William J. Clancy.
KNOWLEDGE BASED TUTORING.
Cambridge, Mass: MIT Press, 1987
$30. pp. 377.

Artificial Intelligence has been described by one of its proponents as "the science of making machines do the sort of things that are done by human minds, such things include holding a conversation, answering questions sensibly on the basis of incomplete knowledge, learning how to do things better." It is not the study of computers, but the study of intelligence, however defined, in thought and action, though it uses computers as tools in its enquiries. We learn that "among the practical applications most recently developed or currently being developed are medical diagnosis and treatment, teaching some subjects such as geography, or electronics, to students with differing degrees of understanding of the material to be explored." MIT Press has issued a *Series in Artificial Intelligence*, starting in 1979, of which the present text (1987) is one of the most recent titles.

Clancy's work began as a Ph.D. project at Stanford in the 1970s, as an attempt to encode a teaching method in a fashion similar to the encoding of the knowledge basis of certain existing disciplines or scientific practices. If such a teaching method, no matter how produced, could be shown to be successful when applied to one area of knowledge, and then applied to other areas of knowledge with similar or greater degrees of success it would demonstrate that it was possible to encode teaching strategies and procedures equally with the knowledge bases of conventional school subjects.

It will be remembered that in the late 1960s and early 1970s much attention was devoted by learning theorists and others to the structure of knowledge, especially in such subjects as mathematics. On the one hand there was a complete revision of the mathematics curriculum, and on the other, attention, within aspects of the curriculum, to the substructure of information required by the student, for the understanding of that particular topic. This attention, and its results, was of great benefit to those who sought to prepare material for Computer Assisted Instruction (CAI). CAI depended for its success not merely upon the organization of the knowledge base of the instruction but upon the authoring skills brought to bear upon its various topics, and these skills in large measure depended upon the theories of instruction and the intuitions of the authors.

Some practises of instruction were deduced from the practises of the "great teachers" as these had been set out by them, or their disciples. The rationale of the History of Education courses in university teacher training departments arose from the work of Joseph Payne and its formalisation in lectures by Fitch, at Cambridge, and Compayre, in Paris, from the 1870s

onwards. The proselytizing of disciples has been most clearly shown by followers of Herbart, Froebel, Montessori, Dewey, Freud, and, to a lesser extent, Piaget.

Of course, as these practises were modified, and sometimes stultified, in their transmission to an ever increasing number of putative teachers, they bore less and less resemblance to the originals from which they had been derived. Some teachers triumphed with what was inculcated in them by such practises; some triumphed in spite of them. However, the hope was ever present that analysis of methods shown to produce knowledge mastery in students might lead to the emergence of a nucleus of a single teaching strategy which could be applied to more than one subject field. In this endeavour, procedures useful in the construction of CAI programmes, especially branching and recursive presentations were initially helpful.

In the terms of the present text, what was required was "the architecture for implementing such a program (to teach multiple problems in multiple domains) made concrete by many examples of teaching rules for directing an instructional dialogue."

Clancy has the advantage of using one well known (i.e., to AI researchers) program of a rule-based expert system used in medical diagnoses. Clancy's program, called GUIDON (pronounced "guide on") has a set of 200 teaching rules. He codifies some twenty-six dialogues, with suggestions for the selection of alternative dialogue sequences. It must be stressed that these are suitable for CAI presentations and for use by other AI researchers seeking to analyse and perfect knowledge-student learning interactions. They are important as a step forward and a s a basis for further steps in the development of better teaching strategies for other subject areas. They are not inherently helpful for the classroom situation which does not employ such sophisticated knowledge acquisition procedures.

The text is well presented, clearly documented, but relies a great deal upon the knowledge and sophistication of its readers, i.e., to a presumed audience interested in and generally familiar with the acronyms and technical language of AI enthusiasts. It could be of use to those about to write software for CAI, and who seek a presentational background wider than their own. It provides a message of hope, though not of hope to be immediately gratified, to all those who believed that the study of the teaching methods and strategies of the "great teachers" of the past was of value to the present. But it is not for the present generation of teachers.

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