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AUTHOR Brittain, Clay V.
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ABSTRACT

A procedural variable, the use of computers to score the students' assignments, is being studied as it affects performance on correspondence courses. The format used is known as CALS-Computer Assisted Lesson Service. Courses were converted to an objective type lesson format which the student responded to using an electronically read answer sheet. The computer scored the lessons and printed comments to the student regarding the specific answer selected. Compared to the conventional course format, the CALS version positively affected lesson submissions, but had no effect on final examination scores. The effects of this procedure on completion rates have not, as of this time, been assessed. It is presumed that CALS will be a viable factor, particularly for identifiable subject matter area courses. (Author)

COMPUTER ASSISTED LESSON SERVICE AT USAFI: AN INTERIM REPORT

Clay V. Brittain, Deputy Director for Research and Evaluation, USAFI

Introduction

The United States Armed Forces Institute (USAFI) offers an extensive array of correspondence courses for personnel on active duty in the Army, Navy, Air Force, Marine Corps, or Coast Guard. The courses are at both the secondary and college levels and cover occupational as well as academic subjects. Last year there were about 84,000 correspondence enrollments in USAFI courses. Approximately 25,000 lessons are received monthly at USAFI.

The computer configuration at USAFI consists of an off-line mark sense reader and a second generation computer with an on-line printer. What has come to be known as the Computer Assisted Lesson Service (CALS) represents an attempt to exploit this rather limited computer capability in the grading and processing of lessons. The aim of CALS was twofold: (1) To save money. The grading of lessons by the computer proved to be considerably less expensive than grading by a human instructor.

(2) To improve service to the student. It was felt that two improvements in service could be realized through CALS:

a. Shorter lesson turnaround time.

b. More comprehensive feedback to the student.

In correspondence study, the long delay between lesson preparation and instructor response is a serious problem, especially for an institution whose students are scattered around the world. Through CALS, lessons are graded within one day of reception and mailed back to the student promptly. This compares with an in-house delay which might otherwise run to several days.

The paucity of instructor feedback to the student is also a problem in correspondence study. In grading lessons, it is usually not practical for the instructor to take the time necessary to write extensive comments on the paper. Sometimes when the instructor does write comments on the margin, the student has difficulty reading them. A crucial element in CALS is the consistent and well thought out instructor comments which are keyed to student responses. In adapting a course to CALS: (1) lesson assignments are converted to objective items--usually multiple choice, (2) instructor comments are developed on the basis of an analysis of probable student errors, and (3) a computer program is written for keying these comments to student response alternatives.

In the preparation of lesson assignments, the student uses answer sheets which can be machine scored. The computer printout returned to him contains a lesson grade and instructor comments appropriate to his responses. A few examples follow:

In an introductory course in refrigeration, an item on one lesson reads as follows:

What kind of tubing should be used inside a refrigerator cabinet?

(a) soft copper
(b) hard copper
(c) tinned soft copper
(d) tinned hard copper

The correct answer is (c) "tinned soft copper." If a student chooses alternative (a) "soft copper," the computer printout returned to him contains the following comment in relation to this item: "You are partially correct in that you indicate soft copper, but this is not the best answer. The tubing should be tinned soft copper. The main reason for tinning is ease of cleaning and appearance."

In a carpentry course, a lesson item reads as follows:

To lay out an ellipse for a pipe going through a roof, you must know:

(a) the slope of the roof
(b) the allowance required for air space around the pipe
(c) the height the pipe will extend above the roof
(d) both a and b

The correct answer is (d).

If a student selects (a), he is told: "This is partly correct. You must know the unit rise per foot of run of the roof but you must also know the allowance for air space around the pipe."

If he selects (b), he is told: "This is partly correct. You must know the allowance for the air space around the pipe but you also have to know the slope of the roof in terms of unit rise per foot." See page ____ of your textbook.

If he selects (c), he is told: "This is a wrong answer. Whether the pipe is to extend one foot or 10 feet above the roof makes no difference when laying out the ellipse in the roof."

If he selects (d), he is told: "Very good. This is the best answer."

In the refrigeration course, the following lesson item appears:

Which of the following statements is not considered to be one of the basic thermal laws?"

(a) Fluids absorb heat while changing from a liquid state to a vapor state, and give up heat in changing from a vapor to a liquid.

(b) The temperature at which a change of state occurs is constant during the change, but this temperature will vary with the pressure.

(c) Heat will flow only from a body at a higher temperature to a body at a lower temperature (hot to cold.)

(d) Refrigerants must be under a high pressure in order to evaporate easily and absorb heat.

The correct answer is (d). Comments keyed to each response are as follows:

(a) This is a basic thermal law. It takes heat to change water to steam, 970.4 BTU/LB at 212F. By the same token, when going from steam to water 970.4 BTU/LB at 212F is given off. Check page 24 in your textbook.

(b) This is a basic thermal law. For example, there is no change in temperature of ice when it melts at 32 F if the pressure remains constant. Melting ice keeps a temperature of 32 F until all the ice is melted. Check page 25 in your textbook.

(c) This is a basic thermal law. Stop and think about it and you will have to agree that heat flows only from hot to cold. If you want to add heat to an object, it is necessary to have a heat source in order for the object to warm. Check and review page 12 in your textbook.

(d) You are right, this is not one of the basic thermal laws. Refrigerants do not have to be under a high pressure to evaporate easily and absorb heat. In fact, the less pressure the easier it is for them to evaporate.

The following lesson item appears in a United States history course:

Opposition to immediate admission of Texas as a state in 1836 came primarily from

(a) Southern cotton-growers

(b) Western cattle-raisers

(c) whigs and abolitionists

(d) Southwestern farmers

(c) is the correct answer. The following comment is keyed to an incorrect response:

"While Southerners and Westerners generally favored the annexation of Texas in 1836, opposition came from Northeastern Whigs and abolitionists. Many eastern Whigs feared a war with Mexico if Texas were taken into the Union, and also were fearful that Texas as a state would enhance Southern political power to block legislation favorable to Northern economic interests. The abolitionists opposed annexation on the grounds it would bring in a new slave state and open the territories to slavery. (p. 275)"

In addition to the comments keyed to specific student responses, there are more general comments appropriate to the student's performance on the lesson. For the student who scores high on his first lesson, it might be: "You are off to a good start. Keep up the good work." The student with a low lesson grade might be offered words of encouragement and asked to resubmit the lesson.

Evaluation

The effectiveness of CALS is being assessed in terms of lesson volume, number of course completions, and student performance on the final examination. In terms of all three criteria, the results are generally favorable.

Sixteen USAFI courses have been adapted in their entirety to CALS. Another 14 courses have been adapted in part. Six of these 30 courses have been adapted to CALS so recently that no assessment has yet been done. Another 12 courses have been so extensively restructured as to make it difficult to assess the effects of CALS per se. In 11 of the remaining 12 CALS courses, increases in lesson submission rates have occurred.

One of the first courses adapted to CALS was a high school general mathematics course. For a period of several months, the CALS version of the course was issued randomly to one group of enrollees and the conventional version to another group. That is, if the enrollee's social security account number ended with an odd number he was issued the CALS version, otherwise he received the conventional version. Statistics on lesson submissions are as follows: (1) The mean number of lessons per student in the CALS group is about seven, as compared to five in the conventional group; (2) Sixty-three percent of the CALS

students have submitted one or more lessons as compared to 55 percent of the others, and (3) Fifteen percent of the CALS students, as compared to 8 percent of the others, have submitted all the lesson assignments in the course.

In terms of mean scores on the final examination for the course, the two groups were virtually identical--51.3 versus 51.1.

Somewhat similar data could be cited for other courses. The results, however, are not uniform across courses. The increase in lesson submissions associated with CALS has been substantially greater in some courses than others. The one course which has shown virtually no increase in lesson volume associated with CALS is an introductory accounting course. The CALS students in this course actually had lower start rates. That is, 70 percent of the students enrolled in the conventional course have submitted one or more lessons as compared to 64 percent of the CALS group. Moreover, the CALS students seem to have more difficulty with subsequent portions of the course.

The courses in which CALS has shown the most marked effects are three high school courses (an English course and two general mathematics courses) and two vocational-technical courses. An auto mechanics course and a refrigeration course have shown quite marked increases in lesson submissions following their adaptation to CALS.

How are these effects of CALS to be accounted for? The increase in lesson submissions seems likely to be due to one or more of the following: (1) the multiple-choice format of lesson assignments, (2) the more prompt return of lessons processed through CALS, (3) the greater feedback to the students,

and (4) the novelty of CALS. Earlier studies at USAFI have shown that converting lesson assignments to multiple-choice items does in itself result in increased lesson submissions. We have not yet been able to assess the effects of the other factors.

Student Reactions

In addition to the analysis of data on lesson submissions and examination scores, we have also surveyed student reactions to CALS. Several months ago, questionnaires were sent to students in four courses--two general mathematics courses, a criminology course, and a refrigeration course. Reactions were somewhat mixed. In response to the statement "Computer printed comments on CALS lessons are helpful and to the point," 75 percent or more of the students in all four courses either agreed or strongly agreed. But the statement "Computer printed comments are more helpful than instructor written comments," got agreement from only 12 percent of the criminology students, 25 percent of the general math students, and 40 percent of the refrigeration students. The item "CALS is another step toward depersonalized instruction," got 50 percent agreement among refrigeration students, 60 percent agreement by general math students, and better than 70 percent agreement by criminology students. Generally, as these data suggest, students in the criminology course were less favorably disposed toward CALS than were the students in the other courses.

Summary

In summary, the effort to improve instructional services to the correspondence student through utilization of a rather limited computer capability has met with at least limited success. While the results are not unmixed, they do indicate that some improvement in instructional effectiveness has been realized through CALS.