Elementary Mathematics and the Computer

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How useful are Computer-Assisted Instruction (CAI) and Computer-Managed Instruction (CMI) in an elementary mathematics program?

In an elementary mathematics program, a significant portion of a teacher's time is spent in monitoring and developing drill and practice activities which are intended to thoroughly acquaint students with newly introduced material and to constantly review the old. In an individualized mathematics program, this involves regularly assessing each student's placement and progress; it means searching through published materials in order to locate exercises and drills that are appropriate to the student's level of skill and ability; where a sufficient quantity of suitable materials is not available, it requires the development and duplication of appropriate materials; and it involves the never-ending corrections and the recording and reporting of each student's successes and failures.

Few elementary teachers would question the importance and value of these activities, but most express concern and frustration over the amount of valuable teaching time that is consumed by drill and practice activities and the paperwork that is associated with an individualized mathematics program. Many would appreciate an alternative method that has been proven instructionally sound and which would reduce the load of paperwork.

CAI and CMI offer teachers such an alternative method. The first step in successful teaching is motivating students; it is evident that students of all ages are motivated by the computer. In the case of a community college system in Ontario, the use of the computer increased the attendance rate of students in remedial or basic mathematics courses from a dropout rate of 60 percent to an attrition rate of only 20 percent with CAI mathematics (Dr.Ludwig Braun, "Computers in Learning Environments, an Imperative for the 1980s," BYTE, July 1980, p.10).

A series of studies on the value of CAI for achievement and time to learn in elementary and secondary education, particularly in the basic skills area, has indicated that augmenting classroom instruction with CAI materials supports the notion that supplementary instruction with

CAI leads to higher achievement than occurs with traditionally taught students (Braun, 1980).

The most recent review of the effectiveness of the use of the computer indicated that when the computer is used to aid instruction in the elementary and secondary school level, the achievement and/or the time reduction to learn materials is significantly improved (Braun, 1980). This covers skills in elementary language arts and mathematics.

CAI has been proven to be instructionally sound both in terms of achievement and in the time required to learn material. A properly designed management system for the computer can drastically reduce a teacher's "paperload."

In a mathematics program, CAI and CMI used together can: assess students' skills and areas of weakness; develop individualized programs through diagnostic and prescriptive procedures; generate traditional worksheets or inexpensively display material electronically; mark assignments; provide students with immediate feedback; offer remediation or enrichment material as appropriate; test students; work out percentages, means, averages, and standard deviations; store students' records; and provide reports on progress.

Generally, the more expensive a CAI or CMI package is, the more sophisticated its functions. But even a simple, inexpensive drill and practice program which presents a question, accepts a student's response, and offers feedback, has its place in an elementary mathematics program and would be a good place for the cautious teacher to start.

For those who are already convinced that the computer is a valuable tool to augment mathematics instruction and management, there are a number of sophisticated but expensive packages on the market. Radio Shack is now offering, for example, the *K-8 Math Program* which provides individualized exercises in addition, subtraction, division, multiplication, and number concepts. One of its features is a placement mode which determines a student's present skill level in terms of the four basic functions of mathematics. The teacher enters a level at which he or she thinks the student should begin, based on a study of the "Curriculum Content Summary" that is provided with the manual. The computer asks the student to work a few problems at that level and placment is made at the appropriate level. The computer will generate drill and practice material that is appropriate and then provide a record for the teacher of how well the student has done based on the number correct on the first, second, or third attempt.

At any point the teacher can ask the computer to test the student. The computer will randomly select as many problems as the teacher chooses from a particular lesson. During testing, the student receives no prompting and has no indication of whether the answers entered are correct or incorrect. At the end of the test, a report shows the number of problems worked, how many were correctly answered, the percentage correct, and the average response time.

SRA's *Classroom Management System* for Grades 4 through 8 provides the teacher with a diagnostic and instructional tool. Utilizing nine survey tests and 49 probe tests, it narrows a student's areas of difficulty down until it can prescribe materials based on 325 objectives and references to six textbooks, 16 SRA kits, and five references which the teacher can include. It keeps a record of each student's progress and will generate a hard-copy report on an individual student or on the entire class.

The system might prescribe SRA's CDIM package which provides computer-

ized drill and practice materials for Grades 4 to 8. Or, teachers can purchase a version which has a management system built into the drill and practice materials.

Milliken's *Mathematics Sequences* incorporates a management system which allows teachers to assign three exercises to each student in as many as five classes. Without requiring any teacher supervision, the student tells the computer his name and it automatically takes him to the assignment his teacher has specified or to his last unfinished assignment. If the student is having too much difficulty, the computer will automatically lower his problem level. It will then produce a hard-copy report which indicates the problem level the student is currently working on, which levels have been successfully completed, and the percentage correct on assignments.

For these CAI and CMI packages to be utilized to their full potential, students need ready and easy access to a microcomputer. At the present time, unfortunately, even one microcomputer per classroom is considered a luxury. Until microcomputers become commonplace in the classroom, teachers will have to be imaginative in working out a schedule which will provide optimum use of the microcomputer.

Students who could benefit the most from using computer materials (perhaps remedial or enrichment students) might be scheduled more frequently than students who work well with traditional teaching methods. Small groups of students might use the computer together, benefiting from the shared problem solving. A very inexpensive, colorful drill and practice program could be used with the whole class as a regular drill each morning. Poorly motivated students could be allowed to use challenging mathematics games, drill and practice in disguise, as a reward for completing assignments. Even if a teacher is determined that each student should have a regular turn, one microcomputer per class of 30 would allow each child to have a session every three days. Whatever plan the teacher chooses, by allowing the microcomputer to do what it does best, it is freeing the teacher to do what he or she does best in innovative, creative, and experimental teaching.