THE FUTURE OF COMPUTER ASSISTED LEARNING IN LAW

by

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Introduction

The use of computers in higher education has grown as the use of computer-assisted learning packages, LEXIS, CD-ROM and word-processing systems has become more widespread. In this paper we examine computer-assisted learning, or "CAL". In the legal field, teachers and researchers have developed a number of CAL programs, and most of their evaluations of the programs have reported encouraging results.[1] CAL has been gaining acceptance steadily, although it has not yet fulfilled the prediction that it would revolutionise teaching. To date, few reservations of a general nature have been expressed concerning its role in legal education.[2] Nevertheless, we feel that it is failing to remedy the need for legal education to develop the type of intellectual skills required of a lawyer. In this paper, we explain why the present forms of CAL are proving disappointing, and the directions which future developments in CAL must take if it is to play an important role in this aspect of legal education.

What are the aims of legal education?

There is vast and diverse literature on the appropriate aims of a legal education, which will undoubtedly continue to grow in the future. Nevertheless, we can find support in recent surveys of students, graduates, teachers and practitioners for the view that a central role should be given to the development of higher intellectual skills, rather than the mere acquisition of a detailed knowledge of substantive rules. Students surveyed by Stott rated the skills of understanding, application and analysis above the acquisition of knowledge.[3] Similarly, Leighton and Sheinman found that law graduates perpetuate this desire, and would have preferred "a greater

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1 For a general reference on recent CAL packages, see Paliwala, *Information Technology in Legal Education: A Resource Book* (1991).

2 See Franson, "IBM-UBC Cooperative Project on Law and Computers: A Tentative Evaluation," (1988-89) 23 *University of British Columbia Law Review* 171, 186. For an example of such reservations, see Korn, "Computer-Assisted Legal Instruction: Some Reservations," (1983) 33 *Journal of Legal Education* 473.

3 Stott, "The Student as Evaluator," 24 *The Law Teacher* 56. A group of students were asked to rate suggested aims of legal education out of five: "In the 'cognitive domain', the mere acquisition of knowledge was accorded the lowest rating (3.46), in favour of the higher cognitive skills of understanding (4.38), application (4.23) and analysis (4.46)." (61ff).

emphasis on skills outside the learning of straight rules".[4] Bright found that although 87% of practitioners felt that substantive law was adequately taught, only one-third felt that graduates had an adequate understanding of law in its wider economic and social contexts.[5] Therefore, although "the majority of law teachers apparently see themselves as primarily responsible for the development of general intellectual skills rather than specialised vocational skills"[6], in combination, these studies indicate that the legal curriculum suffers from an over-emphasis on black-letter law and an insufficient regard to the higher intellectual skills.[7]

There is less agreement when it comes to identifying the higher intellectual skills which need to be taught. Those who advocate a purely vocational education would put the emphasis on practical skills such as negotiation and interviewing; those who advocate an academic or liberal education might emphasise placing law in a broader social or theoretical context.[8] However, we believe that a fundamental and minimum skill necessary, in either case, is the ability to form one's own informed opinion of the subject matter. At a minimum, this requires students to read the primary materials of their subject, discriminate between relevant and irrelevant passages, abstract the relevant principles, and synthesise them into a coherent, defensible theory of their own.[9]

It is, of course, far more difficult for a lecturer to teach these intellectual skills than simply to teach the lecturer's own theory or view of the subject. Teaching the rules of law is easier to monitor and assess than teaching a student to "think like a lawyer"; both the student and the teacher have a comforting sense that a course has been adequately taught when the majority of material found in the standard textbooks has been lectured.

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4 20 *Law Teacher* 3 at 6. Leighton and Sheinman (at 7) also refer to a number of American surveys of law graduates which "gave clear and compatible indications that a greater emphasis on skills outside the learning of straight rules would have been greatly appreciated".

5 Bright, "What, and How, Should we be Teaching?" (1991) 25 *Law Teacher* 11 at 18. In addition, practitioners also said that law graduates do not have sufficient problem solving or written communication skills: Bright, at 17.

6 MacFarlane, Jeeves and Boon, "Education for Life or for Work?" (1987) 137 *NLJ* 835 at 836. See also Twining, "Legal Skills and Legal Education," (1988) 22 *Law Teacher* 4 at 4: "there is a need for more theorising, research and development in respect of skills relevant to both the discipline and practice of law."

7 See also *Report of the Committee on Legal Education* (the *Ormrod Report*) 1971, Cmnd 4595, para. 101.

8 For a description of different models of legal education, see *Report of the BILETA Inquiry into the Provision of Information Technology in UK Law Schools* (1991), para. 3.0 *et seq.*

9 See also the *Ormrod Report*, *supra*, para. 101: students should be provided with "a basic knowledge of the law and where to find it; an understanding of the relationship of law to the social and economic environment in which it operates; and the ability to handle facts and to apply abstract concepts to those facts".

Nevertheless, it is not impossible to teach analytical skills. Numerous studies by educationists demonstrate that skills can be acquired by practise, if accompanied by constructive criticism and advice. It is not surprising, therefore, that the most enduring reforms in legal education, such as the Socratic method, have been those which require the students to develop and apply analytical skills in the classroom. Successful legal teaching techniques have combined both critical, independent thought on the part of the students, and frequent practise in expressing and defending those thoughts through the teacher-student dialogue. The Socratic approach to the case method, as pioneered by Dean Langdell at Harvard, has remained popular because the students form their own views on the meaning of the cases and statutes.[10]

What type of teaching does CAL do?

It was initially thought that computers could provide the type of interaction found in effective learning.[11] In theory, students would work at their own pace, in appropriate areas, and instantly receive informative responses without the pressure which is sometimes found in the traditional classroom. Computers would stimulate the students' interest by scoring their work and incorporating graphics and sound. Teachers were also supposed to benefit: the computer would reduce the time spent on elementary points and could be programmed to store the students' responses for review by the teacher, thereby resulting in better preparation on the part of both students and teachers for classes. CAL "seemed to offer the prospect of reducing long-run instructional costs, while preserving or in some respects improving educational effectiveness."[12]

In both the USA and the UK, individual law schools and teachers have developed programs, but have been held back by the costs and the lack of efficient channels for distribution and publication.[13] For this purpose, a number of co-operative organisations were set up. The leading group in the United States is the Centre for Computer Assisted Legal Instruction (CCALI), set up by the University of Minnesota and Harvard Law School in 1982. Since then, CCALI has received ample research funds and has been able to attract participation from a large number of law schools: by 1988 there were approximately 104 member universities subscribing $2,500 annually in order to share in about 40 programs, information packages and authoring languages. CCALI also played a significant role in the movement

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10 For a recent evaluation of the case method, see Tribe and Tribe, "Paperchase Revisited: The Huddersfield Experiment," (1985) 19 *The Law Teacher* 24.

11 On the benefits of legal CAL, see e.g.: Rio, "Computer Assisted Legal Instruction," (1988) 12 *Legal Studies Forum* 323; Young, "Computer Assisted Contract Law Tutor," (1986) 2 *Yearbook of Law, Computers and Technology* 131; and Franson, *supra*.

12 Clark, "The Rationale for Computer-Aided Instruction," (1983) 33 *Journal of Legal Education* 459.

13 For a general review of the history of teaching with computers, see Tim O'Shea and John Self, *Learning and Teaching with Computers: Artificial Intelligence in Education* (1983), at 67-126.

away from mainframe systems to personal computers, thereby making CAL accessible to a wider number of institutions.[14]

The United Kingdom has several institutions which perform a similar function to CCALI. The first, CALI (UK), was set up in 1985 to fulfil the role of its American counter-part. Its efforts have been concentrated on distributing the LEXICAL and INTERPRO authoring languages without charge. BILETA, the British and Irish Legal Educational Technology Association, has 45 member law schools and jointly runs the Law Technology Centre, which was established with help of a grant from the University Grants Committee in 1987 to the University of Warwick. Research into CAL has recently benefited from an ESRC grant to Leith, Jones and Paliwala to construct a Methodology for Legal CAL (CMLCAL) and a Consortium headed by BILETA has recently received a grant from the Universities Funding Council to develop courseware. Despite the work of these groups, the development of CAL in the UK continues to rely on "a small but productive group of law teachers"[15] and suffers from a "segmented and ad hoc approach".[16]

Evaluations of CAL

There have not yet been any general surveys of the effects of CAL on higher education in law in the UK, although evaluations of individual CAL programs tend to reveal generally positive results. These results are inconclusive, however, as there have been serious methodological limitations in the evaluations themselves.[17] They are rarely detailed enough to indicate the cost, time or benefits of the program.[18] Many of the evaluations can be criticised for failing to compare groups which have used CAL against groups which have not.[19] Few of them compare CAL against alternative methods of

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14 Rio, *supra*, refers to estimates that in 1978, network access cost between $9.80 and $11.35 per hour.

15 Sparkes, (1988) p15.

16 Jones and Van Wyk, "Computers in Legal Education," (1990) 4 *Yearbook of Law, Computers and Technology* 1 at 2. See also Scott, "Students give CAL Marks out of Ten," (1989) *Law Technology Centre & BILETA Newsletter*, vol 2 no 1.

17 Clark, *supra*, at 467: "There is very little research directly on computer-aided legal education, and what there is appears to suffer from clear methodological limitations."

18 Most evaluations are based on interviews and questionnaires administered to the CAL users: e.g. Young, (1986) *supra*; Downes, Widdison and Pritchard, "Computing for Durham Law Students," (1991) 25 *Law Teacher* 26. For example, the questionnaire used by the Downes, Widdison and Pritchard team asked students how "helpful" the CAL program was; the Young (1986) questionnaire asked how "useful" it was.

19 But see recent attempts to compare CAL and traditional teaching methods in a more scientific manner, through the use of split groups (CAL and non-CAL) examination marks: Young, "CAL Tuition for First Year Law Undergraduates: Help with Problem Solving," (1991) 1 *Law Technology Journal* 32; Hogan, Cooke and Sharman, "Interactive Video in Law Teaching," (1990) 4 *Yearbook of Law, Computers and Technology* 104.

teaching; in particular, students are rarely asked whether the same material could be more usefully conveyed to them in written format.[20] Finally, CAL programs are frequently not measured against pre-existing goals. Obviously, a teacher who is unable to specify precisely what a CAL program is intended to accomplish will have little basis on which to judge its effectiveness. The observations made by Clark almost ten years ago remain valid today: "most [evaluations] only convince the reader that some particular instructors, at some particular time and place, used computer-aided instruction or a programmed learning technique and discovered, for reasons about which we cannot be sure, that the technique did (or did not) work better than some conventional technique."[21]

How can the evaluations be improved?[22] As a starting point, they must be produced with the needs of those who will use them clearly in mind. These needs are reflected in decisions that are made regarding the CAL program or CAL in general. Clearly, the evaluation should measure the performance of the CAL program or programs in the manner which is the most useful to the decision maker. The decisions to be made vary considerably, but they can be grouped into several broad categories. Firstly, a student, author or administrator may want to know if they can justify spending time or money on CAL. If so, the evaluation concentrates on a specific program to provide an example of what CAL can do. As resources are usually scarce in education, justification consists of more than merely proving that students found the program 'useful' or 'interesting'. It must be compared with other methods of learning and teaching. The use of the program, and therefore of CAL in general, is not justified unless it can be shown that it is at least as cost-effective as other methods.

In many cases, the people who rely or perform the evaluation may have already decided that using CAL can be justified. If so, the evaluation should determine how CAL be improved. For example, it may indicate how CAL programs should be written, the subjects that are most suitable to CAL, or perhaps on how existing CAL programs should be used. The evaluation focuses upon a particular program in order to arrive at results that are applicable to CAL in general. In contrast to an evaluation that seeks to

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Although control groups were used in these methods, their limits have been appreciated. Hogan *et al* acknowledged that the small number of participants, differences in experience and previous pre-test knowledge, only short term memory recall testing and his own non-educational psychologist evaluation detracted from the effectiveness of the method.

20 For examples of such research, see Franson, *supra*, and Scott, *supra*. There have also been relatively few attempts to evaluate CAL programs against one another, although Franson and Scott offer generalised comments as to the student responses between differing CAL programs.

21 Clark, *supra*, 468.

22 For general reference see, e.g., Jim Ridgway, "Development and Evaluation of CAL Materials," in R Lewis and E D Tagg, eds., *Trends in Computer Assisted Education* (1987), and Gary D Borich and Ron P Jemelka, "Evaluation," in Harold O'Neil Jr., ed., *Computer-Based Instruction: A State-of-the-Art-Assessment* (1981).

justify CAL, this type of evaluation concentrates upon comparing different types of CAL rather than comparing CAL with non-CAL methods of learning. If the results of the evaluation are to be widely applicable, there is little value in merely indicating that the program was well-received by students or lecturers. The evaluation must be more comparative and analytical, and must determine why the program was more or less successful than other CAL programs.

Even when the methodological limitations of the published evaluations are ignored, they exhibit some disappointing trends. CAL has not changed the lecture-tutorial style of teaching to a significant degree, thereby refuting initial predictions that computers would revolutionise teaching methods.[23] The studies which have compared CAL against traditional methods, although far from conclusive, suggest that there is no difference in the test results between groups which have used CAL and groups which have not,[24] and in some cases students prefer traditional lectures to CAL programs.[25] Currently, it has only been used as a supplement to teaching black-letter law, and many feel that is all it will do. Even within the area of black-letter law, it tends to be restricted to rote learning or revision of basic material, rather than the teaching of an intricate set of rules.[26] It will be very discouraging if this is all that CAL can or will do for legal education, as it will have perpetuated the failure to teach the higher intellectual skills. Unless this is overcome, CAL can and should only play a minor role in higher legal education.

Can CAL do more?

Can CAL teach the higher intellectual skills, as described above? Before answering this, we must determine why the current CAL programs have been restricted to introductory and revision lessons in black-letter law.

CAL first developed as an electronic version of a Skinnerian programmed learning text, that is, a progression of questions and explanations which communicate a certain body of legal rules. Every student

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23 Rio, *supra*, 334.

24 E.g. Young (1991), *supra*, and Hogan *et al*, *supra*. Research into elementary school teaching of reading and mathematics found that CAL, when measured by a cost-effectiveness criterion, "does not do as well as peer tutoring": Levin, Glass and Meister, "Cost-Effectiveness of Computer-Assisted Instruction," (1987) 11 *Evaluation Review* 50 at 69. But see Clark, *supra*, 467: "perhaps surprisingly, a fair number of studies show that with computer-aided instruction, as opposed to conventional instruction of some sort, students learn the same amount of material well in a significantly shorter period of time, e.g. 30 percent less time."

25 Hogan *et al, supra*; see also Allen and Robinson, "The Defamation Tutor," *Law Technology Journal* (forthcoming), and "Improving Linear Computer Assisted Learning," *Law Teacher* (forthcoming).

26 Paliwala, *supra*, at 3: "their purpose is usually that the student should understand the basic principles of law involved, before proceeding to a wider discussion of the subject matter". See also Pugh, "The Role of the Computer in Legal Practice and Legal Education." (1986) 7 *Business Law Review* 105.

proceeds through the same set of questions in the same order, regardless of individual ability or success in previous questions. Student input is limited to entering a single word or short phrase, or selecting one answer to a multiple-choice question. It is difficult to see what computerisation added to the value of a programmed text, other than a marginal improvement in convenience; nevertheless, the ease of writing such a program makes this "linear" model of CAL the most common in current practise.[27]

We feel that the primary shortcoming of linear CAL programs relates to the need to have the student develop his or her own theory of an area of law directly from the cases and statutes. The problem with any programmed learning method, including linear CAL, is that it requires the author to embody his or her own theory of the law into the program. In order to complete the CAL program successfully, the student need only learn the author's theory. Students who attempt to approach the subject from their own perspective or to introduce their own ideas are no more likely to complete the programmed tutorial successfully. By its very design, linear CAL does not satisfy the need to develop the student's independent analytical skills.

Furthermore, the nature of the student input also frustrates any attempt to develop intellectual skills. Limiting the entry to short answers or multiple choice responses does not challenge the student adequately. Studies on non-legal types of CAL show that attention spans quickly drop to five or ten minutes, and many students entering answers without thinking about them.[28] By entering short answers or multiple choice responses, the student merely recognises key words, rather than verbalising complex ideas. As Korn points out, "...verbalisation is essential to the ordering, refinement, and crystallisation of concepts in students' minds..."[29] Without it, the dialogue between the student and teacher is not rich enough to give full exposure and practise with legal discourse necessary to develop analytical skills.

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27 The majority of CAL programs developed in the U.K. have been based on a linear approach: Paliwala, *supra*. For examples of such programs, see Young, *supra*; Downes *et al, supra*. On the value added by computerisation, cf Paliwala, *supra*, at 3: "in this respect the CAL materials perform a role adjacent to that of text-books and cases and materials books."

28 John Whiting, "An Evaluation of Some Common CAL and CBT Authoring Styles," 26 *Educational & Training Technology International* 187 (1989) at 187.

29 Korn, *supra*, 482. See also: Burris, "Critical Features of Microcomputer-Based Exercises for Effective Teaching and Learning of Law," (1987) 4 *Yearbook of Law, Computers and Technology* 36 at 39; and Park, in Burris, Keeton, Landis and Park, *Teaching Law with Computers: A Collection of Essays* (1979), at 91.

Current Developments in CAL[30]

Computer instruction authors have been striving to increase the depth and quality of interaction between the computer and the student in order to overcome the two principal shortcomings of CAL programs, namely, their failure to engage the students in independent analysis of the subject, and their failure to incorporate a dialogue of sufficient complexity.

Despite the simple structure of linear CAL programs, they are often written with the idea of mimicking the style of questioning which occurs between a tutor and a student. Currently, most authors have acknowledged the benefits of flexible questioning and are anxious to make programs more sensitive to the needs of the individual student.[31] The development of "branching" programs was a result of this. Rather than requiring every student to answer the same predetermined line of questions, branching CAL programs consist of a complex flow chart of questions.[32] The program determines which branch the student should follow on the basis of factors such as the student's responses to previous questions and his or her overall ability. These systems can be quite sophisticated: for example, the University of Tübingen and the IBM Heidelberg Scientific Centre are working on the integration of CAL with artificial intelligence. They hope to develop an intelligent computer system which will operate on the basis of individual student files stored in memory. The computer will determine a particular student's level of performance from his or her file, and then teach a topic appropriate to that student in a manner which fits his or her ability.[33] Clearly, this type of program represents a significant advance over "linear" CAL programs. Unfortunately, the logical structures of branching programs can be so intricate that producing them becomes prohibitively expensive.[34]

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30 There have been successful innovations in other areas of CAL which are only of limited utility in legal education. For example, some mathematical programs can generate new problems for a student to solve each time he or she uses the computer. See O'Shea and Self, *supra*, and G Isaacs, "Course and Tutorial CAL Lesson Design: Helping Students Take Control of Their Learning," 27 *Educational & Training Technology International* 85 (1990) for general discussions.

31 E.g. Clark, *supra*; Keeton, in Burris *et al*, *supra*, at 28.

32 Franson, *supra*, at 184. Keeton, *supra*, (at 28) stresses the ability of branching to increase the dialogue between the computer and the student: "The instructor-author may carry on a dialogue with the student, using branches of dialogue that the instructor has developed in the thorough consideration that is essential to anticipating all the varied responses that different students may give to each question."

33 For a full description, see Jones, *supra*.

34 For example, the creators of the Paper Case system estimated that there were about 10,000 different trajectories which a student could take through the program. The system cost about £90,000 to develop, although a significant proportion of that would be attributable to the cost of implementing the program on videodisc (see infra). For a discussion of the Paper Case, see Julian Killingley, "Building on the Paper Case," (1992) *Conference Pre-*

Interaction can also be enriched by enabling the computer to respond to questions from the student. Every teacher recognises that questions from students are vital to developing a good teaching dialogue. Questions may arise at any point in the class and may even determine the content and length of the teaching session.[35] Despite the importance of the students' questions in building an effective teaching dialogue, few CAL programs in the legal field are equipped to accept or respond to questions. There is no reason why such a feature could not be incorporated into CAL programs, as expert systems are designed to advise the user on a given legal problem.[36] In theory, expert systems could be adapted and incorporated into CAL programs. However, at present there have been very few attempts made in the legal field to integrate these concepts in order to allow for unstructured or unanticipated questions.[37]

"Hypertext" systems have been advocated as a method of reducing the rigidity of CAL programs.[38] A system typically consists of a group of electronically cross-referenced files or screens of information, and a program which allows the user to jump between the screens quickly and easily.[39] Although there has been extensive use of hypertext facilities in commercial software (often as on-line help keys), the integration of CAL with hypertext is just beginning.[40] We have tested a number of programs which allow the student to interrupt the tutorial to look through a series of case summaries using hypertext, and then return to the tutorial after reading the cases and

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Proceedings BILETA 7th Annual Conference, and Clark, D. "The Paper Case," (1991) *Conference Pre-Proceedings BILETA 6th Annual Conference.*

35 For example, a revision class may begin with the tutor asking for questions from the students and finish when all of their questions have been answered.

36 For a description of an expert system, see "The European Conflicts Guide" Widdison, Pritchard & Robinson (forthcoming). In this system, the user can, in effect, present computer with a legal problem, and the system leads the user to an appropriate answer by asking for information from the user.

37 The SCHOLAR system, used in geography teaching, does allow for a measure of unpredictability in questioning by the student: O'Shea and Self, *supra*, at 115-120.

38 Paliwala, *supra.*

39 See Ian Benest, "An Alternative Approach to Hypertext," 28 *Educational & Training Technology International* 341 (1991) for a description of different types of hypertext design.

40 On supplementing CAL programs with on-line specifically retrievable data, Ashley and Aleven, "Towards an Intelligent Tutoring System for Teaching Law Students to Argue with Cases," (1991) *Proceedings of the Third International Conference on Artificial Intelligence and Law* 77. CCALI is currently investigating the potential of electronic casebooks, although these are seen as a replacement to traditional hard-copy books rather than specifically designed to assist teaching: Myers, "Computer consortium pushes the idea of electronic casebook," (1991) vol 13, no 49 *The National Law Journal* 4.

other materials stored in the database.[41] Our experience, and the experience of those outside law teaching, shows that hypertext can significantly improve the quality of CAL programs.[42] However, the presentation and complexity of the hypertext system must be carefully controlled in order for the student to feel comfortable with it. In particular, some users report that they have felt 'lost in hypertext' if the cross-references do not follow a coherent pattern. A hypertext system cannot equal the responsiveness of a teacher or an expert system, but it does give the students the opportunity of finding an answer to a question on their own.[43] At the very least, it enables the student and the author to escape from the determinate structure of most CAL programs.[44]

Creating effective dialogue has been hindered by the failure to enable computers to respond to ordinary language. In the typical CAL program, the student's interaction with the computer "may well be restricted to answering yes/no questions, selecting from possible answers in a menu, or entering a single word or value as answer."[45] For example, Downes, Widdison and Pritchard used multiple-choice questions because of the technical difficulties in programming a computer to accept free form answers.[46] From the students' perspective, other forms of input are often too cumbersome; for example, research done at University of Warwick found that students prefer to input answers through multiple-choice.[47] As we stated above, this severely restricts CAL's potential.[48] Some authors have attempted to move beyond multiple-choice questions to accept student input. Several programs based on the yes/no input method have developed additional input options such as "reasonable argument yes" and "reasonable argument no" responses. Students can subsequently argue the appropriate authorities, albeit within the confines of that input method.[49]

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41 Allen and Robinson, "Improving Linear Computer Assisted Learning," *Law Teacher* (forthcoming).

42 *Id.* For some examples of hypertext used successfully in non-legal CAL, see Benest, *supra*, and Wendy Hall, Peter Thorogood, Gerard Hutchings and Les Carr, "Using Hypercard and Interactive Video in Education: An Application in Cell Biology," 26 *Educational & Training Technology International* 207 (1989).

43 E J Conklin, "Hypertext: an introduction and survey," 20 *Institute of Electrical and Electronics Engineers Computer* 9 (1987).

44 Cf. Widdison, Pritchard and Robinson, *supra*.

45 Routen, "Complex Input: A Practical Way of Increasing the Bandwidth for Feedback and Student Modelling in a Statute-Based Tutoring System," (1991) *Proceedings of the Third International Conference on Artificial Intelligence and Law* 77.

46 Downes, Widdison and Pritchard, *supra*, at 28.

47 Scott, *supra*. The Warwick students preferred multiple choice input methods over word recognition, and preferred both over essay style answers.

48 Pugh, *supra*.

49 See generally, G Isaacs, "Course and Tutorial CAL Lesson Design: Helping Students Take Control of Their Learning," 27 *Educational & Training Technology International* 85 (1990).

Despite the need for more flexible methods of input, it is unlikely that CAL programs will be able to accept answers given in natural language. Programming a computer to understand natural language has proven to be an intractable problem in the field of artificial intelligence. There are programs which can process ordinary language (although only when confined to a limited and specific subject matter), but they are neither cheap nor powerful enough to do the job adequately. One example of an entirely new method of input is the Statutor system, developed by Routen at Leicester Polytechnic. Students create a diagrammatical representation of a set of propositions into a "proof tree"; as described by its author, "in Statutor, the problem is solved by having the student construct the argument graphically, using only the mouse, by direct manipulation of propositions (as geographical objects) and by using the mouse to draw arrows between the propositions once they have been suitably arranged."[50] The computer compares the student's "proof tree" against an authored answer tree. This program has the virtue of requiring the students to formulate their own logical structure to an area of knowledge; this is at least one step beyond most of the CAL programs currently available.

Simulations of situations or activities which involve the student are a popular use of computers outside the legal field, and are beginning to be used within law. For example, there are CAL programs which run through a trial transcript, which the student can interrupt in order to object to the introduction of evidence.[51] Similar role-playing simulations have been noted by Rio as being particularly well received, partly as a result of inter-group competition.[52] Simulations are already used in traditional legal education (moot courts being an example), and, assuming that programs can simulate sufficiently complex situations, should also be successful in computer teaching. As with branching programs, however, the problem is likely to remain the time and money involved in developing a sufficiently intricate simulation.[53] For example, it took the Franklin Pierce Law Centre, New Hampshire, about 1200 hours of work to develop its "Murder One" simulation.[54]

Other systems have made simulations more realistic by using interactive videodiscs or computer animation. The programs certainly have a very attractive look to them, but unfortunately their educational value has not been as impressive as hoped. For example, Hogan tentatively concluded that his Town and Country Planning Acts tutorial did not make any difference to the surprise test scores between those who had been lectured on the script of the video, those who had passively watched the video and those who had

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50 Routen, *supra*, at 79.

51 See Park, in Burris *et al.*, *supra*, chapter 2.

52 Rio, *supra*, at 323-4.

53 E.g., the "Paper Case", discussed *supra*, note 32.

54 Gibbons, "Murder One - Developing Interactive Simulations for Teaching Law," (1992) *Conference Pre-Proceedings BILETA 7th Annual Conference* 65.

interacted with it.[55] Videodiscs remain a relatively unexplored area of CAL, in part because the cost of setting up and continuing a videodisc system is prohibitive. Rio's estimates of Harvard's expenditure, of $1,000 initial outlay and $500 annual costs per program, are remarkably low in comparison with those given by Hogan, who estimated that the University of London's incomplete videodisc project had cost £83,000 by 1990.[56] Hogan's figures seem more realistic, as the recent "Paper Case" videodisc simulation cost about £90,000 to produce.[57] The true financial cost, in terms of resources and time, therefore puts videodisc technology beyond the reach of most institutions of higher education and far more expensive than providing additional traditional methods of teaching.

Recently, there has been a movement to develop analytical skills by inviting students to create their own expert, problem-solving systems on computers. This differs markedly from the types of CAL previously discussed, as the student, rather than the teacher, programs the computer. Since the students must develop their own scheme or "knowledge representation" of the legal topic before programming the computer, the engagement requires the type of analysis which is missing from most CAL programs. Those who support using computers in this manner "argue that the student himself should use computer programming languages as a means of expressing and developing his own understanding. Once students are able to do this, they then become liberated from the tyranny of a mass educational system".[58] Until recently, the lack of programming skills among students made it impractical to ask them to develop expert systems on the computer. However, software is now commercially available which simplifies the programming task considerably. As students and teachers become more aware of the potential of this method of learning, it should become more popular. The idea of students developing their own expert systems has proven successful in other areas of education, and is promising for legal education.[59]

Conclusions

To date, CAL has not been able to satisfy the need for legal education to provide more than a knowledge of black-letter law and it appears doubtful that the current forms of CAL will be able to do more than this. There are two primary reasons for this. Firstly, the dominant, tutorial-style CAL program will be of limited potential as long as programming a computer to carry on a teaching dialogue remains beyond the reach of current software engineering. Secondly, too many programs embody the teacher's knowledge, and then test and teach this knowledge, to the exclusion of ideas which may have been developed by the student. Clearly, CAL authors will need to

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55 Hogan *et al*, *supra*.

56 Rio, *supra*. Hogan, *supra*, further estimated that British Telecom had spent approximately £100,000 on similar educational programs it had created.

57 See Killingley, and Clark (1991), *supra*.

58 O'Shea and Self, *supra*, at 177.

59 See O'Shea and Self, chap.5.

circumvent these problems if their programs are to be of greater educational value.

Developments have been made in both of these fields, particularly through devices such as videodiscs, branching and hypertext and the incorporation of artificial intelligence. However, the ability of computers to induce higher intellectual skills and knowledge requires students to use computers as a medium through which they can assemble and communicate their own knowledge, rather than as an additional means of receiving the knowledge of others. The indeterminate nature of hypertext linked databases and student programming offer great potential for the computer to escape the confines described above, and address the problem of developing knowledge of black-letter law and higher intellectual skills.