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Table 1. UNL College of Agriculture students by farm background, sex, class, and entry into the college.

Computer Managed Instruction

COMPUTERIZED TESTING

D. W. Doying, E. L. Matheny, D. R. Minnick

Abstract

A computerized test generator has been developed which allows greater latitude, than do existing test generators in selecting specific subject areas from which the test is to be produced. The instructor may select test items from up to 6,000 subject areas and specify number and type of questions to be selected from each subject area. It is being used for a course in which the categorization scheme allows subject areas to be selected from 760 different objectives. Students respond on mark sense test forms which are machine scored, analyzed, stored, and listed by the computer.

Introduction

The computer revolution is continually playing an increasing role in higher education. Presently computers represent one billion dollars of the United States' annual higher education budget and by the end of this decade every student will be expected to have access to a full range of computing services (Gillespie 1981). Although computers cannot replace the psychomotor instruction in biological laboratories (Crovello 1981), computer-aided instruction (CAI) and computer-managed instruction (CMI) have been used successfully in a multitude of instructional techniques (Osburn and Schneeberger 1981; Pelz and Ware 1978; Smith and Sherwood 1976).

Many educational institutions utilize computing services for scoring examinations. The result is fewer errors, increased consistency and efficiency, and the release of instructors from time-consuming activities of scoring and score compilation. This provides more time for improvement of teaching materials and methods (Noble 1980).

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The Department of Entomology-Nematology, University of Florida, has developed a wide range of computer programs which score multiple choice, true-false, and matching questions as well as score tests in which the questions have been scrambled into different versions of the same test. There are programs to store scores for retrieval, add essay scores, produce cumulative grades after each test, drop specified test scores, derive statistical and graphical quantities (i.e., mean score, standard deviation, standard error, Kuder Richardson-20 coefficient, histogram of scores by percent and raw score) and develop a discrimination index. These programs are batch oriented, written in SAS (Statistical Analysis System) and operate on an IBM 3081 double processor in conjunction with an IBM 3082 Controller.

The computer managed instruction thus far has been extremely beneficial, but is related to only part of the testing procedure. Without computer generated tests, instructors still are required to spend large portions of time generating tests.

Many software packages for computer-assisted test construction (CATC) are available commercially with the purchase of microcomputer hardware (Christensen 1979; Huntington 1980). CATC software is also available independent of hardware purchases. Examples include GENTEST (Wasik 1979), TESTER (Hamer and Young 1978), TESTGEN (Arcos and Vano 1978), CATCAMS (Singh 1979), and TESTGEN PROGRAM (Office of Instructional Resources, University of Florida) which can be used by institutions having available computing services. However, these CATC programs do not allow the latitude of correlating subject areas to test items with the degree of specificity we desired; therefore, a comprehensive computerized test generator was developed to produce tests. This paper describes the production of a CATC test generator (TEST GEN).

Methods

Development of the Computerized Test Generator involved (1) production of the computer program and (2) compilation of test items.

Production of Computer Program

TEST GEN is a structured interactive system developed for test production and file maintenance. It is menu driven, written in Pascal and designed to be operated on a Digital Vax II/750® minicomputer in conjunction with a Digital Professional 350 PC® microcomputer. The system is designed to select test items on the basis of type of question (i.e., multiple choice, true-false, completion, short answer, or essay), the Specific subject area (category) from which the question is to be randomly drawn and to include particular test questions which may be desired. Multiple choice and true-false items can be computer scored. If all available test questions within a category have been used, a new category and question type may be entered or a question may be selected randomly from a more general category. For example, if a test question relative to a "chewing insect mouthtype" is requested and none is available, TEST GEN can search the more general category of "insect mouthtypes" and select an item from the category of "sponging insect mouthtype."

File maintenance routines include procedures which allow the user to view sample tests before printing, access database questions, enter new questions, delete undesired questions, view user-entered specifications, print the database, and print a master version of the test. Routines presently being developed include procedures to edit the sample test directly, generate student versions of the test in which the questions have been shuffled, appropriate print procedures for student versions and on line "help."

Development began with the production of a stub program, which is a stripped-down, skeletal version of the final product. The stub was produced as a class project by graduate students in the Department of Computer and Information Sciences at the University of Florida. Stub alterations and implementation details were developed and coded by the senior author. As the program is too lengthy to include procedure listings or a flow chart, a partial overview of program structure is presented below.

Program Structure

Major areas of program structure include data structure, random test generation, manual test generation, database manipulation and printing.

Data Structure: The data structure is line oriented as a series of files of records. Each record has fields for question type, unique record number, category, group (of the category), subgroup (of the group), difficulty logit, boolean flag (for deleting questions), and a varying number of question fields depending on the type of question contained in the file. A separate file is maintained for each question type.

Random Test Generation: Each file record is read consecutively, filling a four dimensional array of a record with two fields; question type and record number. Category, group and subgroup make up the first three dimensions. The fourth dimension contains entries as a record of question type and record number of each file record with the same categorization.

The user is prompted for the type of question, the category, group, subgroup and the number of questions desired. This information is placed in a one dimensional array of a record with fields for question type, category, group, subgroup and record number. If the number of questions requested is greater than one, the entry is repeated in the array. If a zero is entered in one of the categorization fields, a random number is generated and normalized to the proper range for that entry.

Once the desired information is stored, the program enters a large loop which uses a random number to select one of the entries of the proper categorization from the four dimensional array. Variant records, which are activated only while they are being accessed, were used to determine if the entry generated had already been considered in order to save computer space and time. When a valid entry is located, its record number and question type is compared to each entry in the one dimensional array to see if it has already been entered. If it hasn't been entered, the record number is entered in the appropriate field of the one dimensional array. If it has been used, the loop cycles and a new entry is selected. If no entries are available within the category and question type then the user is given the option of 1) entering a new category and/or question type or, 2) having the question selected at random from another subgroup of the same group. If the first option is chosen the loop cycles again with the new user input. If the other option is chosen, another loop is entered which attempts randomly to select an entry from another group of the same category. In the event that none are available, the second option now selects randomly from another category.

Vax dependent open and close procedures are used to gain random access within the data files. The information in the one dimensional array is used to locate the appropriate record in the appropriate data file. This record is read into an array with the same record structure as the file. A different array is used for each file since the number of question fields vary from file to file. Each array is then written to a file which contains two records. The first record is a test header (class, date, etc.), and the second record has the same record structure as the record structure of the largest data file. This file will later be used to produce the test.

Manual Test Generation: Particular questions known to exist in the data bank may be included in the test. The user is prompted for the question type and its record number. This information is read into the one dimensional array which is used to locate the appropriate record in the appropriate file. This step is actually done before "random test generation" and therefore does not need a check to see if the question has already been used.

Database Manipulations: The data is contained in files of records. Therefore, these procedures are simple file manipulations. To enter a new question the program prompts the user for the needed information (i.e., question type, categorization, question, etc.), calculates its record number and adds it to the end of the appropriate file. Accessing a test question requires opening the file for random access, locating the record with the appropriate record number and displaying on the screen. Deleting a test question is handled by changing a boolean flag from true to false. The flag is checked before the question is used in the test. To view user entered specifications, the program writes the proper record fields of the aforementioned one dimensional array to the screen.

Printing: Files produced by a Pascal Program normally cannot be read or written without Pascal code. Printing the test file involves reading the file and writing the information to a text file. The text file may then be printed directly. The print command is given to the printer from inside the program. This is given as a paramenter to the open procedure and activated when the file is closed.

Compilation of Test Items

Test items were developed by departmental faculty so the computer could choose particular questions according to specific subject areas desired by the instructor. Test questions from the past three years were assembled and modified; new test questions also are being developed to provide 5-10 questions per subject area, (x = 7.2 questions per subject area). Subject areas were determined by 760 course objectives found in the first fifteen modules of a course objectives manual developed for use in auto-tutorial instruction (Matheny and Minnick 1981). Graduate students assisted in coding each test item to the specific subject area and coded questions were typed into the computer on a computer terminal. A master file was then produced so test items could be examined for content, clarity, accuracy, and objective coding. Corrections were made, reentered into the computer master file, and stored on floppy disk. In this way a test item bank of about 5600 questions is being generated.

Discussion

The computerized test generator allows instructors to request a test from the computer, select the specific subject area from up to 6,000 objectives, choose the number of questions from each objective, the type of question (i.e., multiple choice, true-false, completion) and include any particular questions desired. Students respond on a standard 3M data test form® which is entered into the computer via a Datronics 5500 data reader® scored, analyzed, stored and listed by the computer.

The test generator presently is being used in our "Principles of Entomology" course. The categorization scheme for this course uses 760 of the total possible objectives from which the test can be drawn. Plans for additional uses include several other classes and for M.S. and Ph.D. qualifying exams. Implementation of these requires development of the appropriate three level categorization scheme and the data bank of questions.

The data bank is stored on floppy disk, which is accessed by the program while it is running. After the program has finished running the disk is removed and placed under lock and key to increase security. The system is most efficient when used with a large data base. Future plans include the development of pointer based routines to allow efficient use with small data bases.

Computer assistance allows the test production and scoring to occur in seconds, a process that takes hours when performed by hand. Arcos and Vano (1978) reported a CATC system which required only 18%, in manhours, of the time required when compared with traditional methods. Their system required card punching of student replies which accounted for 17% of the time, leaving 1% for actual computer operations. Although time studies have not been done on this CATC system, we anticipate that the time required in manhours will be about 1% of the time required with traditional methods because of the use of machine read, rather than hand punched, student replies.

The program may be used for daily and weekly quizzes, midterm and final examinations. The rapid turnaround time of computers affords students daily feedback of their class progress and provides the instructor immediate and continuous information on student achievement. The system is useful in classes having large enrollments where testing frequency is sometimes reduced due to time required to create and hand score exams. It also is useful in producing "make-up" tests and as a screening tool to ascertain the competence level in basic entomology of incoming graduate students.

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Reading Level

Community College Ag Students Compared to Their Textbooks

Tony Chavez, Fred Reneau, Jim Legacy and Tom Stitt

Introduction

Community college agriculture students learn their occupational skills through various types of experiences. Just as "hands-on" experience is vital to learning occupational skills, the classroom experience is essential to develop student knowledge of agriculture. Agricultural textbooks play a major role as an instructional resource in classroom experiences.

Technically trained students who have entered the job market with strong reading abilities have enjoyed a distinct advantage over students with weak reading abilities. By virtue of their manipulative skills and abilities to mentally process written information these students have advanced in their occupations. Agricultural students who lack strong skills in reading have been improperly trained for their occupations (Thorton, 1980).

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"Hands-on" experience has been identified as a powerful instructional tool in teaching occupational skills, and textbooks should be included in the learning process for young agriculturalists.

Reading instruction should be included in school from the pre-elementary grades through the collegiate level (Rerine, 1980). By teaching readers to comprehend progressively more difficult material, educators could lessen the negative effects of the language barrier many students have experienced.

Rerine's study showed that traditional instruction seldom extends beyond the elementary grades. Implementing more rigorous reading instruction at all levels would facilitate more language skill development for coping with burgeoning changes in language. Students enabled themselves, according to Rerine, to prepare for work by heightening their literacy.

Training students to be literate must include reading instruction in preparation for the challenge of learning the complexities of language used for communication in the world of work and school. Reading should be addressed as a vocational skill because vocational and occupational literature require different applications of the English language, which vary by degrees in complexity when compared to general literature. The vocational/technical student must be taught how to read and understand vocational and occupational literature.

Significance of the Problem

The learning difficulties observed within the study population implied deficiencies in reading skills. Such deficiencies prevented students from using their textbooks. This condition for some students was adverse enough to hinder their instructors' efforts to enhance their occupational training with assigned readings from class texts. It was important to know how many of the students were deficient in reading skills.

Objectives

The purpose of this study was to conduct an inventory of the reading abilities of vocational agricultural students and compare their reading abilities to the readability levels of their textbooks.

The specific objectives were:

1. Measure the general reading levels of the agriculture students.
2. Measure the readability levels of the agriculture textbooks.
3. Compare the students' reading abilities to readability levels of their textbooks.

Procedures

Population

Data for this study were collected from sixty-six vocational agriculture students and the twenty-three agriculture textbooks used in the agriculture program at Rend Lake College. All students majoring in agriculture at Rend Lake College in spring of 1982 participated in the study.