.

Quick is a professor in the Department of Agronomy, Colorado State University, Fort Collins, CO 80523, while Talley is a private computing consultant, Edutech Systems, Fort Collins, CO 80525.