A panel session—Computer-assisted instruction: Current status—Future problems

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CAI problems and prospects

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The expression "computer-assisted instruction" (CAI) is generally used to describe situations in which the computer is used as a teaching surrogate in some sense—whether as drill instructor, tester, or specialized tutor. Most applications of this kind have had specific, limited, and modest educational goals. When used to administer drills or branching tests, a computer is not called upon to be intelligent—only useful. Yet it is interesting and important to ask whether the computer can become an intelligent artificial teacher, and more generally, whether there are valuable ways of using computers for teaching and learning.

In artificial teaching, the computer controls the interaction with the student. There are applications of the opposite kind, where the student controls the machine. The most common one is the teaching of computer programming itself. Another is the use of a computer to simulate a "real" laboratory. And, there is a potentially rich spectrum of intermediate arrangements—strong instructional interactions—in which the student and the computer share control and direct each other. As an example, student programming and artificial teaching might be coupled by having the computer monitor a student's work as he uses a programming language to perform a simulated experiment or to solve a problem. No significant experiments in this direction can be done without a great deal of work; but we do know, in principle, how to make a program follow the steps of a student who is not constrained by a stereotyped pattern and how to diagnose his difficulties on the way.

We shall argue that computers will make deep contributions to education in all three areas:

1. first, and with capabilities already well established, through the teaching of programming languages;
2. ultimately, and to an extent largely dependent on progress in artificial intelligence research, as an artificial teacher;
3. intermediately, as an instructional monitor or assistant, in a number of different subjects as diverse as music, language, and physics.

Along the way, we shall elaborate on specific educational contributions including the following.

1. The teaching of programming can provide a conceptual and operational framework for the teaching of mathematics.
2. Using an appropriate language, programming can be introduced routinely to third-graders for its special value in teaching the skills of clear and precise thinking and expression.
3. The computer can enhance the teaching of "practical" subjects (such as navigation or speaking a foreign language) whose mastery requires the integration of mechanical and intellectual skills.

Finally, we shall contrast the present lack of depth and perspective characterizing much of the work in this field with its rich prospects. In particular, we shall discuss our view that a serious investigation of the problems involved in developing an intelligent teaching system will yield rich results in the fields of computers, education, and psychology.

CAI: Research requirements for instructional strategies

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The current developments of computer-assisted instruction (CAI) can be characterized as a phased transition from the creation of hardware and language systems for implementation into the more fundamental examination of the features of optimal instructional strategies for CAI applications. Instructional strategies are the plans by which informational presentations are matched with the current requirements of a learner in order to optimize on a set of criterion objectives. The research approaches into the nature and process of instructional strategies has been twofold, namely, naturalistic and systematic.

The naturalistic approach consists of three applicational types that developed concurrently with the hardware and language CAI systems. First, the complementary CAI type provides instruction that is adjusted to the stage of progress that a student has acquired in the conventional educational classroom; this approach is best exemplified by the Stanford Drill and Practice Mathematics Project. Secondly, the autonomous CAI type provides instruction that is the full corpus of an accredited course; the physics course at Florida State University and the library science course at the University of Illinois best represent the autonomous type. Lastly, the enriched CAI type provides instruction on content considered as extensions of the conventional classroom curriculum; the simulation games at BOCES are excellent examples of the enrichment type. An analysis and comparison of the instructional strategies of these three naturalistic CAI applicational types will be discussed.

The systematic approach to CAI research on instructional strategies resolve into six areas. First, what is the appropriate media for the presentation of a given concept? Second, what are the desirable time parameters for the CAI system to respond to the learner's answer? Third, what are the characteristics of the answer analysis routines that promote the specified learning objectives? Fourth, what is the decision logic of the presentation plan that specifies the sequence, amount of practice, and termination of the instruction? Fifth, what are the payoffs to the instructional process within CAI? And lastly, what kinds and types of reports should be part of CAI application? Current research findings and implications for future investigations are discussed within the framework of the six aspects of instructional strategies for CAI.

Instructional uses of computers to grow gracefully and effectively

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INTRODUCTION

In this brief discussion, it is suggested that three principal functions be recognized and be performed in parallel in order to achieve a graceful and effective growth in the instructional uses of computers. These functions are described as:

1. the practice of teaching using computers as aids;
2. research and development directed toward the practical uses of computers in teaching and learning;
3. basic research in intelligent systems.

Function (1) is dependent on function (2) and (2) is dependent on (3). Computer hardware and software and