COMPUTER-AIDED INSTRUCTION
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I. Introduction

Computer-Aided Instruction (CAI), diverse and rapidly expanding
spectrum of computer technologies that assist the teaching and learning
process. CAI is also known as computer-assisted instruction. Examples
of CAI applications include guided drill and practice exercises,
computer visualization of complex objects, and computer-facilitated
communication between students and teachers. The number of computers in
American schools has risen from one for every 125 students in 1981 to
one for every nine students in 1996. While the United States leads the
world in the number of computers per school student, Western European
and Japanese schools are also highly computerized.

II. Types of CAI

Information that helps teach or encourages interaction can be presented
on computers in the form of text or in multimedia formats, which
include photographs, videos, animation, speech, and music. The guided
drill is a computer program that poses questions to students, returns
feedback, and selects additional questions based on the students'
responses. Recent guided drill systems incorporate the principles of
education in addition to subject matter knowledge into the computer
program.

Computers also can help students visualize objects that are difficult
or impossible to view. For example, computers can be used to display
human anatomy, molecular structures, or complex geometrical objects.
Exploration and manipulation of simulated environments can be
accomplished with CAI-ranging from virtual laboratory experiments that
may be too difficult, expensive, or dangerous to perform in a school
environment to complex virtual worlds like those used in airplane
flight simulators.

CAI tools, such as word processors, spreadsheets, and databases,
collect, organize, analyze, and transmit information. They also
facilitate communication among students, between students and
instructors, and beyond the classroom to distant students, instructors,
and experts.

CAI systems can be categorized based on who controls the progression of
the lesson. Early systems were linear presentations of information and
guided drill, and control was directed by the author of the software.
In modern systems, and especially with visualization systems and
simulated environments, control often rests with the student or with
the instructor. This permits information to be reviewed or examined out
of sequence. Related material also may be explored. In some group
instructional activities, the lesson can progress according to the
dynamics of the group.

III. Advantages and Disadvantages

CAI can dramatically increase a student's access to information. The
program can adapt to the abilities and preferences of the individual
student and increase the amount of personalized instruction a student
receives. Many students benefit from the immediate responsiveness of
computer interactions and appreciate the self-paced and private
learning environment. Moreover, computer-learning experiences often
engage the interest of students, motivating them to learn and
increasing independence and personal responsibility for education.

Although it is difficult to assess the effectiveness of any educational
system, numerous studies have reported that CAI is successful in
raising examination scores, improving student attitudes, and lowering
the amount of time required to master certain material. While study

results vary greatly, there is substantial evidence that CAI can enhance learning at all educational levels.

In some applications, especially those involving abstract reasoning and problem-solving processes, CAI has not been very effective. Critics claim that poorly designed CAI systems can dehumanize or regiment the educational experience and thereby diminish student interest and motivation. Other disadvantages of CAI stem from the difficulty and expense of implementing and maintaining the necessary computer systems. Some student failures can be traced to inadequate teacher training in CAI systems. Student training in the computer technology may be required as well, and this process can distract from the core educational process. Although much effort has been directed at developing CAI systems that are easy to use and incorporate expert knowledge of teaching and learning, such systems are still far from achieving their full potential.

IV. History

In the mid-1950s and early 1960s a collaboration between educators at Stanford University in California and International Business Machines Corporation (IBM) introduced CAI into select elementary schools. Initially, CAI programs were a linear presentation of information with drill and practice sessions. These early CAI systems were limited by the expense and the difficulty of obtaining, maintaining, and using the computers that were available at that time.

Programmed Logic for Automatic Teaching Operations (PLATO) system, another early CAI system initiated at the University of Illinois in the early 1960s and developed by Control Data Corporation, was used for higher learning. It consisted of a mainframe computer that supported up to 1000 terminals for use by individual students. By 1985 over 100 PLATO systems were operating in the United States. From 1978 to 1985 users logged 40 million hours on PLATO systems. PLATO also introduced a communication system between students that was a forerunner of modern electronic mail (messages electronically passed from computer to computer). The Time-shared Interactive Computer-Controlled Information Television (TICCIT) system was a CAI project developed by Mitre Corporation and Brigham Young University in Utah. Based on personal computer and television technology, TICCIT was used in the early 1970s to teach freshman-level mathematics and English courses.

With the advent of cheaper and more powerful personal computers in the 1980s, use of CAI increased dramatically. In 1980 only 5 percent of elementary schools and 20 percent of secondary schools in the United States had computers for assisting instruction. Three years later, both numbers had roughly quadrupled, and by the end of the decade nearly all schools in the United States, and in most industrialized countries, were equipped with teaching computers.

A recent development with far ranging implications for CAI is the vast expansion of the Internet, a consortium of interlinked computers. By connecting millions of computers worldwide, these networks enable students to access huge stores of information, which greatly enhances their research capabilities.

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