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.

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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.

Table 1. Responses Concerning the Use of a Computer-Assisted Rapid Evaluation (CARE) System in Field Crops Breeding (AG 420) at the End of the Spring Semester, 1985[1]

Statement	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
			N = 30		
Evaluation/ feedback is desirable for effective instruction and learning	14	13	2	0	1
The computer system is less intimidating than raising your hand	13	11	4	0	2
Confidence in the accuracy of the system is high	12	15	2	0	1
Speed of response summarization is a valuable aid in evaluating learning progress	14	13	2	0	1
Restriction to true-false or multiple choice questions is a serious limitation	9	2	7	9	3
Use CARE for quizzes at the end of the lecture period	7	11	7	2	3
Use CARE for quizzes at the beginning of the lecture period	3	1	14	7	5
Use CARE for quizzes at various times during the lecture period	5	8	9	5	3
Use CARE for grading of quizzes for credit	4	9	9	3	5
Overall, CARE is a tool which improves learning and instruction	11	14	3	1	1

[1]This evaluation was completed by 30 students after six weeks of CARE use.

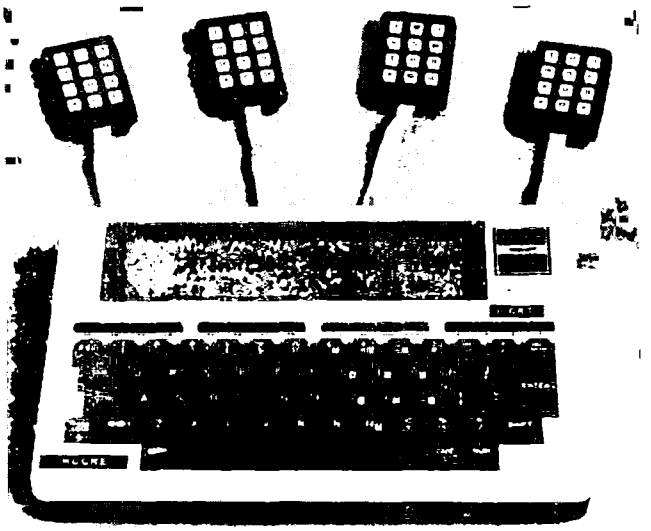

Fig. 1. A microcomputer and terminals used to provide classroom feedback.

Materials and Methods

The hardware and software for CARE were developed by Edutech Systems.[1] The system includes a terminal for each student, and electrical wiring and connectors between terminals and the computer. The terminals are very simple to operate, either dials with five numbered choices or a push button pad with 10 numbered choices. A portable microcomputer (available from several vendors at $500 to $3000) controls display of the instructions, analysis, and storage of the results. Current cost of the system is $30 to $35 per terminal including software and wiring. Cost for our complete system was:

Portable Computer (TRS 80, Model 100)	$499
Terminals including software and connectors ($30 x 30 students)	$900
Wiring installation charges (4 hours x $15)	$60
Total	$1459

Multiple-choice questions for specific courses are displayed via blackboard, overhead projector or a handout by the instructor at any time during the class period. The analysis of student responses are instantaneous when the last student provides the answer via the terminal. The control system software allows the instructor to (a) take roll by accepting student code numbers, (b) poll the students and view results of the current question, (c) provide responses for each student, (d) view a summary of all students and all questions, (e) print a list of students' answers to all questions and percent of questions correct by either name, social security number, or student code number, and (f) store the information in a text file for later retrieval and utilization on a mainframe or minicomputer. The system has a built-in self test to assure that all electrical connections are functioning correctly.

The system was first used in a classroom in March 1985 and was evaluated by 30 students in an in-

[1]Edutech Systems, 3212 Camelot Drive, Fort Collins, CO 80525.

troductory plant breeding course (AG420) after six weeks of use. To judge the effectivenes of the CARE system, the students were asked if they strongly agreed, agreed, were neutral, disagreed, or strongly disagreed with each of 10 statements.

Results and Discussion

Table 1 provides the results of the evaluation. All but one of the students felt that feedback was desirable for effective instruction and learning. Twenty-four of the students agreed that the use of the computer system was less intimidating than raising their hand to answer a question. Confidence in the accuracy of the system was rated high among 27 of the 30 students. The speed with which the computer summarizes results for 30 students was chosen as a valuable aid to instruction by 27 of the students. Student responses were variable in the reaction to the limitations imposed by multiple choice or true-false questions. These types of questions are not the usual types used by this instructor, and with improved construction, should probably be less of a limitation.

Students provided mixed reactions to timing of the feedback quizzes. Less than half of the students indicated that the CARE system should be used for grading of quizzes for credit toward a course letter grade. During the six-week trial period, CARE was not used for recording grades, only for providing feedback. As the instructor and students become more confident and familiar with the system, the use of CARE could be expanded to include both feedback and grading. Overall, 25 of the students who used CARE agreed or strongly agreed that it improved learning and instruction.

The CARE system greatly reduces or eliminates most limitations to effective feedback.

1. The cost of equipment is low.
2. Portable computers can be carried in a small briefcase.
3. Intimidation is greatly reduced.
4. Classes up to 150 students can use the system.

A 10-question quiz can be given in less than 5 minutes, the results discussed, and a printed summary immediately posted for student review. The system provides individual contact via computer between the teacher and student.

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TEACHING METHOD REPORT

Teaching the Construction of Dichotomous Keys

Joseph Laferriers

Teaching high school students and college freshmen to construct dichotomous keys for the identification of plant or animal species is often one of the most difficult and challenging tasks an instructor has to face. Students often have had limited exposure to this type of keys, and have not experienced the types of difficulties which the user of a poorly constructed key is likely to face. Students' first attempts at construction of keys are apt to fall short of the mark in several respects: first, the keys often utilize comparative terms like "big" or "small;" second, they frequently contain ambiguous or poorly defined qualifiers, or qualifiers failing to give proper contrast between opposing legs of the key; and third, many students fail to grasp the dichotomous nature of the standard key format. Even graduate students have been known to err along these same lines.

Some instructors use practice sets of "species" as examples to illustrate the methodology inherent in the construction of keys, such as having the students construct a key to various types of screws (Walters 1977). This method is useful in impressing on the students the necessary procedures involved in key formation. The variation proposed here, a key to the first ten letters of the alphabet, has several advantages, namely that it requires no advance preparation time or acquisition of materials, and involves symbols with which the students are already familiar. It also provides the opportunity for illustrating some of the features of good key construction. For example, if the students suggest contrasting consonants with vowels, this offers an ideal occasion for explaining the need to include criteria for deciding between taxonomic categories rather than basing the decision on extraneous information. If the "J" is written without the seraph, this can give rise to a discussion of the need for proper identification of ambiguous terminology, since some people may interpret the letter as consisting of a single stroke, partially curved and partially straight, while others may consider the letter as two separate strokes. It is, of course, better to avoid such ambiguities altogether or at least to write the description clearly enough so as to avoid confusion.

After students in my freshman biology class had been introduced to the techniques of using dichotomous keys, a key to the first ten letters of the alphabet was constructed on the chalkboard during the laboratory period according to suggestions made by the class. The students were then asked to construct keys to a set of ten herbarium specimens as a homework assignment, with excellent results. Most of the papers submitted showed a satisfactory grasp of the techniques of key construction.

Laferriere is with the Dept. of Ecology and Evolutionary Biology, University of Arizona, Tucson, AZ 85721.