

The Potential of Computer Assisted Learning in Medical Education

T. S. MURRAY, MRCP, MRCP, W. R. DUNN, BSc, M Ed, R. W. CUPPLES, BSc, J. H. BARBER, MD, FRCGP and D. B. SCOTT, BSc, PhD

*Departments of General Practice and Education,
University of Glasgow*

Much of the skill of a doctor relates to his ability to confront and solve a clinical problem. The medical student must develop these skills if he is to make adequate use of the factual information he acquires during his formative undergraduate years. Card (1975) objected to the traditional methods of teaching because each doctor has to train anew to acquire his whole diagnostic programme, which can be extremely skilful but dies with him. There is also a suspicion that the traditional way may not always be the most efficient way.

Newell and Simon (1972) have stated that man is an information processing system when he is solving problems, but their approach is complicated and would be difficult to apply in a medical context. Aitchison (1970) described the application of statistical decision theory to the teaching of clinical decision-making and, in a later publication (Aitchison, 1974), stated that the recognition of numerical patterns is unlikely to be acquired easily by clinicians.

A series of models in computer assisted learning (C.A.L.) is being developed in Glasgow. These models become progressively more statistical and give the student an insight into the way in which the clinician uses information in the clinical situation to make decisions. The first model is expressed in terms of a detailed case history covering the presentation, investigation, diagnosis, treatment and further management of the patient and involving social and psychological aspects of illness in addition to organic disease.

The scoring scale used is from 1 to 5, and each option has to be graded independently. These options have been graded previously by a panel of 'experts'. Any option graded 5 by the expert is considered mandatory and any graded 1 is an action that must not be done. These options have to be graded correctly by the students or they will be asked to grade again the ones they got wrong. The other options (2,3 and 4) are less critical and an error of ± 1 is allowed. Several, or all, of the options can be graded at the same level. The program on the visual display unit provides a stimulus for discussion. The students' rating is compared with those of the 'experts' and, if the group is at variance, quick and relevant 'feed-back' is given which reinforces the learning process. This work has been

described by Murray *et al.* (1976a, b). In traditional teaching great emphasis is given to correct actions; with our present model in C.A.L. emphasis is given to correct actions but the students also receive systematic feedback and positive reinforcement when they correctly eliminate incorrect actions from the number of alternatives they are considering.

When an experienced clinician is presented with a diagnostic problem he formulates a number of differential diagnoses and intuitively makes a mental estimate of the probabilities of each diagnosis. He will later eliminate some possible diagnoses from his differential list as he collects more information and thus threads his way through the diagnostic search tree (Card, 1970). In the more traditional forms of clinical teaching, emphasis is placed on the most probable course of action, on the action that must be done. There is less systematic emphasis on actions that must not be done, could be harmful, or on the possibilities that can be eliminated from the decision-making process. An awareness of these is one of the skills of the experienced clinician.

METHOD

Two groups of six students from the fourth year of the new five-year medical curriculum at the University of Glasgow were asked to participate in this method of teaching. They had not previously been exposed to C.A.L. Each group completed two case problems during an afternoon session and attended for this instruction on three alternate weeks, completing six management programs. The programs chosen related to patients with asthma, hypertension, coronary thrombosis, pernicious anaemia and myxoedema, diabetes mellitus and backache. Each had been valued by a panel of 'experts' and a consensus of the experts' values represented a score of 100 per cent. The purpose of the present study was to determine whether exposure to C.A.L. improved the students' decision-making, especially in decisions considered mandatory by the 'experts'.

RESULTS

Each program can be produced as a print-out and the students' score in the mandatory decisions is compared with the experts' in Table 1. The experts' score is regarded as 100 per cent in all problems.

DISCUSSION

This method of instruction is popular with the students and over 300 have taken part, almost all being keen to have further similar teaching. The opportunity to manage a case over a significant time scale and to apply their knowledge to different decision situations is likely to be an attractive proposition for the students, as it closely parallels their future role as doctors and makes them aware of some of the problems they will face when qualified. The students work in small

Table 1. Mandatory decisions. All students.

	Decision 5	Decision 1
1st problem	73%	71%
6th problem	79%	91%
2nd problem	62%	67%
5th problem	63%	83%
1st and 2nd problems	67%	69%
5th and 6th problems	71%	87%

groups and learn from each other. This extended teaching is seldom possible in traditional medical education.

Traditional forms of clinical teaching place more emphasis on actions that must be done than on actions that are positively harmful. The students were unsure of the latter at the beginning of the study but became much more aware of these as they worked through the programs. Their '5' decisions understandably varied only slightly, because their factual knowledge would not be likely to vary greatly in an interval of two weeks. There was a marked fall in the number of '2' and '4' used, showing that the students became more definite in their decision making. The number of '3' used rose slightly.

The order in which the problems were given to the students was selected by the computer programmer and both groups did the units in the same order. It was felt that the results could be explained as a 'problem' effect: a further six students at the same stage in the curriculum and who had not previously been exposed to C.A.L. then completed the six programs in the reverse order. The trend was even more marked in the decisions '1': from 64 per cent to 100 per cent. On this occasion there was a slight fall in decisions '5', from 79 per cent to 74 per cent.

With C.A.L. the students were made aware of all levels of actions: if their initial decision was at variance with the 'expert', the learning process was reinforced (Skinner, 1954) and this was carried out in a systematic way.

We would argue that through this learning experience the student will be able to make better use of the information available to him in the clinical situation and will be alerted to its misuse. Studies in computer-assisted diagnosis (Taylor *et al.*, 1971; de Dombal *et al.*, 1972) have suggested that the decision making of clinicians had appeared to improve to a marked extent with repeated use. This was thought to be due to their gaining insight into their diagnostic mechanisms. By

gaining insight the students are prepared for the more complicated statistical models.

Emerson (1975) stated that doctors do not readily accept a numerate approach to clinical decision making. One reason for this is that the intellectual reward of medicine lies in making independent judgements and doctors are less comfortable when they have to define precisely the data on which their judgements are based. The present model in C.A.L. is an attempt to introduce the students to these complex processes.

At present the undergraduate course is biased towards acquirement of knowledge, whereas the work of the qualified doctor is concerned with accomplishment. With adequate experience the first leads to the second. C.A.L. is an attempt to compress this process.

Simpson (1975) questioned the value of this method of instruction and stated that to be justified, it must be more effective than other methods.

The development of C.A.L. in Glasgow is at an early stage but we hope we have demonstrated that this method of instruction has unique advantages: it has potential in teaching and offers solutions to problems so far unsolved.

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