DOCUMENT RESUME

ED 089 682 IR 000 394

AUTHOR Honeycutt, Joan K.
TITLE The Effects of Computer Managed Instruction on Content Learning of Undergraduate Students.
PUB DATE Apr 74
NOTE 14p.; Paper presented at the American Educational Research Association Annual Meeting (Chicago, Illinois, April 15 through 19, 1974)

EDRS PRICE MF-$0.75 HC-$1.50 PLUS POSTAGE
DESCRIPTORS *Academic Achievement; *Computer Assisted Instruction; Educational Research; *Education Majors; Independent Study; Individualized Instruction; Individualized Programs; *Knowledge Level; Learning; Pacing; Student Evaluation; Teacher Education; Undergraduate Study
IDENTIFIERS CMI; *Computer Managed Instruction; *Mastery Learning

ABSTRACT

Research was conducted to determine the effectiveness of computer-managed instruction (CMI) as an aid to the mastery of factual content, as compared to the method of frequent, pre-announced quizzes. One section of an undergraduate education course received conventional instruction along with quizzes; another section used a CMI program whose major features included mastery learning, self-pacing, self-instruction, provision for individual differences, and extensive record keeping. All other instructional activities were held constant across both groups. Pre-test evaluation of content knowledge yielded no significan differences between the groups prior to treatments; post-test results indicated that the CMI group achieved significantly greater mastery of the factual content. (Author/LB)

Session Number 11.03

THE EFFECTS OF COMPUTER MANAGED INSTRUCTION ON CONTENT LEARNING OF UNDERGRADUATE STUDENTS

by

Joan K. Honeycutt, Ed.D.
Orange County Department of Education, California

In the typical undergraduate course, students are required to read a textbook which provides the basic course content or subject matter information. Many students, however, do not read their textbook until the day or two preceding the "midterm" and again just prior to the "final." In terms familiar to most instructors, the students were "cramming" just prior to taking a test and not keeping up with their reading on a daily basis. Consequently, the instructor needs to devote class time to the presentation of information which was available in the textbook rather than helping students explore their attitudes toward, and their understanding and application of the content upon which the course is based.

Many different methods have been utilized by instructors in order to facilitate periodic mastery of background material on the part of students in the course; e.g., pop quizzes, weekly quizzes, summaries to be handed in on a frequent regular basis, etc. Computer Managed Instruction (CMI) is a relative newcomer in the field of educational technology, and is one method which could be used to facilitate content mastery.

Baker (1971) lists the four major functions of a computer managed instructional program as test scoring, diagnosing, prescribing and reporting. In his report, Baker describes several variations of the use of computers in the management of instruction. These include the Instructional Management System (IMS) developed by Systems Development Corporation

(Silberman, 1968), the Individually Prescribed Instruction Management and Information System (IPI/MIS) at Pittsburgh Learning Research and Development Center (Glaser, 1969), Program for Learning in Accordance with Needs (PLAN) developed by the American Institute for Research (Flanagan, 1969), Teaching Information Processing System (TIPS) developed by Kelley (1968) at the University of Wisconsin, and the Individualized Mathematics Curriculum Project (IMCP) under development since 1964 at Wisconsin (De Vault, et. al., 1969). For a comprehensive review of the use of computers in education, the reader is referred to "Information Systems Applications in Education" by Silberman and Filep (1968).

The use of Computer-Managed Instruction (CMI) as an aid to teaching may be viewed as an attempt to apply a systems approach to education (Brudner, 1968). In this capacity CMI serves as an information system, keeping track of and providing information about each student's progress. In its more sophisticated use, CMI provides for diagnostic and prescriptive assignments based on student performance (Finch, 1969). While none of these functions are dependent upon the use of a computer, such use is the most efficient and expedient means for managing an individualized program of instruction.

For theoretical reasons, this author selected CMI as a medium to facilitate mastery of content on the part of students. The purpose of the study reported herein was to examine the effectiveness of CMI as an aid to mastery of background information as compared to the method of frequent, pre-announced, classroom quizzes.

BACKGROUND OF THE STUDY

Based on the principle of mastery learning, a Computer Managed Instruction (CMI) program was developed which required a minimum performance of 90 percent correct responses for each unit of work. Multiple-choice questions based on Child Development and Personality (3rd ed.) by Mussen, Conger, and Kagan (1969) were obtained from the teacher's manual, and others were developed by the experimenter for use in the program. Each of these questions was used as a test item during academic quarters preceeding the implementation of CMI and subsequently subjected to item analysis. On the basis of these analyses, questions were selected for the test pool which was then used in the CMI program.

Readings from the textbook were divided into seven units which were further subdivided into two or three topics per unit. The test pool for each unit was composed of twenty items equally divided among topics. Upon completion of the assigned readings for a unit, students were directed to an IBM 2741 communications terminal where they were individually administered a quiz. This quiz consisted of ten questions drawn at random from the twenty-item test pool and equally divided among/ between topics.

Based on the assumption that students would learn more if they were not told whether their answers were correct or incorrect, the CMI program was designed to furnish students with feedback information at the completion of a testing session in terms of the number of correct responses emitted per topic.

Students whose responses met the 90 percent criterion of correctness, were instructed to proceed with the next unit. Those students who responded with 70 - 80 percent correct responses on the quiz, were assigned supplemental reading(s) covering topic(s) in which difficulty was encountered. Upon completion of this supplemental reading assignment, students had to pass a computer-administered quiz based on these readings at the level of 90 percent in order to proceed to the next unit. If a student failed to meet this level of mastery, he was directed to see his instructor. In the event that a student failed to receive at least 70 percent correct responses after two trials on a unit quiz, he, too, was directed to see the instructor. Individual conferences were then arranged for the purpose of helping these students with any problem or problems which he may have had in understanding the material. Subsequently, students resumed activity with the next unit. Completion of the CMI portion of the course was required and constituted minimum performance for all students. (See Figure 1.)

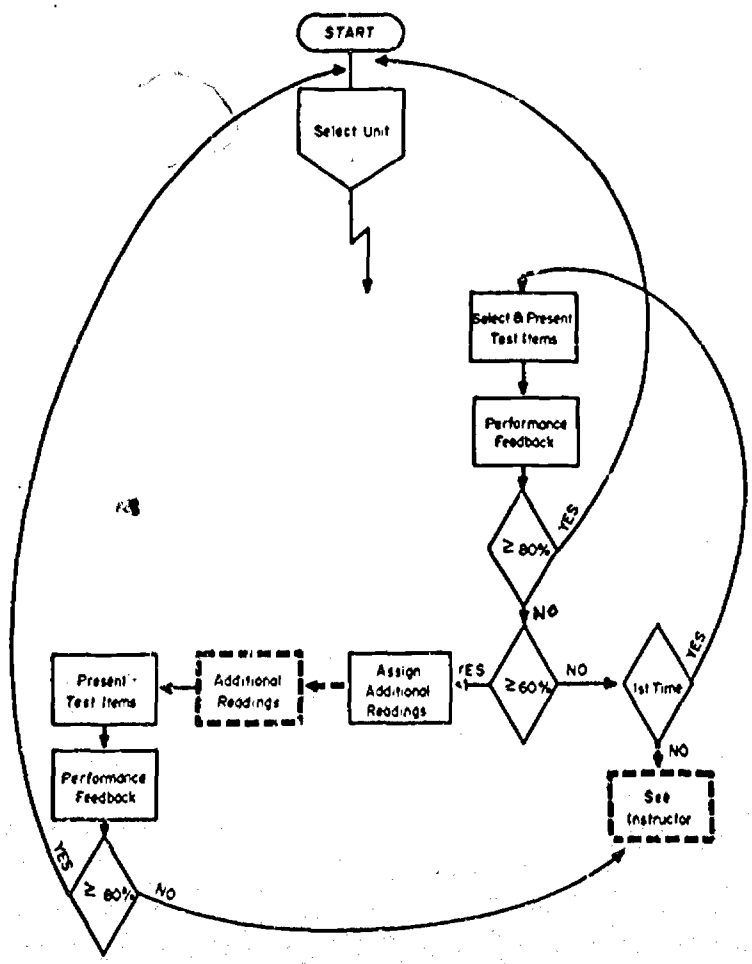

Figure 1

Computer Managed Instruction was initiated during Fall quarter, 1971. During this quarter the program was debugged and the following changes were made:

1. Criterion for pass was changed from 90 percent correct to 80 percent correct. This decision was based on the observation made during student interviews with the instructor that frequently students failed to get 90 percent correct because they had misread a question, pushed the wrong key on the terminal, or became flustered rather than due to a lack of understanding of background material.

2. Criterion for additional reading assignments was changed to 60 - 70 percent correct in keeping with the change in 1, above.

3. Criterion for failure of a unit was changed to 50 percent in keeping with changes in 1 and 2, above.

During the trial quarter of CMI, it was noted that students were going in groups of two and three to the computer terminals and taking the test more or less as a "group endeavor." This "group endeavor" seemed to involve one student sitting at the terminal and one or more students seated around him--all with books and notes in hand. As questions were typed by the terminal, the group of students were all flipping through their books and notes trying to determine the correct answer before the time limit expired. The computer terminals were not monitored, and there was great concern regarding student cheating at this time. In order to control for cheating, students were informed that they would be tested on the final class meeting to determine whether or not they had mastered the content, themselves, or had had someone else take the tests for them. The results of this test would be examined

to determine if any of the students scored lower than the group as a whole. If this did occur, the student(s) would be called in, individually, and an oral examination would be administered by the instructor.

METHOD

Subjects

Junior and senior students at the Ohio State University majoring in early and middle childhood education during Winter quarter, 1972, served as subjects for this study. Two sections of the required course in child development which met at the same time but in different locations served as the experimental (n = 29) and control (n = 34) groups. All students were assigned to sections as part of the normal registration procedure at the institution. While subjects were not randomly assigned to treatment groups, their assignment was by the computorized registration system, and there is no reason to suspect bias between the two groups due to section assignments.

Treatment

The experimental and control groups were taught by instructors with essentially equal experience in teaching the course. Treatment groups differed in that students in the experimental group received Computer Managed Instruction (CMI), while students in the control group were given four (4) pre-announced quizzes composed of questions selected by the instructor from the same test pool as the CMI program in class and a final essay examination.

Lectures covering textbook material were omitted from class activities in both groups. Class sessions for both groups consisted of:

1. films
2. discussion of films based on textbook information
3. implications of these films for the classroom teacher
4. role playing
5. presentation and application of techniques for case study

Since the control group spent class time taking quizzes, students in the experimental group were released from two class sessions in order to equate total class time between the two treatment groups.

Students in both treatment groups spent two hours per week participating in and observing children in a public school setting. On the basis of this participation-observation experience, students in both groups were required to complete an extensive case study on one of the children with whom they had been working.

Final grades for the course were determined differently between treatment groups. Subjects in the experimental (CMI) group received a "C" for completion of the CMI portion only. Grades of "A" and "B" were determined on the basis of superior quality of case study. In contrast, subjects in the control (no CMI) group received letter grades for their performance on each of the quizzes and their final essay examination. Final grades for this group were determined on the basis of test grades and quality of case study.

Procedure

During the first class meeting of the quarter, both treatment groups were administered a pre-test which consisted of 50 items from the course test pool. The same test was administered at the final class meeting as a post-test. Prior to taking the test, subjects in both groups were

informed that research was being conducted into the effectiveness of CMI and that the test results would be used for purposes of this evaluation study. The experimental group was further informed that the post-test would be utilized as a check that students were doing their own work at the terminals and that except in the event of very low performance on the post-test, the results would not effect the final grades in the course.

Prior to administration of the post-test, students were requested not to study. The post-test given for purposes of this study was administered to both the experimental and control groups at the same time: five days prior to the final examination which was administered to the control group. This was done in order to control for possible contamination of post-test results due to students in the control group studying for their final examination. No final examination was given to the experimental group, as their mastery of content was evaluated exclusively through CMI. Results of the pre-test and post-test for both groups are presented in Table 1, below.

Table 1
Pre-Test and Post-Test Results

Treatment Group	Pre-Test		Post-Test		n
	$\bar{X}$	s	$\bar{X}$	s	
Experimental (CMI)	23.3	2.98	39.9	4.86	29
Control (no CMI)	21.9	4.56	34.3	4.93	34

RESULTS

Pre-test scores for the experimental and control groups were compared in order to determine whether or not the two groups had equal background knowledge prior to treatments. The F_{max} statistic was employed to test for homogeneity of variance with a finding of no significant difference between variances. A t-test was conducted on pre-test scores which yielded a t value of 1.327 indicating no significant difference between the groups in the amount of factual knowledge prior to treatments.

Post-test scores were analyzed with a t-test which yielded a t value of 4.455 ($p < .005$) favoring the experimental group. These results are summarized in Table 2, below.

Table 2

Results of t-test comparison of performance between experimental and control groups

	Experimental		Control		t
	$\bar{X}$	s	$\bar{X}$	s	
Pre-test	23.3	2.98	21.9	4.56	1.327 n.s.
Post-test	39.9	4.86	34.3	4.93	4.455*

*$p < .005$

SUMMARY AND DISCUSSION

In order to facilitate mastery of content material, meet individual student needs and provide for student differences, a Computer Managed Instruction (CMI) program was developed by the author which had the following features: (1) Self-pacing. Course of study was divided into seven units, and within the time frame of one academic quarter, students were free to complete the units at their own rate, (2) Mastery Learning. A minimum performance of 80 percent correct responses was required for each unit of work, (3) Individual differences. Materials were developed for each unit which served as supplementary readings for students who were not able to meet the 80 percent mastery level. For the few students who continued to experience difficulty, individual conferences were scheduled with the instructor, (4) Self-teaching. Students were not told which of their answers were correct or incorrect, but were furnished feedback at the completion of each session in terms of the number of correct responses emitted per topic, (5) Record keeping. Summaries of each student's status were available to instructor at any time through the computer terminal.

The study reported herein was designed to examine the effectiveness of CMI as an aide to mastery of background information as compared to the method of frequent, pre-announced classroom quizzes.

The results of this study indicated a highly significant difference in post-test standing ($p < .005$) between the experimental (CMI) and control (no CMI) groups which favored the experimental group. It would appear that Computer Managed Instruction (CMI) based on mastery of content and self-pacing is a highly effective aid for maximizing content learning by undergraduate college students.

It should be pointed out that six subjects in the experimental group (21%) had not completed all seven units prior to post-testing. Conceivably, these subjects had not yet read all the material covered by the post-test. Nevertheless, the mean post-test score for the experimental group was significantly higher than that of the control group.

Of interest was the observation that the experimental group mean on the post-test was 39.9 or 80 percent of the questions correct--the same criterion as that required for each unit of the CMI program. This could be interpreted as a chance factor; however, it could also be hypothesized that since the experimental subjects had been required to attain a minimum response rate of 80 percent correct, they were, in fact, still operating under this condition.

The "group endeavor" described in the Background of the Study which consisted of students working together at the terminals was an unanticipated bonus. Observation of this group learning was a beautiful and exciting teaching-learning situation to witness. We in the field of education, talk about the merit found in group learning vs. individual learning situations, and the results of this study would certainly lend support to group learning.

Rigid control was not maintained as to the exact content of what happened in each class session. While the two instructors had comparable experience in teaching the course, used the same materials, and the same course objectives, the actual effect of individual differences between instructors cannot be ascertained. Since the material covered in class was of the nature of expansion and application

of textbook material rather than direct presentation of this material, it would seem reasonable to assume that any bias relating to instructor differences would not be reflected in the criterion measures used in this study.

As part of a university-wide project, students in the experimental group were administered an attitudinal questionnaire during the last week of class. These questionnaires were answered anonymously and requested opinions of and attitudes toward Computer Assisted Instruction (CAI) and Computer Managed Instruction (CMI). The results of this survey indicated much frustration on the part of students with CMI. Problems which they identified were such things as glare on the glass coverings of communications terminals, difficulty with paper feed on the typewriter rolls, amount of noise in the rooms where the terminals were located, and the threat which some students felt in taking a test under these conditions. One would expect that such negative reactions would adversely affect the results for the experimental group. However, analysis of the data indicated that the group on CMI (experimental) achieved a significantly greater mastery of content than those not on CMI(control). One might say that the students may not have liked CMI, but they definitely seemed to learn more on it.

There is a need for replication of this study; in particular, one which would include control for differences between instructors. For example, if two instructors were involved in the study, each could teach one class with CMI and one class without CMI.

In no way should the results of this study be interpreted as offering a panacea for all educational ills. The Computer Managed Instruction program used in this study was designed for a specific population of students; namely, undergraduate students taking a required course which necessitated mastery of content background information. In a course where mastery of content is a necessary condition for meeting the overall objectives of the course, a Computer Managed Instructional program such as this would seem to be a very effective method to be utilized. One would suspect that there are many courses which have such a requirement.

REFERENCES

Baker, F. B. Computer-based instructional management systems: A first look. Review of Educational Research, 1971, 41, 51-70.

Brudner, H. J. Computer managed instruction. Science, 1968, 162, 970-976.

De Vault, M. V., et. al. Description of the school context for the computer managed systems of mathematics instruction project. Research and Development Center for Cognitive Learning, University of Wisconsin, 1969.

Finch, J. M. Computer-Managed Instruction: An annotated bibliography. Audiovisual Instruction, March, 1972, 72-76.

Glaser, R. Evaluation of instruction and changing educational models. In M. C. Wittrock & D. Wiley (Ed.), Evaluation of Instruction.

Kelley, A. C. An experiment with TIPS: A computer aided instructional system for undergraduate education. The American Economic Review, 1968, 58, 446-457.

Mussen, P. H., et. al. Child Development and Personality (3rd ed.). New York: Harper & Row, 1969.

Silberman, H. F. Design objectives of the instructional management system. SP 3088/001/00, Systems Development Corporation, Santa Monica, CA, 1968.

Silberman, H. F. & Filep, R. T. Information systems applications in education. In Cuadra, C. A. (Ed.) Annual Review of Information Science and Technology, 3, Chicago: Encyclopedia Brittanica, 1968, 357-395.