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SOME EFFECTS OF THE APPLICATION OF COMPUTER ASSISTED MASTERY LEARNING TECHNIQUES ON BLACK COLLEGE STUDENTS

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The use of the computer to complement existing instructional programs is now almost common-place among American colleges and universities (Lippert, 1971). Technical developments in computer assisted instruction (CAI) have demonstrated a great potential for large scale individualized instructional support for which the time-shared computer is uniquely suited (Lekan, 1971).

However, progress in writing instructional programs under CAI systems has not kept pace with technical developments (DeCecco, 1968). In particular, research concerned with the instruction of Black or other minority students is lacking, although research efforts have been directed toward programmed instruction and mastery learning.

Serious exploration of CAI and its ramifications as a tool of instruction for Black college students is virtually non-existent. Some first steps in this direction have been taken at Howard University (OCS, 1971, 1973). A review of CAI research activities at other universities across the country does not support a promise of strong CAI research activity involving Blacks outside of the Black campus (Lekan, 1971).

Research on the two principal approaches to programmed instruction and, in particular, on their relative validity has been conducted. Coulson and Silberman (1959) reported that when the performance of junior college students using the Holland-Skinner constructed response programmed instruction technique was compared with their performance using the Crowder multiple choice technique, no significant difference in post test scores was found. Evans, in 1960, during his experiment with symbolic logic (Fry, 1963), and Roe, also, in 1960, while teaching probability to engineering students with these two principal programmed instruction types both found no significant difference in post test scores. In a fourth study, however, Fry in 1960, teaching Spanish words and phrases to high school students, found a significant difference in favor of students using a constructed response program over those using multiple choice items (Fry, 1963). But, when a multiple choice type of post test was used, the difference was not significant. Thus, it appears that the two types of programmed instruction do not significantly differ in effectiveness.

During an investigation of a strategy for mastery learning, Bloom found that 90 percent of the students achieved mastery of given material when instruction was made appropraite to the

characteristics and needs of each student (Bloom, 1968a). This study utilized frequent detailed evaluations and diagnostic techniques as well as prescriptive feedback within its operating procedures. The study was supported by the earlier work of Carroll in 1963 on whose classic model strategy for mastery learning Bloom's work was based (Bloom, 1968b).

An overview of these investigations suggested the query: How might a computer assisted mastery learning strategy affect the performance of Black college students? More precisely, how might a mastery learning strategy within a given discipline and for the achievement of a specific instructional objective in a CAI environment affect the performance of Black college students?

The purpose of this study, then, was to investigate the effects of the application of a mastery learning strategy in mathematics instruction within a CAI environment on Black college students. In particular, the experiment investigated the "time to mastery" differences among Black college students in proving a minor theorem in number theory which might result from the application of such an instrument.

The null hypothesis was stated as follows: The "time to mastery" in proving a minor theorem by an experimental group using a mastery learning strategy within a CAI environment will not differ significantly from that of a control group exposed to traditional instruction.

The study was conducted over a five day period both in a standard classroom and in a computer laboratory. The subjects were twenty Black sophomore and junior mathematics and engineering majors of both sexes currently enrolled in Howard University. The twenty students ranged in age from 18 to 22 years. The students were assigned numbers randomly as they arrived for the experiment. The median was computed for these numbers and the subjects with numbers greater than the median were designated control group; the remaining students were assigned to the experimental group. Thus, each group consisted of ten subjects.

The investigator developed a computer assisted programmed instruction instrument based on a minor theorem in number theory which had been treated in an intrinsic program sequence by Norman Crowder (Fry, 1963b). Since research cited earlier indicated that neither of the two principal programmed instruction types was significantly superior to the other in effectiveness, this investigator arbitrarily chose the Crowder method to use in the study.

The Crowder program was transformed into a conversational computer program written in the BASIC language and placed under the Howard University CALL/360 Timesharing System. Certain modifications were made in the content and flow of the Crowder program during transformation although its basic integrity was preserved. These modifications demanded by an adherence to mastery learning concepts, were introduced to

provide greater feedback to the student and additional explanation of "branched" material. Additional programming provisions measured each subject's cumulative elapsed time while using the program. Access to the instrument was provided through interactive typewriter-like terminals. The instrument was conversational, thus, allowing subjects to be provided with immediate reward and feedback.

In one session both the control and experimental groups were given 20 minutes of instruction which covered approaches to mathematical proofs (Polya, 1957). Each group was given the statement of the theorem to be proved and an illustration of its application. The theorem and its proof are provided in the appendix. Subjects in the control group were provided with paper and pencil and told to prove the theorem. Subjects in the experimental group were given 5 minutes of instruction in the use of the interactive terminals and told to prove the theorem at the terminal. Both groups were told to work through to completion of the proof.

The results of the performance of each subject was evaluated and the cumulative elapsed time for each subject was recorded. The mean time to mastery for each group was computed and the difference between these means was tested for significance using the Student t ratio as outlined in Anderson and Bancroft (1952).

All subjects completed the proof of the theorem. The mean times to mastery for each group are presented in Table 1.

TABLE 1

T-Test for Mean Time to Mastery in Minutes of Experimental and Control Groups

	Means	**Computed**	**Critical Value (.01)**
Control	39.3		
Experimental	19.7		
		-3.1215	2.552

The time to mastery in the control group ranged from 18 to 85 minutes while the range in the experimental group was 13 to 27 minutes. The standard deviations were 19.2933 and 4.6916 for the control and experimental groups respectively. When the difference between the two mean times to mastery was tested, it was found to be not significant at the .01 level (Anderson and Bancroft, 1952b). Thus, the null hypothesis was not rejected.

Although the null hypothesis was not rejected the nearly 2 to 1 difference in mean scores indicate that there is considerable merit to the use of a mastery learning strategy within a CAI environment and this instrument as an aid to mathematical instruction is a useful alternative to the use of the lecture method alone. In addition, these results demonstrated that this instrument is an effective instructional aid to Black college students.

Several questions may be posed as a result of this study: How effective is the instrument with larger groups of students? How might this technique be utilized in other areas of the mathematics curriculum or within other academic disciplines? What are the implications of the application of this technique to Black students with known academic deficiencies? As a result of the substantial savings in instruction time, how might course scheduling and curriculum be affected? How cost-effective is this technique when measured against more traditional instructional techniques?

Hopefully, the results of this study will encourage further serious exploration of the use of this and similar techniques in support of instructional objectives of college curricula.

APPENDIX 1

Theorem:

Let N be any odd integer such that N 1.

Then,

N2-1

is divisible by 8.

Proof:

Since N is odd, then set $N = 2M+1$ where M is an integer. Hence,

$$N2\text{-}1 = (2M+1)^2\text{-}1$$
$$= 4M^2 + 4M .$$

But now,

$$N^2\text{-}1 = 4(M^2 + M)$$

is clearly divisible by 4 and it remains to be shown that $M^2 + M$ is divisible by 2.

If M is odd, then M^2 is odd. Also, $M^2 + M$ is even since the sum of odd integers is even.

If M is even, then M^2 is even. Also, $M^2 + M$ is even since the sum of even integers is even.

Thus, $M^2 + M$ is even and is divisible by 2. The theorem follows.

APPENDIX 2

Time to Mastery (in Minutes)

Control	Experimental
23	16
18	24
42	13
22	18
50	27
38	20
85	14
45	18
30	23
40	24

REFERENCES

Anderson, R. L. and T. A. Bancroft, *Statistical Theory in Research,* New York: McGraw-Hill Book Company, Inc., 1952 (a) p. 81; (b) p. 385.

Bloom, Benjamin S., "Learning for Mastery", RELCV Topical Papers and Reprints, No. 1, (1968) (a) p. 10; (b) p. 2.

Coulson, J. E. and H. F. Silberman, "Results of Initial Experiment and Automated Teaching," Santa Monica, California: System Development Corporation, July, 1959.

"CAI - Systems and Projects", *Automated Education Letter, No. 1,* Detroit: Automated Education Center, 1966, pp. 3-13.

DeCecco, John P., *The Psychology of Learning and Instruction: Educational Psychology,* New Jersey: Prentice Hall, Inc., 1968, p. 538.

Fry, Edward B., *Teaching Machines and Programmed Instruction,* New York: McGraw-Hill Book Company, Inc., 1963, (a) pp. 103-104; (b) pp. 225-239.

Lekan, Helen A., *Index to Computer Assisted Instruction,* Harcourt Brace Jovanovich, Inc., New York, 1971.

Roe, A., "Automated Teaching Methods Using Linear Programs", *Department of Engineering Report,* Los Angeles: University of California, 1960.

Polya, G., *How To Solve It,* Garden City, New York: Doubleday Anchor Books, 1957, pp. 33-36.

"CAI Festival at Howard University", *OCS PRINTOUT, Vol IV, No. 1,* Washington, D. C.: Howard University Office of Computer Services, 1971, p. 2.

"Time Sharing System Scorecard — A Survey of On-Line Multiple User Computer Systems", No. 2, Belmont, Mass.: Computer Research Corporation (CRC), 1965, pp. 1-4.

Lippert, Henry T., "Computer Support of Instruction and Student Services in a College or University", Educational Technology, May 1971, pp. 40-43.

"OCS Seeks Full CAI Program", *OCS PRINTOUT,* Vol. V, No. 1, Washington, D. C.: Howard University Office of Computer Services, 1973, p. 2.