Extendible Computer Assisted Instruction System

Patricia Denny

Department of Mathematics, Statistics and Computing Science

University of New England

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Declaration

I certify that the substance of this thesis has not already been submitted for any degree and is not currently being submitted for any other degree.

I certify that to the best of my knowledge any help received in preparing this thesis, and all sources used, have been acknowledged in this thesis.

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Abstract

A Computer Assisted Instructional (CAI) system is an instructional system in which the instructional contents or instructional activities are delivered via computer. CAI have evolved considerably since their inception in the 1950s. Abilities of some of the contemporary CAI systems range from systems that are unable to provide feedback or individual instructions to students, to Intelligent Computer Assisted Instruction (ICAI) systems (more commonly known as Intelligent Tutoring Systems (ITS)). CAI systems are usually specially designed to cater for a specific need. A typical CAI system can be used to do any of the following: teach a particular subject; collect detailed performance data to better understand students' problem solving techniques; or provide individualised instruction and the opportunity to work in group situations. There are still a considerable amount of research problems that need to be addressed in building CAI systems.

The *objective* of this thesis is to investigate, design and implement an extendible CAI system for teaching LOGO programming concepts and Geometry concepts, and to carry out case studies and comparative studies to evaluate its capabilities.

To achieve this objective, the main *research aims* of this thesis are as follows:

- identifying suitable teaching strategy and associated teaching tactics to enable effective teaching of LOGO and Geometry concepts;
- identifying suitable techniques for organising and presenting the instructional material to the students for effective learning;
- developing student monitoring mechanism for the collection of student performance data;
- developing techniques to match student answers with expert solutions for a particular task and consequently detecting common errors and misconceptions; and
- developing a suitable human-computer interface between the student and the system, and a suitable human-computer interface between the teacher and the system.

The author's main *scientific contribution* in this thesis is to design a CAI system to teach LOGO and Geometry concepts using the appropriate teaching strategies, and the CAI system is capable of collecting student perfromance data. The author achieved this in five steps. Firstly, the author examines different theories of learning, and identifies tutorial and discovery learning as the two most appropriate teaching strategies for teaching LOGO and Geometry. Secondly, the author designed and built a CAI that has the following three main components: Lesson Component; Student

Monitoring Component; and the Human-Computer Interface Component. The design of these components and their interrelationships are examined in detail in this thesis. The three *principle features* of this CAI system are as follows: allow students to be taught on several levels of expertise; enable teachers to control the instructional content; and provide the teacher with performance data for future research. Thirdly, the author describes the procedure to follow to ensure that the CAI system is operationally ready. These procedures have to be followed in preparing the CAI system for group or individual use. Fourthly, the author carried out two case studies to demonstrate the potential of the CAI system as a teaching and as a research tool. Following this, the author identifies the criteria for building an effective CAI system, and compares the developed CAI system with a commercially developed CAI system using these criteria. Finally, the author concludes that the developed CAI system effectively meets the research aims, and looks at future developments which will further enhance this CAI system.

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Glossary

ASCII American Standard Code for Information Interchange. Information is stored in binary code to make it interchangeable between different computers.

Branch Branch to another part of the computer program instead of the next sequential instruction.

E-R Diagram Entity-Relationship Diagram. Used to represent the relationship between data in a database such as a one to many relationship.

Edit Make alterations or corrections to text.

Node Current position in a tree. (c.f., tree).

Tree Pictorial description of how data is organised. The first item of data can "branch" to one or more other items - which in turn can branch down to other items.