INTRODUCTION TO THE SPECIAL ISSUE ON MODELLING HUMAN TEACHING TACTICS AND STRATEGIES

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INTRODUCTION

This Special Issue has emerged from a workshop on Modelling Human Teaching Tactics and Strategies held in conjunction with ITS2000 in Montreal. The purpose of this workshop was to explore the issues concerned with capturing human teaching tactics and strategies as well as attempts to model and evaluate those tactics and strategies in systems. The former topic covers studies both of expert as well as "ordinary" teachers. The latter includes issues of modelling motivation, timing, conversation, learning as well as simply knowledge traversal.

This workshop was a follow-on from the panel discussion at AI-ED'99 that stimulated a debate about the whole issue of how and whether, and with what effect, human teaching tactics can/should be modelled. The description of that panel was as follows:

> "According to Bloom, one-on-one tutoring is the most successful form of instruction. Bloom was referring to human tutoring but the AI-ED community has replicated this finding with computer tutors in intelligent tutoring systems where computers generate adaptive forms of tutoring for individual learners. Recently, the AI-ED community has been exploring issues of human tutoring in terms of how experts coach novices, when do tutors tutor, how do they tutor in terms of the types of things they say to the learner, and when do they fade their assistance? One issue this panel will address is should computer tutors mimic human tutors or are there special advantages or disadvantages of computers that should be drawn on or avoided?
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> "Even if the computer could accurately diagnose the student's affective state and even if the computer could respond to that state (in combination with its diagnosis of the learner's cognitive state) exactly as a human tutor would, there remains one final potential difficulty: the plausibility, or perhaps the acceptability, problem. The issue here is whether the same actions and the same statements that human tutors use will have the same effect if delivered instead by a computer, even a computer with a virtually human voice." (Lepper et al., 1993)
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> Human-to-human tutoring incorporates mechanisms that are associated with normal conversational dialogue, but rarely incorporates most ideal tutoring strategies. Some of the normal conversational mechanisms can be simulated on computer, whereas others are too difficult to incorporate in current computational technologies. It would be prudent for an ITS to incorporate both ideal pedagogical strategies and some conversational mechanisms that are within the immediate grasp of modern technologies. But this solution is periodically confronted with trade-offs and conflicts between ideal strategies and natural conversation. These issues will be addressed by this panel."

The papers presented at the ITS2000 workshop covered a wide range of issues from observation of expert teachers and untrained tutors via provision of teaching tactics in an authoring system to modelling teaching tactics in a variety of teaching systems (see http://www.cogs.susx.ac.uk/users/bend/its2000/webpage.html)

The four papers selected here offer differing perspectives on the topic. Du Boulay and Luckin's paper is itself designed as an overall introduction to the field, which is why this Editorial introduction is quite brief. They take as their starting point Ohlsson's (1987) critique of the limited range of teaching tactics employed in intelligent tutoring systems. They examine various methods that have been used to extend this range, including observation of teachers, application of learning theory and observation of students. They describe two recent examples of their own work. One has used the literature on the observation of expert teachers to develop a system with an explicit theory of teaching tactics to maintain the student in an optimum motivational state for learning. The other has applied Contingent Teaching and Vygotsky's notion of the Zone of Proximal Development to a range of learning environments that attempt to maintain the student in an optimum cognitive state for learning.

Wood addresses the history of the development Contingent Teaching and scaffolding in his paper. Contingent Teaching is based on the notions that teaching tactics adopted by tutors are contingent on what their learners do and, ideally, should give the learner as much autonomy as possible while they are making good progress but offer increasing degrees of help when things start to go wrong. Wood's paper describes experiments that he and his colleagues have conducted observing individual differences between learners and between human and machine tutors. Within these studies they explore the interesting interactions between help-seeking behaviour among learners, learner aptitudes, and the degree to which different learners make best use of the help that is available from systems.

While Wood's work has been mostly with children and focused largely on how different teaching and help provision strategies affect them, Lajoie and her colleagues have looked at an expert human teacher teaching adult medical students. Their analysis shows how different tutorial actions are used to produce a wide variety of outcomes e.g. metacognitive, prioritization of tasks, encouraging collaboration, conceptual model building and so on. Their paper provides design guidelines for a particular kind of tutoring system.

One of the skills of the expert teacher is weaving together a variety of tactics, being responsive to individual students and unexpected events, and yet maintaining coherence within the learning episode. Some early systems had particular capabilities in this direction: SOPHIE (Brown and Burton, 1975) remains an impressive example of this. But we now see systems that use statistical parsing techniques (such as Latent Semantic Analysis) rather than the formal domain-based method of Semantic Grammars applied in SOPHIE in order to allow a rather freer textual interaction. The possibility of making reasonable sense of whatever the student types (within the constraints of the domain) needs to be coupled with techniques that enable the tutor be act as a "conversation partner that comprehends, speaks, points, and displays emotions, all in a coordinated fashion" (Graesser et al., 2000)

Graesser and his colleagues are developing a series of tutors under the generic title AutoTutor. Their paper in this volume describes an analysis they have conducted of ordinary people acting as tutors and how they have designed AutoTutor to be able to simulate many of the dialogue moves so observed. It is organized around a richly structured (but handcrafted) "curriculum script" containing questions, examples, hints, prompts, anticipated answers, corrections and summaries. The system exploits a theory of dialogue in order to determine what kind of conversational move it should make given the tutorial dialogue so far and its assessment of the student's state of knowledge. It's interaction with the student is conducted via an animated agent, MARCO, which (who?) acts as a talking head. Input from the student is via the keyboard.

Taken as a set, the papers provide an interesting mix of observational work with human learners operating under different teaching regimes, observational work with human tutors of varying degrees of expertise as well as system implementations in a number of domains.

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