

The development of computer-assisted instruction (CAI)  
using the ABC authoring system for teaching basic electronics

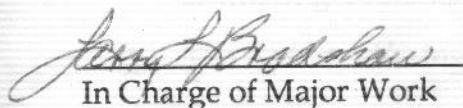
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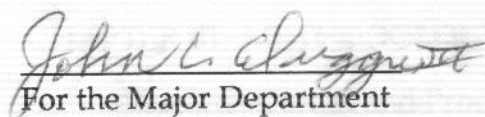
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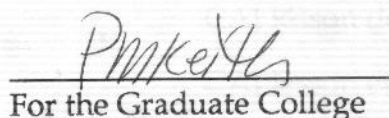
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## CHAPTER I. INTRODUCTION

Recently, educators have gained access to a wide variety of instructional technologies to support teaching and learning. An emerging technology that is particularly appropriate for teaching electronics is the microcomputer. Prior to 1981, there were fewer than 30,000 microcomputers in U.S. schools, but by 1990 the number grew to more than 2 million (Roth et al., 1990). The availability of microcomputers in schools and their potential for helping achieve educational goals make them an ideal instructional tool (Imel, 1992).

A wide range of instructional approaches is available on the computer. The most common types of instruction are drill and practice, simulation, tutorials, and games. Computerized drill and practice offers repeated opportunity for developing speed and accuracy necessary in certain subjects. It also offers immediate feedback and error correction, which increases both efficiency and motivation (Sloane, 1989).

In the last twenty-five years significant resources and time have been invested in computer assisted instruction (CAI) (Levin et al., 1987). A number of experimental studies have been conducted to assess the effectiveness of various CAI software packages. These studies, especially those conducted recently, tend to conclude that CAI does enhance achievement in the absence of any other programmed instructional material (Nordstrom, 1988).

There is ample evidence that CAI is both very effective and efficient. Recent research has argued that CAI leads to faster learning with better comprehension, retention, completion rate, and attitudes, when compared with more traditional educational approaches (Bright, 1983). Students learn more

material or retain more of what they have learned. There is a higher student completion rate for courses of study using CAI (Levin et al., 1987).

In addition, a meta-analysis conducted by Kulik (1985) produced some interesting results concerning the effectiveness of CAI. Kulik concluded that computer-based education has had positive effects on student learning.

Others, such as Richard Clark, however, presented a different summary of the research on CAI. Clark critiqued Kulik's meta-analyses and reported that the achievement gains attributed to the computer mode were probably due to the method of teaching used by the software, especially, the difference between the way the teacher taught and the way the computer program presented the instruction (Simonson & Thompson, 1990).

Although many studies have demonstrated that CAI can be an effective form of instruction, these studies also indicate that simply placing some materials on a computer will not improve its effectiveness (Clark, 1983). These contrary interpretations of the research data occur because they explain the information according to different sets of rules. Probably neither are absolutely correct. The advantages of using computers in specific situations and for teaching specific topics should be the focus of research efforts (Simonson & Thompson, 1990).

It is important that effective CAI should be carefully developed for a special topic. The development of CAI using the ABC authoring system for teaching basic electronics is considered in the present research study. ABC is an object-oriented programming system which is designed for development of instructional applications (Boysen, 1994).

### **Statement of the Problem**

This study was designed to develop a computer-assisted instruction (CAI) lesson using the ABC authoring system for teaching basic electronics and to evaluate some aspects of the lesson by investigating the students' perceptions after completing the lesson.

### **Objectives of the Study**

The objectives of the study were to:

1. design and develop a CAI lesson employing the ABC authoring system which could be used for teaching basic electronics; and
2. evaluate some aspects of the lesson by investigating the students' perceptions after completing the lesson and by viewing videotape of the students who were learning the lesson.

### **Research Questions**

This study was conducted to answer the following questions:

1. How can the ABC authoring system be used to design and develop a CAI program for teaching basic electronics?
2. What will be the students' perceptions about the CAI lesson concerning the following aspects: (a) subject matter; (b) presentation; (c) student interaction; and (d) program interaction?
3. Will the students learn anything from the lesson?

### **Procedures of the Study**

The procedures for this research study involved three major steps. The first step was to design and develop the CAI lesson using the ABC authoring



system. The second step was to administer the CAI lesson and collect data. The final step was to analyze and summarize the data obtained through observation and testing of the students.

The procedures of the study were as follows:

### 1. Development the CAI Lesson

- Review the related literature
- Review the ABC authoring system
- Identify some concepts in basic electronics
- Design the presentation techniques
- Develop a CAI lesson
- Make the lesson available for the public
- Have an expert review the lesson
- Perform some revisions

### 2. Data Collection

- Obtain approval from the University Human Subjects Review Committee
- Arrange for data collection
- Administer a pretest one week before administering the CAI lesson
- Administer the CAI lesson and videotape the subjects
- Administer the questionnaires and a post-test

### 3. Data Analysis and Summarizing

- Code and categorize data from the questionnaires
- Analyze data from questionnaires and achievement tests
- Analyze data from the videotape
- Summarize the data

### Limitations of the Study

This study was conducted under the followings limitations:

1. The CAI lesson covered some basic topics on DC circuits: basic quantities, Ohm's Law, series circuit, parallel circuits, and series-parallel circuits.
2. The CAI lesson could be accessed from the Project Vincent terminal.
3. The subjects of the study were undergraduate students at Iowa State University who were not taking and had not taken any college-level electronics class.

### Definition of Terms

**ABC:** an object-oriented programming system which was designed at Iowa State University for the development of instructional applications (Boysen, 1994).

**Authoring Language:** a special-purpose computer language that is designed expressly to facilitate the writing of educational programs (Maddux, 1992).

**Click:** when a mouse is used, pushing the button on it is called "clicking."

**Computer-Assisted Instruction:** the use of the computer as an aid in the teaching/learning process.

**Courseware:** a specialized type of software that provides course content instruction via computer program (Chambers, 1983).

**Method:** a term in the ABC authoring system as a function in C Language or a procedure in Pascal. A method defines how an operation is performed.