Modelling Human Testing Strategies: A Computer-Aided Approach to Knowledge Acquisition

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This research describes an approach to developing adaptive tests based on modelling the strategies of an expert teacher. It is concerned with the assessment of student knowledge in a particular domain of arithmetic. The expert teacher works with a population of male adults, who are serving time at a local prison. The main aim of the teacher is to provide plans of remedial tuition designed to prepare students for public examinations.

These students are quite different from conventional classroom students. For example, there is a diversity of backgrounds and no common prior knowledge. Many of the students have very low motivation and lack confidence. Also, as there are no fixed academic terms in prison, the prisoners join tutorial sessions at different times. These factors make the job of the teacher very difficult, and create a need for flexible tuition plans based on individual assessments of need.

This research involves a knowledge elicitation exercise focussed on the teacher's evaluation of students. This exercise took the form of structured interviews and task analysis lasting approximately twenty hours and spread over a period of three months.

Four interesting things emerged. First the teacher had already developed an informal testing technique, which could properly be described as adaptive testing. Secondly, constraint logic software successfully provided support for knowledge acquisition. It proved to be much more convenient and controllable than paper-based methods that had been used at first. The software enabled the teacher's sometimes tentative descriptions to be made precise and, most importantly, allowed examples to be constructed in the presence of the teacher so that they could be used to confirm the validity of the on-going knowledge acquisition process. Tasks involving sequencing of problems, which had been particularly difficult to handle with paper-based methods, became much more tractable. Thirdly, the notation of constraint logic programming proved to be suitable for knowledge representation in the domain of elementary arithmetic of fractions, which was the tutor's topic. Fourthly, the way in which the expert teacher explored a student's knowledge of a syllabus could be represented as a state-space search. The state-space was progressively pruned as the teacher discovered more about the student's knowledge.