Designing Interactive Learning Environments

A dissertation presented in partial fulfilment of the requirements for the degree of Doctor of Philosophy in Computer Science at Massey University Palmerston North, New Zealand.

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1995

Abstract

The trend towards teaching by facilitating learning rather than by direct instruction is an important one. As part of this movement, there is a growing interest in the concept of interactive learning environments (ILEs), where students learn by experimenting with a computer system that simulates some device, system or situation. Although ILEs can act as effective teaching aids they are time-consuming to create. In this thesis, principles that are useful for guiding the development of these systems are proposed, and design issues are explored.

In order to determine what the principles for development should be, the history of teaching by computer is reviewed, with an emphasis on interactive systems that have a learning rather than instructional bias. The important concepts of modelling, discovery learning and fidelity are examined in some detail.

One of the conclusions of the initial survey is that it is not feasible to think in terms of general design primitives that can be used for the development of all interactive learning environments. Since there is a diverse range of possible environments, two specific types are examined. In each case, a framework for design is proposed.

First, the teaching of procedural skills is considered. These skills include the ability to understand the operation of mechanical devices, to be able to carry out tasks with them, and to correctly assemble and dismantle pieces of equipment. Providing a realistic model which can include informative feedback is seen as important. It is demonstrated that a scheme adapted from AI planning can economically provide an appropriate level of fidelity for modelling device operation. A compatible notation for denoting tasks is also developed.

A methodology for the design of ILEs for teaching procedural skills is proposed, complete with graphical specification for both domains and tasks. It is envisaged that such a scheme would allow domain experts and teachers to take a full part in the design process, even if they are unable to write or understand computer programs.

The second kind of ILE considered involves the simulation of human behaviour. Two schemes for knowledge-based simulation are examined: one based on CYC and one on Schank and Abelson's behavioural model. The former is used to outline a system for simulating problem-oriented policing. The latter is extended to facilitate the

development of knowledge-based simulation teaching systems. This second scheme is then applied to the simulation of domestic disputes.

Since many of the problems of simulating real world events by computer software have yet to be solved, a full computer implementation is not yet a realistic proposition. Instead, the domestic disputes model is tested using a 'Wizard of Oz' approach. Results show that a scheme based on the model proposed is feasible, that subjects can successfully use such a system and that, as a result, they believe their understanding of the issues being presented is improved.

Acknowledgments

First and foremost, I would like to acknowledge the support of my main supervisor Mark Apperley, without whom this research would not have got off the ground. Besides steering me through the project he provided those two most invaluable commodities: time and space.

Next, I would like to express my gratitude to Ross St George, my second supervisor, who has always given me thoughtful feedback on my writing and proffered enthusiastic support throughout. Ross introduced me to the work of Pittsburgh's Learning Research and Development Center and helped me organise study leave in that city to talk to researchers at LRDC and Carnegie-Mellon. This has had a very great impact on my views and on the direction that the project has taken.

Thanks are also due to other people who have provided useful and often detailed comments on drafts of the thesis. These include Noel Craske, Geoff Cumming, Andre Everett, Gord McCalla, Jean McKendree and John Self. Without their input this document would have been completed several months earlier. Hopefully, however, the final product contains far fewer mistakes and is much more cohesive than would otherwise have been the case.

Lastly, I would like to thank various people who have contributed in other ways to the completion of this project and the content of the thesis: Shamus Smith, who has implemented some of the teaching system ideas, tested out the models and helped set up the Wizard of Oz experiment, as well as carrying out other smaller tasks too numerous to mention; John Andreae, who helped me get into shape material for the IJHCS paper, much of which has been used in Chapters 4 and 5; Dave Burns, who suggested and helped with the development of the POPIT police teaching system; Phil Carter, who conducted the domestic violence survey used as a basis for the model in Chapter 7; Stephen Cranefield, who validated the planning schema used in Chapter 4; the Computer Science secretarial staff, particularly Rosemary and Wendy, who were always very helpful; and most of all my family: Rebecca and Stephen for their support, and my wife Elizabeth who kept me focussed and sane.

Publications

The following publications are associated with the research presented in this thesis.

Journal Articles

Kemp, R. H. (1992). Intelligent Computer Assisted Instruction: a knowledge-based perspective. *Australian Computer Journal*, *24*(3), 121-129.

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