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ABSTRACT

Recent studies have demonstrated that computer based training programs which incorporate adaptive branching are superior to fixed sequence programs that require each student to see and respond to every training frame. A study was therefore devised to investigate two different ways to control such branching (student controlled or program controlled) and also to test the effects of remediation using a no-remediation control group. Subjects were 108 trainees in a basic Naval electronics course, each of whom participated in 11 lessons (one half were subject and the other program controlled branching), responded to a questionnaire assessing attitudes about the branching modes and about remediation, and completed a final examination. Results showed no significant differences between branching conditions or remediation conditions for training time or final examination performance. However, because students preferred student controlled training and because these lessons are simpler to prepare, it was concluded that the student controlled CAI training materials should be developed and used wherever possible. (Author/SH)

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RESEARCH REPORT SRR 73-19 APRIL 1973

POST LESSON REMEDIATION AND STUDENT CONTROL OF BRANCHING IN COMPUTER BASED TRAINING

GEORGE F. LAHEY
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PATRICK H. McCANN

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POST LESSON REMEDIATION AND STUDENT CONTROL OF BRANCHING IN COMPUTER BASED TRAINING

by

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Navy Training Research Laboratory
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San Diego, California 92152

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SUMMARY AND CONCLUSIONS

Problem

The goals of this research were: (1) to determine whether students prefer a CAI training mode in which they select their own training materials, or one in which their training materials are selected for them; and (2) to evaluate the effectiveness of post lesson remediation as a training paradigm.

Background

Recent research using CAI materials showed that students free to select their own training materials did as well on final examinations as students for whom CAI training materials were programmed on the basis of pretest questions. The CAI research did not have control conditions to determine: (1) whether students preferred the student controlled or the program controlled training mode, or (2) whether post lesson remediation had improved final examination scores. This research was directed at answering these questions.

Approach

CAI training materials relating to AC series circuit analysis were prepared so that students individually selected their own training materials in half of the lessons and program logics controlled the selection of training materials in the other half of the lessons. Students failing to pass lesson tests were subject to post lesson remediation. Remediation was presented to one group of students on a student controlled basis and to another group on a program controlled basis. A control group received no post lesson remediation. A total of 108 students participated in the study. Each student was required to complete the 11 lessons prepared for CAI presentation before completing a questionnaire which assessed his attitude about the training and remediation conditions. Upon completion of the CAI training and questionnaire, the BE/E School final examination was administered to each student.

Findings and Conclusions

There were no significant differences in training time or final examination performance as a result of the experimental conditions. Students did just as well in lessons where they selected training as in lessons where selection was program controlled. Students in the no-remediation control group did just as well as students taking remediation. Because students preferred the student controlled training and because CAI lesson materials developed under this design are simpler to prepare than lessons which employ program controlled strategies, it was concluded that the student controlled CAI training materials should be developed and used whenever possible. It was also concluded that post lesson remediation is ineffective in improving final test performance. Alternate remediation strategies are discussed.

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ACKNOWLEDGEMENTS

The research described herein would not have been possible without the support of the Basic Electricity/Electronics School, Service School Command, San Diego, who furnished students, housed the equipment, and provided the basic materials from which the CAI materials were developed. We are also indebted to B. E. Ellis, J. A. Fey, EMCS, USN, P. S. Fredericks, and W. A. King, who developed a number of the lessons used and served as proctors during the experiment; and to W. L. Sarati, A. Sassano, and B. S. Whitehill for operational support.

POST LESSON REMEDIATION AND STUDENT CONTROL OF BRANCHING IN COMPUTER BASED TRAINING

I. Introduction

Recent studies (Slough, Ellis, & Lahey, 1972; Hurlock, 1972) have demonstrated that computer based training programs which incorporate adaptive branching are superior to fixed sequence programs that require each student to see and respond to every training frame. The question that remains unanswered is what is the best way to control branching.

Adaptive branching may be accomplished by program controlled branching, in which the student's ability to skip training is controlled by his performance in prior frames, or by student controlled branching, in which the student has a choice of taking or skipping training. Slough, Ellis & Lahey (1972) report on double criterion branching, a combination of program controlled and student controlled branching, in which the student controlled the branching only after first passing a criterion test. Each method of branching control would seem to have advantages: program controlled branching should keep unmotivated students from skipping; student controlled branching should avoid the monotony of performance testing, and result in an overall time saving for abler students. When McCann, Lahey and Hurlock (1973) tested students under program controlled vs. student controlled conditions, they found no difference in performance. Students allowed a free choice of training materials did just as well as those taken through the training under program control.

The McCann experiment also tested the preorganizanizing effect of reading a narrative before taking the CAI training. Half of the students in each training group (program controlled and student controlled) read a brief narrative which had "stand-alone" capability, i.e., contained all the information essential to acquire the desired terminal behaviors. Neither training time nor test performance differed for the narrative and non-narrative students, and there was no training-by-narrative interaction. Because each student received only one training condition, it was not possible to determine attitudes or preferences for student controlled and program controlled training.

The training materials used for the McCann, Lahey, Hurlock (1972) experiment included program controlled remediation sequences after each lesson test. These sequences where designed to remediate students who failed the lesson test. The remediation training was expected to cut down the number of failures in the course. The study did not have a design which allowed for evaluating the remediation condition.

The current experiment was designed to gather data on student preference for student controlled and program controlled training modes and to test the effects of remediation using a no-remediation control group.

II. Method

A. Subjects

The subjects were trainees assigned to the Basic Electricity and Electronics (BE/E) School, Naval Training Center, San Diego. A total of 108 students participated in the study.

B. Apparatus

The lesson materials were presented using an IBM 1500 Instructional System. Students were seated at individual carrels in booths designed to minimize the effects of distracting stimuli. Each carrel included a CRT display with attached typewriter keyboard and light pen, and a random access image projector (See Figure 1). There were 12 to 14 carrels available daily for student use.

C. CAI Training Materials

The CAI training materials consisted of 11 lessons on AC series circuit analysis, designed to provide training compatible with that of Module 12 of the Basic Electricity and Electronics Individualized Learning Systems (BEEINLES) materials currently being used by the BE/E School. These same materials had been used earlier for the McCann, Lahey, & Hurlock (1973) experiment.

Except for Lessons 1 and 2, each lesson was prepared to provide a student controlled mode in which each student could select training on only those lesson objectives he wanted to take, or a program controlled mode in which the student skipped training on a particular training objective only if he successfully answered a criterion question. Program controlled students who failed to pass the criterion question went immediately through the training sequence for the tested lesson objective before going on to the next pretest question. Program controlled students could not retake a lesson objective training sequence, nor go back to one they had skipped. Student controlled mode students, on the other hand, could elect to retake any objective training sequence or go back to one they'd skipped before starting the lesson test which concluded each lesson.

Lesson test score criteria controlled whether individual students got remediation for a particular lesson. Students whose scores exceeded the criterion went on to the next lesson. Students who failed to meet the criterion were given feedback on their test errors and immediately branched to the lesson remedial segment.

Lesson remediation sequences were scheduled to provide training related only to those objectives missed during the lesson test. There were three remediation conditions for each training condition (see Experimental Design). Students in the student controlled remediation condition were presented with an index of the particular lesson objectives on which they had failed. They could select or skip the scheduled remediation. They were also free to repeat remediation sequences. Students assigned to the

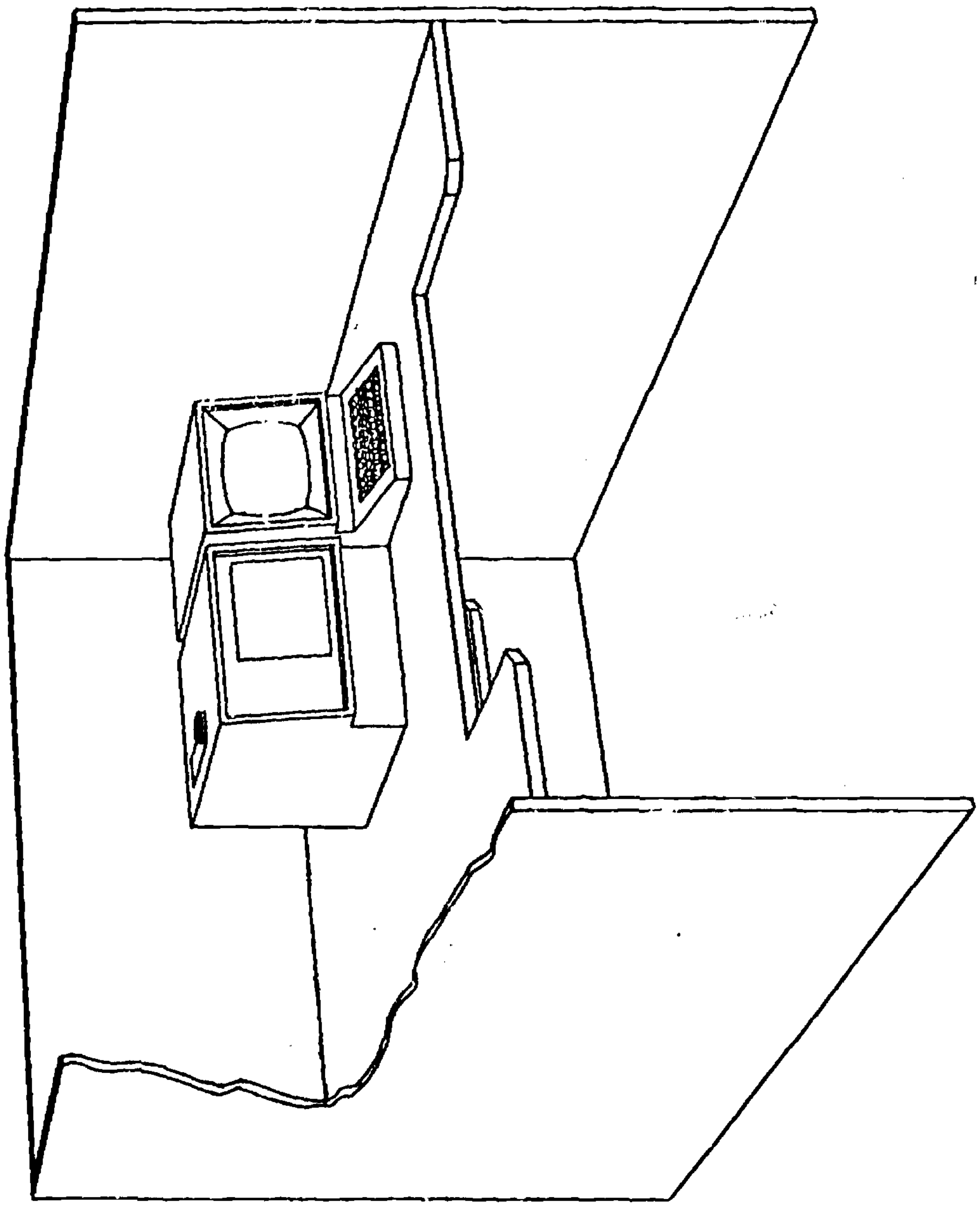

Figure 1. Student carrel

program controlled remediation condition were forced through all applicable remediation training. Following remediation, each student took a remediation test. Students assigned to the remediation control group were given no remediation and went directly to the remediation test. After completing the remediation test, students proceeded to the next lesson.

It should be pointed out that the remediation sequences scheduled after the lesson tests were not the only remediations available to the student. Within lesson remediation was also provided.

It has been standard practice for instructional designers preparing lessons for this project to include remedial sequences reached by adaptive branching techniques within lessons. Thus, the student who made errors was usually (1) told that he had erred, and (2) branched to a retry sequence or remediational sequence, the latter varying in length from one to several frames related to the type of error the student had made. Often the remediation would be based on the student's having made the same or a similar error previously. All within lesson remediation was left intact for this experiment.

D. Off line Reference Materials

Each student was given an introductory instruction memo (Appendix A) and a study guide upon arriving at the test facility. In addition, each student had a narrative booklet available at his carrel with separate sections covering each CAI lesson. Each lesson narrative was capable of providing "stand-alone" training, i.e., bright students could use the narrative to learn sufficient terminal behaviors to meet all lesson training objectives. However, all students were advised to read through the narrative primarily to get acquainted with the materials (see the Introductory Memo, Appendix A). Comparable pages from the study guide and the narrative are presented in Appendix B. (For a discussion of the preparation and use of study guides see Ford and Slough, 1970; and Hurlock, 1971.)

E. Experimental Design

Students were assigned to one of two lesson treatment groups and to one of three lesson remediation groups, using systematic randomization to obtain equal *n*'s in each treatment condition. Students in one lesson group, Group I, took odd-numbered lessons starting with Lesson 3 under program control and even-numbered lessons under student control. Group II received the training strategies in reverse order, to provide a counter-balancing design across lessons. Lessons 1 and 2 were the same for all students.

Within each training treatment group, one-third of the students were assigned to receive the program controlled remediation treatment, one-third were assigned to the student controlled remediation treatment, and one-third were assigned to a no remediation control group. The design is presented in Table 1.

TABLE 1

Experimental Design

Training Method	Remediation Treatment		
	Student Control	Program Control	No Remediation
Group I (n = 54)	18*	18*	18*
Group II (n = 54)	18*	18*	18*

*n for each cell dependent on individual lesson test performance.

F. Procedure

As each student reported to the CAI room, he was assigned to a carrel, then signed on to an introductory CAI lesson which taught him how to use the light pen and the typewriter keyboard. It also acquainted him with the general format of the lessons, the use of the image projector, and the administration of lesson tests. He then proceeded through the training materials at his own pace. Carrels were available to the students for approximately five hours per day, weekdays only.

After completion of each lesson test and lesson remediation test, students were advised to take a 10 minute break before proceeding with the next lesson.

Upon concluding all 11 CAI lessons, and before taking his final examination, each student was asked to complete a CAI questionnaire (Appendix A). Students were then allowed to study their off line reference materials briefly before taking the final examination. The final examination was the same examination as is given in BE/E School.

III. Results

All data were analyzed using a 2 x 3 analysis of covariance. The data analyzed were: time to complete each individual lesson, lesson test score, time to complete each remediation test, remediation test score, total training time, grand lesson score, final examination test score and total course hours attended. For the purposes of the analyses, total training time was taken to be the sum of the times spent on the 11 CAI lessons and lesson tests, and grand lesson score was the percent of correct answers given during all 11 lesson tests.

The lesson and remediation data were obtained from computer printouts. Overall data (times and final examination scores) were recorded by course

proctors. The covariants used in the analyses were (1) time required to complete the preceeding BEEINLES modules (Modules 1 through 11) in BE/E School prior to CAI training, and (2) mean module score on the final examinations for the proceeding BEEINLES modules.

A. CAI Module Performance

There were no significant differences in CAI module performance due to either lesson training conditions or lesson remediation conditions. The remediation control groups did just as well as the experimental groups. The CAI module performance data are summarized in Table 2, pooling the data for Groups I and II.

TABLE 2

Mean Module Performance

Measures	Remediation Conditions					
	Student Controlled		Program Controlled		Control	
	Mean	SD	Mean	SD	Mean	SD
Grand Lesson score (%)	84.2	10.0	82.1	9.5	81.5	7.9
Final exam score	85.0	10.8	82.4	10.9	80.0	12.6
Total training time (hrs: min)	10:02	2:24	9:45	2:36	10:25	3:02
Course hours attended (hrs: min)	15:40	4:04	15:29	3:35	15:21	3:48
Students with final exam score < 80%	8	---	11	---	13	---

The failure rate (final exam score < 80%) on this experiment was slightly higher than was expected. During tryouts and revisions to these training materials approximately 25% of the students failed to reach the 80% correct criterion on their first attempt to pass the final examination. During this experiment the rate was 30%. The difference from the expected figure was however not significant ($\chi^2 = 3.11$, $\underline{df} = 2$, $p > 0.25$).

Examining this data further: out of the 69 students who were scheduled for remediation on fewer than 6 lessons, only 8 students failed. Among the 39 students scheduled for remediation on 6 or more lessons, 24 students failed. Among the 35 students who were scheduled for remediation on 6, 7, 8, or 9 lessons, 6 out of 13 in the student controlled condition, 5 out of 8 in the program controlled condition, and 9 out of 17 in the no remediation

or control condition failed. Adjusting this data for sample size, there is no significant difference in failure rate under the three conditions (χ^2 = .85, df = 2, p > .50). The failure rate data thus substantiate the absence of effect noted in the performance data.

A high positive correlation (r = .96, df = 10, p < .001) existed between the number of lessons on which remediation was scheduled and failure to score above 80% correct on the final examination. This relationship is diagramed in Figure 2. The mean number of remediation segments scheduled for successful students (n = 76) was 3.5, versus 6.9 for the unsuccessful students (n = 32). The difference was significant at the .001 level (F = 45.6, df = 1/106).

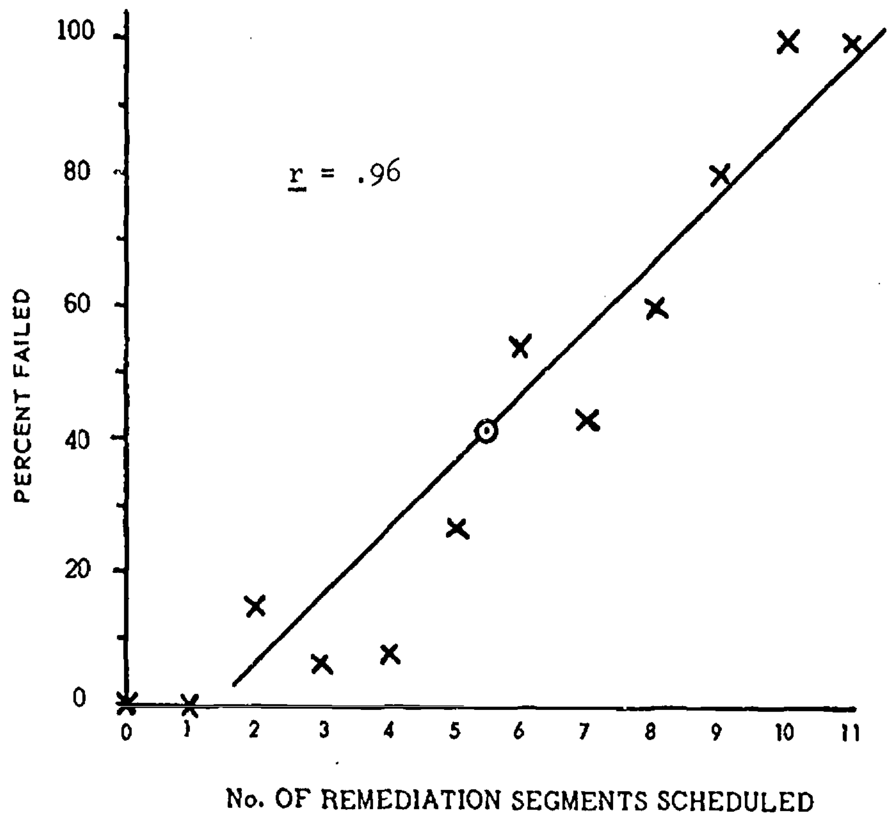

Figure 2. Final examination failure rate as a function of remediation segments scheduled.

A difference was also found between successful and unsuccessful students in the number of responses made during training. The mean number of training responses was 720 for the successful students, 862 for the unsuccessful students. The difference was significant at the .001 level (F = 27.6, df = 1/106).

The mean times taken to complete training were almost the same for successful and unsuccessful students (see Figure 3). The mean training time was 9 hours 51 minutes for successful students, 10 hours 23 minutes for unsuccessful students ($p > .25$). However, among the successful students, 54% finished their training in less than 10 hours, while only 44% of the unsuccessful students did so. The difference is primarily attributable to the fact that 16% of the successful students finished in less than 7 hours, whereas only 9% of the unsuccessful students did so. Interestingly, while 17% of the successful students took longer than 13 hours, only 6% of the unsuccessful students did so.

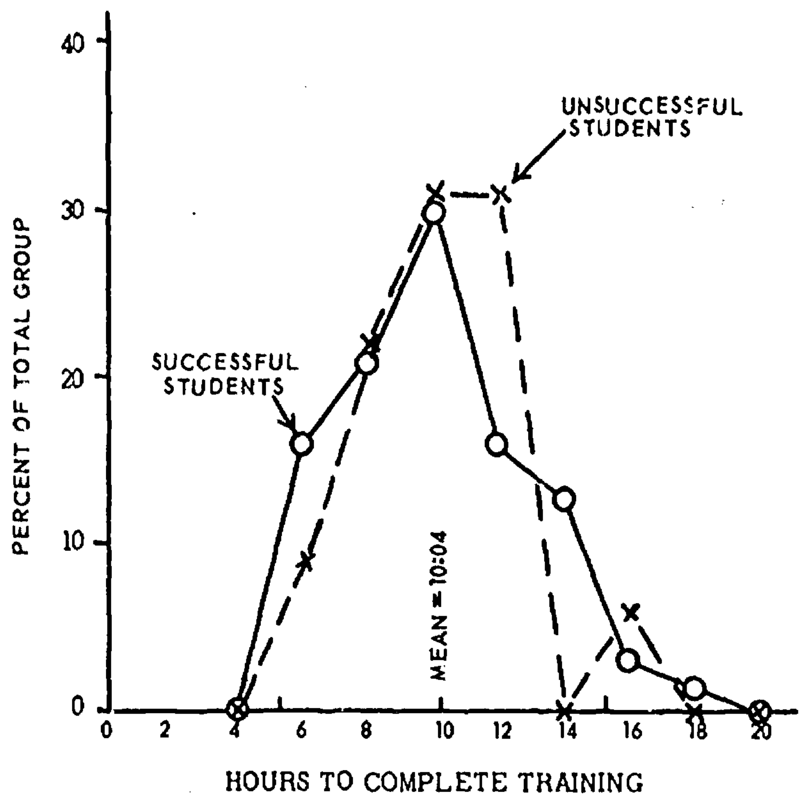

Figure 3. Proportion of students completing training in specified times.

The mean rate at which successful students responded during training was found to be significantly slower than the mean rate at which unsuccessful students responded. The means were 1.27 and 1.49 responses per minute, respectively, yielding an $F = 8.8$, $df = 1/106$, $p < .01$. The range for the successful students was from .69 to 2.25 responses per minute. The range for the unsuccessful students was from .81 to 2.13 responses per minute.

During the experiment, students were observed to be working under an unseemly amount of time pressure. Many students complained initially that they were being delayed by being assigned to the CAI training, in spite of being told by the proctors that the CAI module would take no longer than the BEEINLES module (a fact available from earlier data).

B. Lesson Performance

Differences in performance on individual lessons as a result of the treatment variables were minor. Students in Group I finished Lesson 3 (program controlled) and Lesson 6 (student controlled) significantly faster than their peers in Group II, $F = 5.5$, $df = 1/100$, $p < .05$, and $F = 11.3$, $df = 1/100$, $p < .01$, respectively. However, they took longer to complete Lesson 11 (program controlled) $F = 5.6$, $df = 1/100$, $p = .05$. There was not a consistent pattern of performance. There were no significant differences in lesson test scores.

C. Remediation Performance

The number of students taking remediation varied between lessons and between treatment conditions. In the student controlled condition, 28 students were scheduled for remediation on a total of 148 lessons. In the program controlled condition, 33 students were scheduled for remediation on a total of 151 lessons. In the control group, 35 students missed lesson objectives on a total of 185 lessons. Twelve students passed all of the lesson test criteria and took no remediation. The mean number of remediations scheduled per student was 5 and did not differ between the remediation conditions.

The mean total time spent in remediation for all students was 84 minutes (range 5 to 912 minutes). The mean remediation test time was 9 minutes (range from 1 to 68 minutes).

The remediation test scores varied from 0 to 100%, the overall mean being 71%. There were no differences in remediation test scores due to the remediation conditions.

D. Power

The basic data do not show evidence of any differences in performance due to the lesson training modes or remediation training modes, at either the .01 or .05 level of significance. However, the power of the tests of remediation performance ($1-\beta$) was quite low. The power of the test of final examination scores, assuming we would wish to detect a difference in the scores of 5% due to the remediation conditions, was less than 0.33. The power of the test of total training time, assuming we would wish to detect a difference of 90 minutes, was less than 0.40.

E. Correlations

In the McCann, Lahey, & Hurlock (1972) experiment the performance of students on the CAI materials had been found to be highly correlated with the time to complete previous BE/E School modules, and with BE/E School examination scores. These variables were therefore selected as covariants for the analyses conducted in the present study.

The time the student had taken to complete previous BE/E School training (previous hours attended, PHAT) proved to be highly correlated with total time spent in CAI training, $r = .48$, and with CAI hours attended, $r = .54$. The mean module score obtained on BE/E School modules (PRS) was highly correlated with CAI grand lesson score, $r = .58$, and with final examination score, $r = .59$.

Data on the predictive value of the Electronic Technician Selection Test (ETST), General Capability Test (GCT), and Arithmetic Test (ARI) administered prior to entry into BE/E School were included in the analysis. The ARI was generally a better predictor than the others for predicting lesson performance and emphasized the importance of arithmetic to this theory-oriented course. The ETST was the best predictor of final examination score (.46 vs .43 for the ARI and .39 for the GCT), while ARI was also the better predictor of the course hours attended (-.53 vs -.40 for the ETST and -.45 for the GCT).

The correlational analysis confirmed findings of earlier reports (Ford and Slough, 1970; McCann, Lahey, & Hurlock, 1972) that time spent in training is not a useful measure of how well the student will perform. The time spent in training apparently does not correlate with success or failure, either as to individual lessons or overall measures (median $r < .10$).

F. Questionnaire

The student questionnaire (Appendix A) included items intended to explore the student's feelings about CAI, plus items which tested his awareness. One student failed to complete a questionnaire. The basic results for the other 107 students were as follows:

1. 79% of the students rated CAI "above average" or "outstanding."

2. Students chose student controlled over program controlled training by a ratio of 4:1, independent of how they rated CAI.

IV. Discussion

This study exposed students to both student controlled and program controlled selection of training materials. When students were then asked which method they preferred, four out of five chose the student controlled training over program controlled training. However, the fact they preferred the student controlled mode apparently did not cause any difference in training efficiency. As in an earlier experiment (McCann, Lahey, & Hurlock, 1972) no differences were found between the performance of students taking training under the two training conditions.

The finding that student control was as effective as program control may have implications beyond the selection of training sequences. If it is logical to ask, "Do you want training on this objective?", it is also logical to ask, "Do you want another practice problem?", or, "Do you want more help with

this kind of problem?" This experiment suggests then that the student can successfully act as his own mentor throughout the lesson that instructional designers can let the student, rather than the computer program logic, keep track of and control lesson progress.

The use of student controlled training has two desirable features: (1) the student participates actively in the training process, and (2) the instructional designer avoids the necessity of writing pretest frames, deciding upon performance criteria to determine branching, and devising extensive branching sequences. The designer can then concentrate on his major responsibility, the production of effective training sequences.

This study also addressed the question of whether remediation which followed the lesson test could improve final examination performance. Three treatment conditions were used; student controlled, program controlled, and a control group which got no remediation. In each treatment condition, the number of students scheduled for remediation was a variable dependent on the scores obtained by individuals during lesson tests. Analysis and evaluation of final examination scores seems to indicate that remediation which follows a lesson test does not affect performance. Control students who did not receive remediation did as well on individual lessons and the final examination as those who got remediation. Scheduling may be a critical variable in remediation training, e.g., remediation after a group of lessons or at the end of training may improve final examination performance. Future research should address this question.

Time was an important variable in this experiment. As noted in the module performance paragraphs of the results section, the students were operating under a considerable amount of time pressure. The experimenters were also operating under pressure due to pending system changes which limited the number of students available during the experiment and made it impossible to pretest the training efficiency of the remediation sequences. However, an opportunity to examine student data trails had been provided during the tryouts and the earlier use of the remediation training (McCann, et al, 1972), so that instructional designers were able to examine the errors made by students on those occasions and upgrade the material accordingly. From the data thus provided, the instructional designers felt that the remedial sequences were at least as good as the basic lesson materials for training purposes.

Because the number of students available was low, the power of the tests of remedial performance was also quite low, 0.33 for the final examination scores and 0.40 for the total training time. Thus, there is some possibility of making a Type II error by concluding that there was no difference in the remediation conditions. This possibility may be offset somewhat by the high relationship ($\underline{r}$ = .96) between the failure rate and the number of remediations scheduled for individual students which indicates that remediation did not improve performance.

The initial student reaction to participating in this experiment was varied. While some students were eager for the new experience, most students showed concern over the possibility of falling behind their BE/E

School classmates and appeared to have negative attitudes towards CAI upon arrival. Some students did not modify their initial reaction sufficiently to participate fully. Several students complained continuously about any momentary delay. It therefore surprised the experimenters to find that: (1) after finishing the module, the students rated CAI highly favorably; (2) 80% reported they thought they learned as fast or faster than when using BEEINLES materials; and (3) most students indicated a preference for CAI over BEEINLES. In the face of the pressures they were under and considering their previous experience with the BEEINLESS materials, this speaks well for CAI acceptability and offers an interesting comparison with a non-computer based, individualized self-instructional training system.

The response rate data obtained during this experiment suggest a difference in style between successful and unsuccessful students. As a group, the 32 unsuccessful students responded significantly faster than their successful counterparts, 1.49 responses/minute compared to 1.27 responses/minute. During training, they made a greater number of responses, 862 vs. 720, during almost the same length of time, 10 hours 23 minutes vs. 9 hours 51 minutes. Individually, however, these differences dissappeared by the end of training. The response rates for successful students (.69 to 2.25 responses/minute) overlap the rates for unsuccessful students (.81 to 2.13 responses/minute). An unsuccessful student who made 696 training responses in 5 hours responded at about the same rate as a successful student who made 671 training responses in 4 hours 50 minutes. He made a final examination score of 50%; the other made a score of 87%. Thus, while the mechanics of responding do not in themselves yield an answer to style, there would seem to be something worth researching in the variation of the success/failure groups during CAI training.

V. Conclusion

Student controlled choice of CAI training seems clearly preferable to program control. The results of this experiment suggest that it is at least as good as program controlled selection of materials as a training rationale, and is highly preferred by students. As Mager (1961 & 1963) pointed out, students learn better when they take a positive hand in selecting training materials. As has been stated earlier, student controlled choice rationales greatly simplify the presentation of tutorial CAI programs. Research to provide choices as free as those used by Mager would seem to be a worthwhile next CAI project.

It would further appear that remediation which follows immediately after a lesson test is ineffective. Alternative approaches such as remediation at the end of a group of lessons should be researched. The indications of this report are that providing remedial training immediately after a lesson test will not improve student performance. How and when to provide remediation merits additional research.

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Appendix A

Introductory Memo and
Student Questionnaire

ERIC
Full Text Provided by ERIC

CAI Student # ______

Name ______________

Date ______________

Introduction to CAI Module 12

1. CAI training is an experience which we hope you will enjoy. The Navy is interested in it as a way to let students set their own pace and get highly individualized instruction.

Note: The instruction you are about to receive has been worked out over a period of roughly two years. You will find it to be as good as the best classroom instruction, and comparable to BEEINLES.

2. You can expect some differences in the way you learn using CAI. Don't take notes. Do try to establish a comfortable pace. You will do best if you go ahead at a pace which makes you feel at ease. Your best strategy is to answer each question as soon as you think you know the answer. (Incidentally, do check your arithmetic carefully before you insert answers which require calculations. It doesn't help if you know the answer but blow the arithmetic!)

3. You should take roughly 2 to 4 days to complete this module (12 to 18 classroom hours). Classroom hours for morning students are 0645 to 1150, for afternoon students 1200 to 1700. Please try to be at your terminal promptly as each day begins.

4. The CAI course consists of 11 lessons. Each lesson concludes with a brief test. Errors you make on these tests will be pointed out to you, and you'll be told what the proper answers were. You will receive additional training at the end of the lesson if it looks like you need it. After "retraining" you will be given a brief retest.

5. The green loose-leaf binder placed at your carrel contains lesson narratives for Lessons 3 through 11. Be sure to read them through when you are told to do so in each of these lessons. The narrative is designed to acquaint you with the lesson material. You should read it through once, carefully, then go on with the CAI lesson. Don't attempt to memorize what's in the narrative or your study guide. All the material you will need to learn is presented thoroughly in each CAI lesson. (Please do not remove the narrative booklet from your carrel.)

6. The Study Guide attached to this memo is yours to keep. It is a substitute for your BEEINLES materials for this module. Use it to keep track of your progress and for reference as you need it. If you need to study at home, use the study guide rather than your BEEINLES or other materials. Be sure to refer to the study guide during lessons when told to do so.

7. The format of alternate lessons in this experiment is slightly different. In some lessons you will have an option to elect training on the lesson objectives. In others you will not. Try to do just as well in both types of lessons. When you are offered an option, be sure you read the description of the lesson objectives in your study guide <u>before</u> you make your choice to receive or not receive training on that objective.

8. About breaks - Take them. CAI is tiring. After 50 minutes or an hour, your reactions will be slowing. Take a <u>10 minute</u> break about every hour, usually at the end of a lesson where "break" frames are located. You'll feel refreshed <u>and</u> you'll get through the lessons both easier and faster. Five hours with four breaks is a cinch. Five hours without breaks can be a grind. A coffee mess and candy machines are available.

9. Proctors will be available to assist you at all times if you need them. Usually the computer can straighten out any problems you may have if you just keep going. But if you get bogged down and need help, call the proctor.

10. After you have completed all of the lessons, you will be given two paper and pencil tests which wind up the module. The first test is an area test which tests limited portions of the module. The second test is the module test for Module 12. Your score on the module test will be reported to your BEEINLES learning instructor. It is the only <u>official</u> test. The other tests, lesson and area, are like progress checks.

11. Your CAI student number is used to control your progress through the lessons. Be sure to use it when you are signed on to start the lessons. Initially, you will also be assigned to a particular CRT terminal. Use it through the lessons unless the proctor has to move you for some reason.

12. The first lesson in the Module will tell you how to use the computer. Each terminal has an image projector and a CRT terminal for output, and a typewriter keyboard and light pen for input. Don't worry if you're not a typist. The hunt and peck system is all you'll ever need.

13. Okay - that's it. When you're ready to start, tap the space bar on your typewriter keyboard, and have at it. Good luck!

Date ______________

CAI Student # ______

Student Questionnaire - CAI Instruction

Please consider each question carefully!

1. How do you rate CAI training?

   poor _____ fair _____ average _____ above average _____

   outstanding _____.

2. In this experiment, some students went through each lesson under program control (no option), some were offered options to select or skip lesson objectives, others got a mixture of lessons which had no options and lessons which had options. Which group were you in?

   no option _____ student option _____ mixture _____

3. If you had to take all training on an option or no option basis only, which would you prefer?

   option _____ no option _____

4. In this experiment, some students had additional training after the lesson test under program control (no options), some went through as they chose (student option), and some were retested as soon as they had gotten feedback after the lesson test. Which group were you in?

   no option _____ student option _____ test/retest _____

5. If you were now given a choice as to how you took remediation after the self test, which way would you chose?

   option _____ no option _____ test/retest _____

6. In the lesson tests, would you rather have had all multiple choice questions or all "fill-in" questions?

   multiple choice _____ Why? faster _____

   fill-in _____ easier _____

   mixture _____ better test _____

   more interesting _____

7. During the lessons, you were sometimes asked if you wanted practice or review. Did you like this? Liked it _____ disliked it _____. Would you have preferred to have the computer decide for you? Wanted computer to decide _____ wanted more choices _____.

8. How much help was the Study Guide?

none _____ not enough _____ fair _____ lots _____

9. How much did the narrative help you get through the lesson?

none _____ some _____ quite a bit _____ a lot _____

10. How often did you refer to the narrative or study guide on your own (when you were not specifically directed to do so)?

never _____ some _____ often _____ all the time _____

11. Did you learn faster using CAI than you would have in BEINLES?

no _____ not sure _____ think so _____ yes _____

12. In all likelihood, future training will be accomplished on a mixed media basis (some classroom, some instruction using materials like BEEINLES, some CAI). Please indicate the proportions of each you would prefer.

classroom _____% BEEINLES _____% CAI _____%

13. What did you like least about CAI?

____

____

____

14. What did you like most about CAI?

____

____

____

15. What would you change about CAI if you could?

____

____

____

Use back of page for any additional remarks you'd like to make.

Appendix B

Sample Pages from
Study Guide and Narrative

CAI Experimental Course
Lesson J (SC-9)

Related Coures:
BEEP School, Module 12

STUDY GUIDE - LESSON J

VARIATIONAL ANALYSIS FOR POWER

OVERVIEW

This lesson is an application of what you already know about power. Your main task here is to determine how the circuit variables of frequency, inductance (or capacitance), applied voltage, and resistance affect apparent and true power, the circuit phase angle, and the power factor. The following table summarizes the relationships between these quantities:

↑ Increase ↓ Decrease → No Change

	IF:	F↑ RL	F↑ RC	L ↑	C ↑	R ↑	E_a ↑
THEN:	P_a	↓	↑	↓	↑	↓	↑
	P_t	↓	↑	↓	↑	↓	↑
	θ	↑	↓	↑	↓	↓	→
	P.F.	↓	↑	↓	↑	↑	→

OBJECTIVES

Objective A

When frequency (f) in an RL circuit is changed, identify the corresponding change in the following: P_t, P_a power factor (P.F.), and circuit phase angle (θ).

Objective B

When inductance (L) in an RL circuit is changed, identify the accompanying change in: P_t, P_a, P.F., and θ.

Objective C

When resistance (R) in an RL circuit is changed, identify the changes in: P_t, P_a, P.F., and θ.

CAI Experimental Course
Lesson J (SC-9)

Related Course:
BEEP School, Module 12

NARRATIVE

LESSON J

VARIATIONAL ANALYSIS FOR POWER

What Happens to P_t and P_a in a Series RL Circuit

Increasing Frequency

After determining what happens to I_T, it is a simple matter to skip ahead to true power and apparent power and see how they change with an increase in frequency. Because the formula for true power is $P_t = I^2R$, if I decreases, true power decreases.

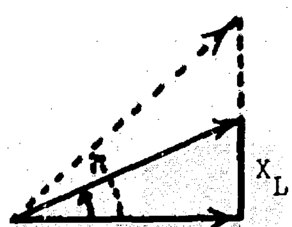
Similarly, by the formula $P_a = E_a \times I$ and $P_a = I^2Z_t$ if current decreases, apparent power decreases.

A rule to remember in analyzing a series RL circuit is that whatever I does - increase or decrease - P_a also does.

	f↑
Z_T	↑
X_L	↑
I_T	↓
P_t	↓
P_a	↓
θ	
P.F.	

What Happens to θ and P.F.

The best way to see what happens to θ is to look at the impedance triangle.



Observe that as X_L increases, θ increases.

Whatever θ does, power factor does the opposite; therefore, P.F. decreases. This is quite understandable when you consider the formula $P.F. = \frac{P_t}{P_a}$.

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13. ABSTRACT

CAI training materials were prepared so that students took lessons on AC series circuit analysis alternatively in a student controlled and a program controlled mode. The performance of students taking each mode was compared to that of students taking the opposite mode. The effectiveness of remediation sequences which immediately followed individual lesson tests was also evaluated. Upon completion of training students were asked which training mode they preferred. They chose student controlled over program controlled training by a ratio of 4:1, in spite of there being no significant difference in performance in the two modes. It was concluded that student controlled CAI materials are a preferable alternative to program controlled materials, both because they are simpler to prepare. It was also concluded that remediation which follows immediately after failure to meet a reasonably high criterion (80% correct) on a lesson test is ineffective.

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