

Computer assisted instruction comes of age in a public school system

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INTRODUCTION

During the late 1960's a number of public schools began experimenting with the development and use of computer-assisted and computer-managed instruction. Funding for these public school projects was provided primarily by Title III of the Elementary and Secondary Education Act of 1965, or other sources of federal funds. Due to the reduced availability of federal funding, few new public school CAI projects have been initiated since 1970. It is, however, very encouraging to analyze the results of the few active public schools CAI projects.

The paper will provide evidence that CAI/CMI can produce increased achievement when properly integrated into the instructional process. In deference to some of the early concerns with the application of computer technology, it will be shown that the computer can in fact provide greater individual and personalized instruction to students. Although computer-assisted and computer-managed instruction are not today cost-affordable when applied to all students within a school system, it will be shown how the use of CAI can be cost-justifiable for selected student target populations. In addition, public school systems have shown that they can effectively work with computer technology as both users and developers. The concluding premise of the paper is that the public education sector is rapidly approaching the time when it can effectively utilize widespread CAI as a direct aid to the instructional program.

BACKGROUND

The MCPS Title III CAI Project goals were the demonstration of the feasibility of computer-assisted instruction as an instructional medium and the assessment of its role in the K-12 public school setting. The project currently utilizes 31 time-shared computer terminals cable connected to the IBM 1500 instructional system. The project fulfilled its stated objectives by (1) developing, using, and evaluating over 40 modular instructional CAI and CMI packages, (2) providing the Montgomery County Public School System with a cadre of 70 individuals capable of developing and using CAI instruction, (3) providing an orientation to CAI to

approximately 5,000 school administrators, supervisors, and teachers, and (4) making recommendations to MCPS concerning the future implementation of CAI.

Program design teams composed of project staff and classroom teachers developed approximately 40 modular instructional packages, most of which are in the mathematics and science areas. The instructional design for each program, including objectives, entering behaviors, hierarchy, and strategy has been completely documented in the *Project Reflect Title III Final Report*, June 30, 1972.

Federal funding for the project ended in June 1971. Since that date, MCPS has supported a staff of 12.5, maintenance on the computer and all additional expenses of the program. The manufacturer is providing the computer system lease free for instructional purposes.

RESULTS

Experiences over the six-year period have shown that learning and teaching philosophies could be altered, and that individualization with computer support is logistically feasible. When school faculties are provided with valid CAI/CMI materials related to student needs, teachers are able to integrate new technology into the regular instructional process. In this connection, experience has shown that teachers need time and training to effectively utilize these materials. In addition, it was found that selected teachers have the talents and interests to develop effective individualized CAI modules.

Year-long research studies on achievement, class size, and teacher-student interaction were completed in June 1972.

Results of these studies showed that:

1. Fifty-eight matched pairs of sixth-grade students with one-half hour weekly CAI experience as part of their regular arithmetic made significantly greater mean gains in achievement ($t = 2.08$, $df = 114$, $p < .05$);
2. High school students in two computer-managed geometry classes, which averaged over 33 students, showed no significant differences in mean gain scores than students in three traditional classes with an average of 23 students ($t = 1.23$, $df = 81$, n.s.); and

3. Secondary mathematics students enrolled in three classes with CAI and CMI support received significantly more individual attention from their teachers than students in three traditional classes ($F = 38.78$, $df = \frac{1}{4}$, $p < .01$).

In addition, a mini-study with a few special education students was conducted in one secondary school. Ten students from this school participated in a four-month study to determine if they could benefit from the use of the arithmetic materials prepared for the regular school population. Results of this study, in which the analysis of data was prepared as though the average I.Q. were normal, showed significantly greater gains in achievement than could be expected in the time period allotted ($t = 2.71$, $df = 9$, $p < .05$).

Evidence collected by the CAI Program and substantiated by other CAI installations showed that the hardware system and terminal components used for instruction must function in a reliable manner and that the response time for students must not exceed three (3) seconds.

IMPLICATIONS

It would appear that with minimal use at the elementary school level, students can be expected to increase their proficiency in basic arithmetic skills. Four terminals per school can provide 300 students a half hour CAI session each week and result in significant achievement gains.

When computer support for diagnosis and prescription is provided, students can receive significantly more individual attention from their teachers. In secondary schools utilizing the computer for management in geometry, class size may be increased with no loss in achievement.

Students in special education present a different kind of problem and require special consideration. However, it may be that computer-assisted instruction serves as a means by which the less able student can effectively organize his mathematical thinking. Every student who was pretested and posttested in this study showed a gain in arithmetic scores.

THE YEARS AHEAD

The CAI Program has acquired strong evidence that computers can have an important role in the instructional process. Although it is anticipated that CAI will be economically feasible for wide-spread utilization within 3-5 years, it must be understood that with the existing IBM 1500 CAI system or the proposed IBM 370 system that CAI is not currently economically feasible for all students. Therefore, the use of this technology should be limited to instruction for those students for whom the significant achievement gains justify the expenditure of extra dollars. To be specific, it is recommended that CAI be provided to those students who are achieving below grade level, to special education students, to those situations where increased class sizes can help displace hardware costs, or for computer education courses and problems solving which requires computer support.

Based upon the experiences of the last six years, results of evaluation studies and cost analysis, two major CAI Program thrusts are anticipated for the 1974-75 school year, elementary arithmetic and secondary mathematics.

ELEMENTARY ARITHMETIC

Validated CAI arithmetic packages will be provided to students achieving one or more years below grade level in 13 elementary schools. This will provide approximately 4,000 students with 30 minutes per week of CAI diagnosis and drill in operations with whole numbers, fractions, and percents.

The CAI arithmetic materials will be provided to under-achieving students based upon the following predictions:

1. That the achievement of at least 90 percent of the underachieving students using the CAI programs will be at or above grade level in arithmetic within two years. This means that a child entering the fourth grade one or two grade levels behind, will enter the sixth grade at or above grade level in arithmetic skills. The total two-year cost per student will be \$216. This amount will provide the student with CAI for a one-half hour period for each week for two years at a cost of \$6 per hour which covers computer, staff, communications, and all other program costs.
- As computer equipment and instructional terminal costs are projected to decrease dramatically within the next five years, the cost for improved arithmetic achievement should be reduced from \$216 to \$72 or less per student for a similar two-year period by 1978.
2. That arithmetic achievement for students in special education will be substantially increased above expectancy. It is predicted that 80 percent of these students will achieve an increase in arithmetic skills of one grade level per school year. The cost for this achievement is \$108 per student per year, which will provide one-half hour per week of CAI. By 1978, it is projected that similar results can be obtained for special education students for \$36 per year.

The above projections are supported by evaluation data collected at the CAI Program. The 1971-72 sixth-grade study showed significantly greater achievement through CAI than by traditional instruction. A retention study conducted in the fall showed that these significant gains were maintained. In addition, using the Iowa Test of Basic Skills arithmetic scores given in October 1972, showed the CAI students with a mean grade score of 7.52, and the control students with a mean grade of 7.02. A 1972-73 fourth-grade study showed that CAI students made an average gain of 7.7 months in four months as compared with the control students mean gains of 4.5 months. An examination of the low halves showed the CAI group making a mean gain of 5.74 in raw score as compared with the control with a mean gain of 2.68 in raw score. All of the above CAI students received CAI 30 minutes per week.

During the past three school years, students from a special education high school have used the CAI arithmetic programs at Einstein High School. The average gain for these students during the 1971-72 school year was 7.6 months after 40-50 minutes of CAI use per week during a four-month period. During the 1972-73 school year, these students made a mean gain of one year in arithmetic achievement using CAI for an average of only 17.8 hours. National studies which have been conducted with mentally retarded adolescents show that achievement in the basic skills is difficult to maintain and increased achievement is rare. Special education students whose basic skills are improved will be able to perform simple clerical tasks and therefore increase the possibilities of their securing gainful employment.

SECONDARY MATHEMATICS

One computer-managed (CMI) and ten computer-assisted (CAI) instruction packages will be provided to 7 senior high schools beginning in September 1974. The two objectives for this action are:

1. To provide greater individualization and personalization with equal or greater achievement at potentially lower cost. Classes with computer management support may have 40 percent more students than classes without this technology; and
2. To increase achievement for students who are underachieving.

Computer support to the secondary mathematics program is based upon the following predictions:

—That computer-managed geometry classes can be indi-

vidualized. Class size can be increased by 40 percent and each student will receive significantly more individual attention from his teachers than in traditional classes. Students will achieve as well or better than in traditional classes with average or underachieving students achieving above expectancy. Increasing the number of students in six classes will offset \$7200 of the \$18,000 program costs per school.

—With two nationally known computer hardware developers predicting a cost of 60¢-80¢ per terminal hour by 1978, the \$18,000 terminal cost will be between \$3600 and \$4800 per year against a saving of \$9000 in teachers salaries (assuming a conservative 5 percent per year salary increase). This would represent a net savings of between \$700 and \$900 per section of geometry per year.

CAI Program data supports the above statements on individual attention and overall achievement. A doctoral study by a MCPS administrator provided the information relative to average students in CAI classes achieving above expectancy.

SUMMARY

As in MCPS, other school systems that are active in CAI are moving forward and will be providing CAI exposure to greater and greater numbers of students. This trend marks a significant departure from the CAI activities of the last few years, and will provide expanded knowledge on the implementation planning necessary to achieve widespread effective utilization of CAI. The author feels that school use of CAI may, at least, be moving into the next phase of the implementation cycle.

