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# Simulation of Legal Analysis and Instruction on the Computer†‡

MARGRET M. HAZEN\*  
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## INTRODUCTION

With the advent of the computer age, a great deal of thought has been given to computerizing legal reasoning. The logical, algorithmic nature of legal reasoning led many to believe that the computer could simulate much if not all of the reasoning process.<sup>1</sup> It soon became clear, however, that technological limitations plus the complexity of legal decision-making rendered the idea of the electronic decision-maker unrealistic.<sup>2</sup> Computers cannot replace the lawyer, but computers can aid the legal profession in several useful ways. Automated retrieval systems are now commonplace in legal research, legal documents can be drafted with the aid of the computer,<sup>3</sup> and there have been a few computer assisted legal analysis programs.<sup>4</sup> Additionally, computers have begun to enter law schools in the form of computer assisted instruction. Although there are approximately seventy computer based exercises in law,<sup>5</sup> the pedagogical use of computers in legal education is relatively limited but developing rapidly. This Article will focus on the current optimal uses of computers in legal analysis training.

The body of knowledge a lawyer can learn far exceeds what can be reasonably absorbed within a law school career. It cannot realistically be

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1. See, e.g., *LAW AND ELECTRONICS: THE CHALLENGE OF A NEW ERA* (E. Jones ed. 1962). For a discussion of algorithms see Rickert, *Algorithms as an Approach to Learning*, 12 *JURIMETRICS J.* 170 (1972).

2. For an in-depth analysis of the possible approaches and their limitations see Maggs & de Bessonnet, *Automated Logical Analysis of Systems of Legal Rules*, 12 *JURIMETRICS J.* 158 (1972). See also, e.g., D'Amato, *Can/Should Computers Replace Judges?* 11 *GA. L. REV.* 1277 (1977).

3. See *infra* note 12.

4. See *infra* note 44 and accompanying text.

5. See Burris & Park, *Computer Instruction in the Classroom: Update*, 4 *NAT'L L.J.*, Jan. 11, 1982, at 17, 20.

expected that upon graduation the successful Juris Doctor candidate will be fully versed in all aspects of the law profession. As in most professions, a certain amount of apprenticeship and continuing education is necessary in order to assure continuing growth of legal knowledge and skills. It is the task of legal education to provide its graduates with the basic analytical skills as a foundation for the continuing education process after graduation.

Law schools are beginning to realize that it is necessary to furnish students with some exposure to the practice of law as well as to the more abstract aspects of legal reasoning.<sup>6</sup> Accordingly, traditional legal education has increasingly emphasized the need for learning legal processes or the skills of legal analysis. While factual knowledge and straightforward legal doctrine can be readily transmitted in large lecture classroom situations, the more complex processes involved with investigating, analyzing, and synthesizing legal problems cannot. Processes are transmitted in a case by case individualized approach. The Socratic dialogue represents an effort to expose the student to these processes in the traditional classroom setting. Although occupying an important place in the law school curriculum, there are well recognized limits to the use of the traditional case approach in the large classroom setting. Clinical educational programs have developed over the past ten years in part to solve this dilemma. Law students need to become expert in acquiring knowledge whenever new situations for problem solving occur, and they need to know how to analyze and synthesize knowledge with respect to the existing legal problem.

This Article will not address the ongoing debate as to the continued viability of traditional law teaching methods.<sup>7</sup> We assume that they will remain the center of any quality legal education. The position of this Article is that computer based exercises can supplement all aspects of the law school curriculum.

Live-client clinical education addresses many of these problems but at great financial costs.<sup>8</sup> Simulation techniques such as role playing also deal with these

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6. The literature on legal education is voluminous and need not be reviewed here. See generally K. LLEWELLYN, *THE BRAMBLE BUSH: ON OUR LAW AND ITS STUDY* (1951); Chase, *Origins of Modern Professional Education: The Harvard Case Method Conceived as Clinical Instruction in Law*, 5 NOVA L.J. 323 (1981); Dillon, *Paper Chase and the Socratic Method of Teaching Law*, 30 J. LEGAL EDUC. 582 (1980); McManis, *The History of First Century Legal Education: A Revisionist Perspective*, 59 WASH. U.L.Q. 597 (1981); Pound, Frank & Vanderbilt, *What Constitutes a Good Legal Education?*, 7 AM. L. SCH. REV. 887 (1933).

7. In recent years there has been an on-going debate as to the continued vitality of traditional legal education. See generally Cramton, *Change and Continuity in Legal Education*, 79 MICH. L. REV. 460 (1981); Gee & Jackson, *Current Studies of Legal Education: Findings and Recommendations*, 32 J. LEGAL EDUC. 471 (1982); Gorman, *Law Curriculum in the 80's*, 32 J. LEGAL EDUC. 367 (1982); Keeton, *Symposium: Teaching and Testing for Competence in Law Schools*, 40 MD. L. REV. 203 (1981); Seymour, *Symposium on Current Trends in Legal Education and the Legal Profession*, 50 ST. JOHN'S L. REV. 431 (1976).

8. It has been estimated that the law school-supervised clinic is 14 times more expensive than a traditional class. See Swords & Walwer, *Clinical Legal Education: Cost Aspects*, 13 SYLLABUS 3 (1982). For a detailed study of instructional costs in legal education, see P. SWORDS & F. WALWER, *THE COSTS AND RESOURCES OF LEGAL EDUCATION: A STUDY IN THE MANAGEMENT OF EDUCATIONAL RESOURCES* 50-190 (1974).

problems and at a lower cost.<sup>9</sup> Another alternative has recently become feasible with the growth of the microelectronic technology. The rapid growth of microcomputing power has provided an excellent and useful alternative to large scale computer systems of the past thirty years.<sup>10</sup> In particular, simulation exercises on the microcomputer provide a very desirable alternative or enhancement to clinical education. Simulation exercises can also be used to enhance the more traditional Socratic approach as well as lecture courses. Microcomputers are not, however, the new technological panacea for legal education, and therefore need to be discussed for what they can reasonably be expected to provide in the law school environment.<sup>11</sup>

Coincidentally, an unintended but desirable outcome of having microcomputers within the law school setting is the possibility of addressing the issue of computer literacy among law students and faculty, a useful by-product as microcomputers are becoming a dominant technology of our age. If the microcomputer does not exist in the home, then having one at one's place of work or study is useful in developing computer literacy. Computers are already being used in law practice for office accounting and billing, legal research, word processing, and document drafting.<sup>12</sup>

This Article will focus on the three separate topics of computer assisted instruction (CAI), microcomputers, and instructional design as they interrelate in legal education. First, computer assisted instruction will be discussed in terms of classifying different types of CAI so that simulation CAI can be placed in its proper perspective. Then past evaluations of CAI including higher education and legal education will be reviewed in order to gain the perspective of past CAI experiences.<sup>13</sup> Second, in order to assess the different

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9. Although simulation is also a form of clinical education it is important to keep in mind the distinction between live-client and non live-client simulated clinics. Not only is there a difference in cost but also a difference in the educational product that is delivered. See Hoffman, *Clinical Course Design and the Supervisory Process*, 1982 ARIZ. ST. L.J. 277, 291. Simulation, for example, gives the instructor more control than live-client situations.

10. A microcomputer is a computer using a silicon chip for its central processor. This has allowed for the miniaturization of computers so that they now fit on top of a desk. For renewed hopes concerning microcomputers in education see Lautsch, *Computers in Education*, in R. BIGELOW, *COMPUTERS AND THE LAW* (3d ed. 1981).

11. For a skeptical view of the role of computers in legal instruction, see Korn, *Computer Assisted Legal Instruction: Some Reservations*, 33 J. LEGAL EDUC. 473 (1983). Compare Clark, *A Postscript on Gary Korn's Reservations About CAI*, 33 J. LEGAL EDUC. 489 (1983).

12. Practicing lawyers use computers for document preparation, e.g. computerized document editing systems. See Saxon, *Computer-Aided Drafting of Legal Documents*, 1982 AM. B. FOUND. RESEARCH J. 685 (1982).

Computers record attorney time recording and client billing tasks for many firms. Many firms are also using computer data retrieval systems for cases, statutes, and litigation data. See Maggs, *Tube Watching in Law School*, TRIAL MAG. (Dec. 1976) at 35. See also, e.g., R. BIGELOW, *COMPUTERS AND THE LAW* (3d ed. 1981); Fleischmann & Scaletta, *Use of Computer Technology in Legal Analysis and Prediction*, 11 AM. BUS. L.J. 251 (1974).

13. The term CAI is used to cover a broad range of applications involving the use of computers in education. Other terms that have been used similarly are CBE (Computer Based Education), CBI (Computer Based Instruction), CAL (Computer Aided Learning) and CMI (Computer Managed Instruction). CAI remains however the most frequently used term.

capabilities that a microcomputer promises to offer, past computer technologies will also be analyzed as they have historically been applied in legal education. Third, instructional design concepts as they specifically apply to CAI will be reviewed for guidelines in generating CAI courseware. These three discussions will allow us to draw conclusions with respect to the "do's and don't's" of microcomputer simulation and to provide information on how to proceed as successfully as possible in this area of microcomputer simulation.

## I. COMPUTER ASSISTED INSTRUCTION (CAI)

Computer assisted instruction was the joint outcome of the new computer technology of the 1960's and the educational development of programmed instruction which gained widespread recognition in the early 1960's.<sup>14</sup> Initial attempts at programming instruction for the computer strongly resembled the paper and pencil programmed instruction workbook formats.<sup>15</sup> Several desirable techniques for individualizing instruction arose out of this early work in programmed instruction. A number of potential advantages also emerged.<sup>16</sup> Students could proceed at their own pace and could be active in responding. The student using a computer based lesson can receive feedback on correct or incorrect responses and receive remedial or enhanced instruction as needed. The user thus can be presented with organized, meaningful units of instruction. Additionally, with the aid of the computer, the programming feature of branching eliminates the need for students to progress linearly (the same sequence of questions and responses for everyone) through the programmed instruction materials. Branching forward or backward<sup>17</sup> within the materials permits learning from errors at a more individual pace or format.

As instructional computer programming became more sophisticated, and as experience with CAI dictated the boundaries of successful CAI, a whole

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14. See, e.g., R. BURKE, CAI SOURCEBOOK 23 (1982); Kulik, Kulik & Cohen, *Effectiveness of Computer-based College Teaching: A Meta-Analysis of Findings*, 50 REV. OF EDUC. RESEARCH 525 (1980); Park & Burris, *Computer-Aided Instruction in Law; Theories, Techniques, and Trepidations*, 1978 Am. B. Found. Research J. 1.

15. Several law professors including Robert J. Lynn, Thomas A. Wills, Robert C. McClure, Charles D. Kelso, and Robert Keeton produced printed programmed exercises. For examples of programmed instruction that do not require use of a computer, see R. KEETON, *COMPUTER-AIDED AND WORKBOOK EXERCISES ON TORT LAW* (1976); E. KIMBALL, *PROGRAMMED MATERIALS ON PROBLEMS IN EVIDENCE* (1978). For an excellent detailed history of legal programmed instruction, see Park & Burris, *supra* note 14.

16. Blaisdell, *Historical Development of Computer Assisted Instruction*, 5 J. OF EDUC. TECH. Sys. 155, 166 (1976-1977); Clark, *The Rationale for Computer-Aided Instruction*, 33 J. LEGAL EDUC. 459 (1983).

17. Branching allows the computer program to respond differentially to student responses. See Park & Burris, *supra* note 14. For example, if the student gives response "A" to a given question the program will continue along one path whereas if the student gives response "B" the program will *branch* to a different path, perhaps explaining an incorrect choice and providing the option for remedial information before returning to the original place in the program or proceeding further.

range of possibilities for CAI taxonomic structure emerged. These categories are listed below in descending order of complexity and difficulty with respect to programming:

- Student-developed simulations
- Dialogue/inquiry problem-solving
- Student-developed instruction-tutorials
- Exploration of simulated systems or environments
- Interactive information retrieval
- Tutorial (generative, multi-level branching) CAI
- Instructional management systems (CMI)
- Calculator computations
- Tutorial (multiple choice or programmed instruction) CAI
- Testing and record keeping (CMI)
- Drill and practice CAI<sup>18</sup>

The order of these categories of computer based instruction also reflect increasing control by the students over the CAI lesson modules or over their own instruction. Increasing student control encourages the development of intellectual and inquiry skills, since such students are in a better position to engage in their own learning activity. As the taxonomic hierarchy indicates, however, the greater the student control, the greater the need for computer resources and complex programming.

The categories listed above represent all possible dimensions of CAI some of which may not truly be instructional by themselves, but instead can be used within the instructional setting. The broader terms "computer based instruction" and "computer based education" have often been used to encompass all these uses of computers in education. Only a few categories are commonly implemented and truly instructional. The more salient of these categories are: drill and practice, tutorial, and simulation gaming. Certain other applications take advantage of the computer's computational power and have wide applicability outside of education. Testing and record keeping, or instructional

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18. This hierarchy was established as a result of consulting several authorities. See Milner & Wildberger, *Determining Appropriate Uses of Computers in Education*, 1 *COMPUTERS & EDUC.* 117 (1977). See also Dence, *Toward Defining the Role of CAI: A Review*, 20 *EDUC. TECH.*, Nov. 1980, at 50; Kulik, Kulik & Cohen *supra* note 14, at 529; Thomas, *The Effectiveness of Computer-Assisted Instruction*, *AEDS J.*, Spring 1979, at 103. The focus of this Article will be on simulation gaming which is referred to as exploration of simulated systems or environments in the taxonomy. The Article will also focus on computer assisted legal analysis as a future potential form of open-ended problem solving which is also on this hierarchy.

Professor Robert Keeton suggested the following hierarchy for traditional instruction which is in many ways analogous to the CAI taxonomy:

- supervised experience
- supervised simulation
- discussion
- demonstration
- exposition

Keeton, *Why Use a Computer in Teaching and Learning Law*, in R. BURRIS, R. KEETON, C. LANDIS & R. PARK, *TEACHING LAW WITH COMPUTERS: A COLLECTION OF ESSAYS* (1979). For an excellent discussion of the great potential of computer aided instruction in legal education see Clark, *supra* note 16.

management systems<sup>19</sup> as administrative functions, and calculator computations are easily accomplished by computers across a variety of applications. Interactive information retrieval systems such as the Westlaw or LEXIS systems take advantage of the computer's capability to store large amounts of data in data banks and provide quick access via keyword searches.<sup>20</sup> While these applications can aid the instructional process and in that sense can be considered computer assisted instruction, they do not by themselves accomplish any instruction.

Drill and practice was one of the first CAI techniques to be implemented. Such computer assisted instruction involves practice problems that are generated and evaluated by the CAI lesson. This technique closely resembles the techniques of elementary programmed instruction or flash cards and rarely provides a context either before or after the CAI lesson. They are very well suited for practicing mathematics operations or foreign language vocabulary acquisition, for example.<sup>21</sup>

Tutorial CAI can take on a broader range of meaning. At one level, tutorial (generative, multi-branched) CAI is meant to mimic a natural Socratic dialogue wherein the student passes through the lesson once or twice to accomplish the learning of concepts.<sup>22</sup> This implies that the lesson has the capability to teach without prior instruction or assistance during the lesson. Since it is impossible to predict how much instruction any individual student requires, tutorials can become extremely complex as all possible situations or student responses are anticipated, and computer responses are programmed. Without such complexity and thereby resorting mostly to multiple choice formats, tutorial CAI can also closely resemble programmed instruction.

The majority of current CAI programs, including legal CAI, fall into the categories of drill and practice and tutorial CAI. The literature reveals that tutorial instructional techniques in 1973, and drill and practice techniques in 1976, predominated the various strategies used by CAI authors.<sup>23</sup> As indicated

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19. See, e.g., Trainor, *ABA Readies In-House Computer Courses*, 3 NAT'L L.J., Apr. 27, 1981, at 23.

20. See Neth, *Computer-Assisted Teaching*, in F. DUTILE, *LEGAL EDUCATION AND LAWYER COMPETENCY* 152 (1981) for a brief sketch of the legal search systems Westlaw, JURIS, and LEXIS.

21. Professor Keeton's computer generated intent questions provide an example of drill and practice. See R. KEETON, *COMPUTER-AIDED AND WORKBOOK EXERCISES ON TORT LAW 2.1-2.16* (1976).

22. See Maggs & Morgan, *Computer-Based Legal Education at the University of Illinois: A Report of Two Years' Experience*, 27 J. LEGAL EDUC. 138 (1975) for an example of generative, multi-branched tutorial CAI.

23. Kearsley, *Some 'Facts' About CAI: Trends 1970-1976*, 13 J. OF EDUC. DATA PROCESSING 1, 3 (1976). In law, the tutorial form of CAI has also predominated. See Maggs, *supra* note 12, for a description of a tutorial written by Professor Roger Park of the University of Minnesota which deals with some of the intricacies of the hearsay rule wherein he points out the advantages of tutorial CAI (active learning role and individualized attention). He also reviews Professor Harry G. Henn's corporate tutorial and simulation at the Cornell Law School. *Id.* at 34. See also Henn & Platt, *Computer Assisted Law Instruction: Clinical Education's Bionic Sibling*, 28 J. LEG. EDUC. 423 (1977). For a description of Professor Park's "Evidence" tutorial, see Landis, *Teaching Law With Computers: Workshop Report*, 11 EDUCOM BULL., 7 Summer 1976, at 7; Park, *Computer-Assisted Teaching* in F. DUTILE, *supra* note 20, at 146; Keeton, *How*

above, these are easier to program, and therefore less expensive to produce. While these methods serve a function in supplementing traditional instruction, they do not present any significantly different type of learning from what is already provided by the classroom setting and assigned reading.<sup>24</sup> While drill and practice and tutorial CAI increase knowledge and recall, they are not generally the best techniques for optimal development of intellectual and inquiry skills. Simulations of real life experiences do, however, promise to accomplish that goal and there has been some movement toward simulation with CAI in law.<sup>25</sup> The knowledge of facts and processes acquired during a simulation learning exercise, for example, transfers far more easily to real life problem situations than does learning from lectures. Simulation learning exercises can produce learning changes in all three of the possible dimensions of learning: cognitive, affective, and behavioral,<sup>26</sup> while lectures focus primarily on only the cognitive aspects of learning.

### *Simulation Gaming*

Simulation gaming as a form of instruction existed long before the advent of the computer. Modern technology, however, enhances simulation gaming

*Do Computer-Aided Exercises in Law Work*, in R. BURRIS, R. KEETON, C. LANDIS & R. PARK, *supra* note 18, at 29 (for excerpt of his computerized exercises on the Code of Professional Responsibility); Park, *How Can Professors Best Use Computer-aided Exercises*, *id.* at 17 (for an evidence excerpt).

For a list of exercises available as of 1976, see Landis, *supra*, at 14; Munro & Noah, *PLATO, EDUCOM, and Legal Education*, 30 J. LEGAL EDUC. 582, 589 (1980). The Center for Computer Assisted Legal Instruction, *see infra* note 102, maintains a list of currently available programs.

24. Professor Keeton explains that computers have a distinct advantage for discussion and supervised simulation. In contrast, demonstration and exposition can be equally well accomplished through the use of books or other printed medium. *See supra* note 10. Computers offer unique features such as individualized dialogue. *See Burris & Park, supra* note 5, at 20; Clark, *supra* note 15, at 463-67.

25. Professor Roger Park has developed simulated trial and evidence exercises. Judge Robert Keeton has authored a module on decisions before trial. Letter from the Center for Computer Assisted Legal Instruction (June 30, 1982); *see infra* note 102. Professor Roger Kirst is developing a simulated trial using computer and videodisk. *See infra* note 98. For a discussion of current efforts, see Burris & Park, *supra* note 5. The authors of this article are currently working on a simulation exercise involving corporate takeovers. Also under development by Professor Lynn Lopucki is a multi-user debtor-creditor game. The simulation requires ten players and is designed for use over a seven to twelve week period.

26. The terms cognitive, affective, and psychomotor or behavioral were first clearly specified by Krathwohl and Bloom. *See A TAXONOMY OF EDUCATIONAL OBJECTIVES, HANDBOOK I: THE COGNITIVE DOMAIN* (B. Bloom ed. 1956); D. KRATHWOHL, B. BLOOM & B. MASIA, *TAXONOMY OF EDUCATIONAL OBJECTIVES, HANDBOOK II: AFFECTIVE DOMAIN* (1964). Cognitive knowledge refers to the actual actions carried out by the individual. For an outline of the taxonomy of cognitive and affective domain, see Hoffman, *supra* note 9, at 282. For example, with regard to legal education, it has been observed:

Traditional legal education, with a major goal of teaching the student "to think like a lawyer," has concentrated on modifying the student's behavior primarily in one of these dimensions, the cognitive. However, a great part of a lawyer's work involves understanding the feelings of self and others (the affective dimensions) and engaging in tasks on behalf of self and others (the active dimension).

Harbough, *Simulation and Gaming*, 13 SYLLABUS June 1982, at 3.



techniques since computers can organize the facts, compute any necessary statistics, and allow students to proceed at their own pace. Historically, simulation and gaming have had distinct and different connotations. Strictly speaking, the term simulation does not require any human intervention. On the other hand, the term gaming is more likely to be used when humans are involved in the decision making process, but can also refer to games played for entertainment.<sup>27</sup> Gaming has been described as a type of simulation involving the use of human decision makers in the simulation of a real life situation which involves conflicting interests.<sup>28</sup> In gaming, the players form an integral part of the simulation, often filling those roles or elements of the simulations that cannot easily be programmed into a simulation model.

The dual term "simulation gaming" is perhaps somewhat confusing. Games vary widely in their concepts and processes. Some can be classified as simulation and some not. Games generally are played for entertainment, and the normal outcome of repeating the game should be increased proficiency. When the game principles can be transferred to real life situations, simulation gaming occurs. Thus, the simulation game can be valid for legal educational purposes only if it is transferable to realistic situations.<sup>29</sup>

For the purpose of this Article, therefore, the terms simulation and simulation gaming will be used interchangeably to refer to the dual quality of students as decision makers in a simulation of a real life problematic situation.

Simulation in the last thirty years has proven to be invaluable in certain situations.

[S]imulation (1) can focus on a specific skill, (2) allows for the simplification of complex factual and legal problems, (3) can be repeated until the student has reached a satisfactory level of performance, (4) can be halted at any point to analyze and evaluate the student's performance, (5) allows students to perform roles and work on problems not possible with real cases, (6) permits the use of videotaping, (7) avoids the risk of harm to real clients, (8) permits experimentation and the use of different approaches to problems, (9) causes less student anxiety, and (10) is less expensive and permits higher student-teacher ratios.<sup>30</sup>

Although it has not yet been conclusively established whether simulation games are a superior mode of instruction, simulation gaming has enjoyed rapid growth over the last thirteen years.<sup>31</sup> Simulations have been used frequently in disciplines other than law. For example, inter-nation simulations have provided political science and other social science skills for a number of years.<sup>32</sup>

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27. Munro & Noah, *supra* note 23, at 583.

28. Hollander, *The Simulated Law Firm and Other Contemporary Law Simulations*, 29 J. LEGAL EDUC. 311, 313 (1978).

29. Munro & Noah, *supra* note 23, at 583.

30. Hoffman, *supra* note 9, at 290. See also Note, *Computer Simulation and Gaming: An Interdisciplinary Survey with a View Towards Legal Applications*, 24 STAN. L. REV. 712, 720 (1972).

31. Munro & Noah, *supra* note 23, at 583. See also, e.g., Hollander, *supra* note 28.

32. See *id.* Harold Guetzkow's Inter-Nation Simulation is described by M. Glenn Newkirk and William R. Hamilton, *Simulations in Political Science and International Studies* in R. DUKES

In the area of legal education, clinical programs that are not live-client programs provide the greatest use of simulation.<sup>33</sup> Additionally, moot court and trial techniques, as well as courses in client counselling, estate planning, business planning, and real estate planning can provide a similar kind of simulated legal experience.

These simulated learning experiences continue to be used in learning situations because they provide the sense of immediacy and involvement that motivates a student to engage in intensive learning environments. Such learning transfers more readily to the real legal practice situation than does the learning from other forms of instruction.<sup>34</sup> Potential areas of simulations include simulated trials and business situations.<sup>35</sup>

Computers, and more specifically microcomputers, promise to provide increased flexibility and experimentation within the simulated experience without the heavy burden of one-on-one faculty instruction. Computers can introduce a student to the simulated situations (a model of reality), ask the student to make decisions based on evidence provided as well as researched facts, and continue the simulation based on the student's decision. There have been a number of trial related computer simulations.<sup>36</sup> The computer can simulate an individual client or a corporate client. It can also simulate tax situations, real estate situations, corporate, securities, and antitrust problems as well as other situations involving a combination of legal and strategic decision-making.<sup>37</sup>

Computer models for simulation gaming make available to the student very small, very slow, or very rapid changes that cannot be observed in actuality. These models are particularly useful in situations where real experience is

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& C. SEIDNER, *LEARNING WITH SIMULATIONS AND GAMES* 142 (1978). It simulates the interactions of an international system and exposes students to such concepts as conflict, power, coercion, and decision-making.

33. See *supra* note 9. One such clinical program is the Simulated Law Firm (SLF), which was first used at the State University of New York at Buffalo Law School. The SLF consists of a faculty member serving as managing partner, practicing attorneys serving as senior partners, and law students serving as associates in the firm. It permits the student associates to handle cases from initial interview with the client through trial and closing of the file. For a more detailed description of SLF, see Hollander, *supra* note 28, at 311-13.

34. It has been observed that,

[s]imulation has the potential to provide a better transfer from the training situation to the real situation than the lecture method provides. Simulation also supplies a responsive environment which may give law students a sense of immediacy and involvement. This cannot be empirically proved, but this result is obvious when a simulation has been discussed with a law student.

Munro & Noah, *supra* note 23, at 584. A frequent criticism of legal education has been that law students do not get sufficient practice experience during the course of their law school education. See Hollander, *supra* note 28; Henn & Platt, *supra* note 23, at 103; Maggs, *supra* note 12; Park & Burris, *supra* note 14.

35. Note, *supra* note 30, at 726-29 (for examples of subject matter areas that have substantial potential for simulation exercises). See also Clark, *supra* note 16.

36. See *supra* note 25.

37. Utilizing PLATO, the American Bar Association has been developing a forty-five minute simulation entitled "Interviewing Skills in Basic Choice of Business Entity Problems." See Trainor, *supra* note 19, at 23.

theoretically available but impractical to use for instruction due to safety, equipment costs or availability, or prohibitive setup time. Therefore, one finds scientific lab experiments and medical, or corporate processes modeled most frequently. For example, Professor Harbaugh has commented that "realistic problems of interviewing, fact investigating, counseling, drafting, negotiating, arbitrating, and litigating are being simulated in the safety of the classroom instead of being tested in the risky environment of the law office."<sup>38</sup> It is feasible to experiment safely and easily with simulations, and such experimentation takes place over a relatively short period of time.

Nevertheless, the past thirty years have also revealed the disadvantages of simulation in education. First, it is difficult to evaluate the pedagogical effects of simulation. In addition, simulations are expensive,<sup>39</sup> time consuming, and difficult to design.<sup>40</sup> It has also been suggested that simulation is too artificial to involve the student on an emotional level.<sup>41</sup>

### *Computer Assisted Legal Analysis*

Although at one time, many commentators had high hopes for computerized legal decision-making,<sup>42</sup> technological limitations have put to rest the notion that computers can replace lawyers or judges.<sup>43</sup> Computerized legal reasoning has, however, been implemented on a smaller scale within the context of relatively narrow legal problems. This class of computer programs, which might be categorized as computer assisted legal analysis, has also been variously referred to as automated legal reasoning, computer aided legal analysis, or "artificial intelligence and legal reasoning."<sup>44</sup> To date there have been six

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38. See Harbough, *supra* note 26, at 4. The computer is not suited for all simulations. For example, it cannot readily simulate interviewing and counselling skills. *But see* Burris & Park, *supra* note 5, at 20; Trainor *supra* note 19. The computer's strengths lie in the areas of legal and strategic decision-making. See generally Clark, *supra* note 16.

39. The costs of computerized simulations include the initial capital outlay for field testing and research and the costs of training law faculty and library staff for effective use of instructional simulations. If the simulation is not on a computer then often the physical environment also requires some costly alterations before a simulator can be installed. Munro & Noah, *supra* note 23.

40. Munro & Noah, *supra* note 23.

41.

[S]imulation cannot approximate the greater factual richness and uncertainty introduced by real cases. Nor, does simulation cause the same intensity of emotional involvement as actual cases, thereby giving the simulated experience a make-believe quality. Without emotional involvement, students are not forced to confront and resolve ethical problems, a necessary requirement in the teaching of professional responsibility. The lack of emotional involvement and the students' skepticism of the verisimilitude of simulation also results in lower motivation and a correspondingly lower level of learning. Lastly, to be effective, simulation requires the same degree of supervision as real cases and, therefore, is just as expensive.

Hoffman, *supra* note 9, at 291.

42. See *supra* note 1.

43. See *supra* note 2.

44. See Comment, *Emerging Computer-Assisted Legal Analysis Systems*, 1980 B.Y.U. L. REV. 116, 117.

reported programs that have been placed in this category and it is useful to investigate the differences between these programs and simulation gaming programs, as well as to investigate the advantages and disadvantages of computer assisted legal analysis with respect to education.<sup>45</sup> While these two categories of programs are quite different in scope they are similar in purpose and historical foundations.<sup>46</sup>

At one level, computer assisted legal analysis is a simulation program; the user of the legal analysis program (whether lawyer or student) provides the factual information, and the computer simulates the lawyer. With instructional simulation programs, however, the user plays the role of the lawyer while the computer simulates the rest of the world whether it is a client, another lawyer, a judge, or a combination thereof. In the instructional simulation setting, the facts are presented to the user of the program and the user in turn is asked to make decisions with respect to these facts. A primary concern in designing such simulation programs is the instructional value of exploring a variety of decision avenues and seeing the stated outcomes of each decision.

In contrast, with computer assisted legal analysis, the computer program asks questions that are meant primarily to gather the facts of a particular case. Once the computer program has enough facts, it can, ideally, determine the appropriate cause of action, it can determine if the elements of legal doctrine or statute are satisfied, or it can write the legal document such as a contract or form for filing that is required by the factual situation.<sup>47</sup> The

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45. The six programs commonly classified as computer assisted legal analysis programs are:

JUDITH  
ABF processor  
CORPTAX and CHOOSE  
TAXMAN  
Meldman's system

See Hellawell, *CHOOSE: A Computer Program for Legal Planning and Analysis*, 19 COLUM. J. TRANSNAT'L L. 339 (1981) [hereinafter cited as Hellawell, *CHOOSE*]; Hellawell, *A Computer Program for Legal Planning and Analysis: Taxation of Stock Redemptions*, 80 COLUM. L. REV. 1363 (1980) [hereinafter cited as Hellawell, *CORPTAX*]; McCarty, *Reflections on TAXMAN: An Experiment in Artificial Intelligence and Legal Reasoning*, 90 HARV. L. REV. 837 (1977); Meldman, *A Structural Model for Computer-Aided Legal Analysis*, 6 RUT. J. COMPUTERS & L. 27 (1977); Popp & Schlink, *JUDITH, A Computer Program to Advise Lawyers in Reasoning a Case*, 15 JURIMETRICS J. 303 (1975); Sprowl, *Automating the Legal Reasoning Process: A Computer that Uses Regulations and Statutes to Draft Legal Documents*, 1979 AM. B. FOUND. RESEARCH J. 1. See also Comment, *supra* note 44, at 116 n.7 for a list of unpublished programs.

46. Historical foundations of computer assisted legal analysis include the renewed efforts in the 1960's towards "normalizing" the law or stating the law in propositional calculus. See Allen, *An Analysis of Law by Symbolic Logic*, in R. BIGELOW, *COMPUTERS AND THE LAW* 167 (2d ed. 1969); Allen, *Logic-Language-Law*, in R. BIGELOW, *COMPUTERS AND THE LAW* 79 (1966); Meldman, *A Structural Model for Computer-Aided Legal Analysis*, 6 RUT. J. COMPUTERS & L. 27 (1977).

47. The ABF processor produces legal documents while the other five computer assisted legal analysis programs are meant to analyze legal cases. See Comment, *supra* note 44, at 138-40. TAXMAN, for example, is described as: "given a 'description' of the 'facts' of a corporate reorganization case, it can develop an 'analysis' of these facts in terms of several legal 'concepts.'" McCarty, *supra* note 45, at 838. Hellawell's CORPTAX program, for example accumulates and arranges

law is never explained, since a lawyer's training and expertise is expected as a prerequisite to being a user.<sup>48</sup> Computer assisted legal analysis was written originally for practicing lawyers; simulation programs continue to be primarily instructional aids written for students.

Properly designed computer assisted legal analysis programs should be able to anticipate a multitude of factual situations, and it is this flexibility that has been their greatest appeal and their greatest advantage. The user can be expected to question the knowledge data base and relationships of the program in an almost infinite number of ways. If these legal analysis programs were rewritten for instructional purposes, they would have that same advantage of flexibility. The progression through a legal analysis program is open-ended and determined only by the facts and the user (or the student) of the program. The program would therefore be under student control. Within the taxonomy established earlier they would be classified as open-ended problem solving CAI.<sup>49</sup>

As a CAI program becomes more flexible, there is a corresponding increase in the complexity of the programming involved. It is this complexity that engenders the major disadvantage of legal analysis or open-ended problem solving CAI programs. In order to understand the nature of the complexity of the computer programming involved in legal analysis programs, these programs will be analyzed in further detail.

Legal analysis programs accomplish the simulation of the lawyer in two steps. First, a "knowledge base" or an image of the law for the subject matter in question must be structured and represented within the program. Second, the relationships between the different facts of the law must be clearly specified within the program. The facts gathered by any one client situation can then be applied to the stored information in order to generate decisions or documents. This has been often documented as a very tedious and time consuming task.<sup>50</sup>

Furthermore, some legal analysis programs are more complex than others. The existing programs simulate legal reasoning by using one of two different approaches: deductive and analogical. The majority of the legal analysis pro-

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facts relevant to the problem and performs all necessary mathematical calculations and logical deductions with respect to the treatment of redemptions. Hellowell, *CORPTAX*, *supra* note 45.

48. See, e.g., Hellowell, *CHOOSE*, *supra* note 45, at 356; Hellowell, *CORPTAX*, *supra* note 45, at 1392-93; Comment, *supra* note 44, at 140; Meldman, *supra* note 46.

49. See *supra* note 18.

50. "While the future of legal programs is promising, an extensive library of programs may be slow in coming. Writing good legal programs requires an unusually thorough analysis of the legal problem being programmed. . . . [T]he programmer must provide a result for all fact situations that come within the program's ambit . . . ." Hellowell, *CHOOSE*, *supra* note 45, at 355-56.

It has also been observed that "[t]he plan or algorithm of the program is almost wholly one of legal decisions," which Hellowell also refers to as professional decisionmaking. Hellowell, *CORPTAX*, *supra* note 45, at 1396. He further notes that "[a] possible obstacle to using computers for legal analysis will be that writing programs on complex legal subjects is a difficult and time-consuming job." *Id.* at 1393.

grams use the deductive approach to arrive at decisions.<sup>51</sup> Deduction is a formal method reasoning based on syllogistic logic which can be easily recast into the IF-THEN format used in computers. Only two legal reasoning programs use the analogical approach.<sup>52</sup> Analogy is a method of reasoning based on factual comparison to determine similarity. The analogical approach requires the development of complex semantic networks which are then "matched" against the relationships of a particular case to see if that case matches the jurisdiction of that law.<sup>53</sup>

Programs using the deductive approach have largely been written in common computer and microcomputer languages (such as BASIC and FORTRAN) or in languages based on the same concepts and structures as these languages (such as ABF).<sup>54</sup> Analogical programs, on the other hand, have been written in languages like LISP which were developed within the artificial intelligence field for examining semantic information processing research questions.<sup>55</sup> The artificial intelligence computer languages differ from other computer languages in several important ways. First, they were written and developed for natural language processing in order to process primarily words as opposed to numbers. Most of the increased flexibility of the analogical approach is due to the choice of LISP-like languages. The ideal hope for CAI is that the computer will be able to process natural language commands; however, even data entry cannot yet be accomplished in the natural language format. Second, LISP is a highly specialized language that may not be available on all computers (and especially microcomputers). Third, far fewer programmers are available for LISP programming than BASIC for example. Finally, semantic network representations are extremely complex to develop.<sup>56</sup>

Therefore, while the specifications of the law and the interrelationships within the law are a very time consuming and tedious task for any computer assisted legal analysis program, the analogical approach encompasses even

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51. They are: CORPTAX, CHOOSE, JUDITH, ABF Processor, and Meldman's system which uses both deduction and analogy techniques.

52. They are: TAXMAN and Meldman's system.

53. See McCarty, *supra* note 45. For summaries of semantic network processing, see Grossman & Solomon, *Computers and Legal Reasoning*, 69 A.B.A. J. 66 (1983); Comment, *supra* note 44, at 132.

54. See Sprowl, *supra* note 45. Professor Hellawell's programs were written in BASIC. See Hellawell, *CHOOSE*, *supra* note 45; Hellawell, *CORPTAX*, *supra* note 45. The JUDITH programs used the FORTRAN language. See Popp & Schlink, *supra* note 45.

55. Micro-PLANNER was used by TAXMAN, and PSL was used by Meldman. See Comment *supra* note 44, at 122. Micro-PLANNER is a high level language written in LISP, a principal tool for artificial intelligence research for over 15 years. PSL (Preliminary Study Language) is similar to, although less complex than, LISP.

56. The two hurdles of data entry and complex semantic networks are summarized in Grossman & Solomon, *supra* note 53, at 69. See also Comment, *supra* note 44, at 136 for a section on the comparative ease of analogical and deductive approaches. For example, deductive systems are easy to operate but may ask ambiguous questions. Analogical systems are difficult to operate because 1) the user cannot be sure which facts to include in the description and 2) which facts may be translated into word groups in more than one way, i.e., user/computer do not communicate in complete sentences.

more time and effort.<sup>57</sup> It is far more difficult to simulate the working of a human mind, including the lawyer's mind, than a problematic situation. As a consequence, the six reported legal analysis programs are not only restricted in terms of the domains of law they can address, but in many cases they have not even been tested in the field due to constraints imposed by these difficulties. Ideally, the analogical approach is the most flexible approach holding the most promise for the future, but in fact this is also the most difficult type to program.<sup>58</sup>

Within computer science it is often recognized that there are no ideal languages or systems for all purposes. When languages or systems become easier to use, they also impose more constraints on the user and/or they become less flexible. Accordingly, computer assisted legal analysis has reached close to the potential of ideal flexibilities, but the complexities of generating these programs or systems is so great that most legal analysis programs have not been evaluated and are not being used in an office setting.<sup>59</sup>

While computer assisted legal analysis does not currently hold much promise for widespread use in an applied, and even less in an instructional, setting,<sup>60</sup> it does provide a model of the structure of legal concepts. In many ways, legal analysis programs can be considered a repository of the law.<sup>61</sup> There is great value within legal theory for the ability to construct formal systems<sup>62</sup> in order to test theories with respect to the nature of legal reasoning. Furthermore, the quality of future computer assisted legal analysis or instruction will improve if more research is directed towards the development of intelligent systems.

#### *CAI Evaluation (Legal and Higher Education CAI)*

Some of the advantages and disadvantages of CAI can best be assessed by analyzing analogous literature with respect to CAI in various higher educational settings in addition to the legal education setting. Many research studies of varying quality have appeared since the first use of computers in the

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57. "Although each relationship may be simple to express, the sheer complexity of even a simple fact pattern would make this system quite burdensome for a nontechnical user." Grossman & Solomon, *supra* note 53, at 69.

58. For the hierarchy, see *supra* note 18.

59. See Grossman & Solomon, *supra* note 53, at 70; Comment, *supra* note 44, at 139. The fact that analogical programs are more difficult to set up can also be seen from the fact that these two programs are not in use. "Clearly the TAXMAN system in its present form does not yet provide a very useful tool for the practicing tax lawyer." McCarty, *supra* note 45, at 882. For a critical view of computers' limitations, see Korn, *supra* note 11, at 487.

60. See Fleischmann & Scaletta, *supra* note 12 for an assessment of the use of computer assisted legal analysis.

61. See Hellawell, *CORPTAX*, *supra* note 45. See also Grossman & Solomon, *supra* note 53, at 66.

62. See Grossman & Solomon, *supra* note 53, at 66; Comment, *supra* note 44, at 140. See also, Edwards & Barber, *A Computer Method for Legal Drafting Using Propositional Logic*, 53 *TEX. L. REV.* 965, 972 (1975).

classroom in the late 1960's. The earliest reports and evaluations of CAI projects consisted of journalistic accounts containing little supportive data. As evaluation techniques improved, more sophisticated and controlled designs for evaluation and research studies emerged.<sup>63</sup>

The most common paradigm of research and evaluation studies in the last ten years has been the classical experimental design. Within the classical experimental design there are usually two different modes of instruction which are compared, the CAI mode and a more traditional mode such as the lecture method of instruction. The essential question for research or evaluation thus became "Is computer assisted instruction superior to or more effective than another form of traditional instruction?"

Most research or evaluation studies define effectiveness in terms of differences in achievement between students taught on a computer and students taught via lectures.<sup>64</sup> That is, CAI is declared to be more effective if students have achieved more. Outcomes are frequently measured using existing examinations or quizzes. However, other interesting variables that could also define effectiveness include: attitudes toward the computer and attitudes toward course content, student withdrawal rates or attrition, retention of knowledge over time, the length of time necessary to accomplish learning, the utility of working individually or in small groups, and the costs of CAI. Fewer studies have reported results with respect to these measures of the effectiveness of CAI implementations.

The results of studies with respect to comparing CAI to more traditional forms of instruction are not always conclusive when cognitive measures are used. Cognitive measures of achievement include standardized achievement tests as well as the nonstandardized quizzes, examinations, and projects assigned by instructors in the classroom. Within the law curriculum, it has been reported several times that students do not necessarily achieve more with computer assisted instruction than with traditional instruction.<sup>65</sup> Similar results were obtained in studies of CAI in higher education. When only cognitive

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63. Jamison, Suppes & Wells, *The Effectiveness of Alternative Instructional Media: A Survey*, 44 REV. EDUC. RESEARCH 1, 3 (1974).

64. For reviews of the relevant literature, see Chambers & Sprecher, *Computer Assisted Instruction: Current Trends and Critical Issues*, 23 COM. OF THE ACM 332 (June 1980). Edwards, Norton, Taylor, Weiss & Van Dusseldorp, *How Effective is CAI? A Review of the Research*, 33 EDUC. LEADERSHIP 147 (1975); Forman, *Search of the Literature*, THE COMPUTING TEACHER, Jan. 1982, at 37; Jamison, Suppes & Wells, *supra* note 63; Schoen & Hunt, *The Effect of Technology on Instruction: The Literature of the Last 20 Years*, AEDS J., Spring 1977, at 68; Thomas, *supra* note 18. See also Kulik, Kulik & Cohen, *supra* note 14. Very few studies measure effectiveness in terms of the difference in cost between CAI and traditional methods. In general this is due to the fact that cost algorithms are not yet standardized and therefore it is difficult to find comparable means for comparison. Thomas, *supra* note 17, at 711. For discussions of cost estimates, see Chambers & Sprecher, *supra*, at 337; Forman, *supra*, at 39-40; Thomas, *supra* note 17, at 110.

65. Professor Burris found that there were no apparent differences in achievement. See R. BURRIS, *COMPUTER NETWORK EXPERIMENTS IN TEACHING LAW* 53 (1980). See also Park & Burris, *supra* note 14 (citing Henn & Platt, *supra* note 23 and Maggs & Morgan, *supra* note 22).



variables are measured and reported, most studies indicate that there are no significant differences between traditional instruction and computer assisted instruction, while a few studies have found that CAI is superior.<sup>66</sup> Thus, it appears that students generally learn equally well or perhaps slightly better under computer assisted instruction.<sup>67</sup>

When student attitudes towards CAI are measured, the results usually indicate a positive attitude towards computer assisted instruction as a medium of instruction.<sup>68</sup> Students enjoy being able to interact and proceed at their own pace and being given feedback on responses.<sup>69</sup> Affective outcomes of CAI include a tendency to exhibit "enhanced self-confidence, curiosity and exploratory behaviors, a strong degree of motivation, and favorable attitudes towards learning in general."<sup>70</sup> Negative comments usually refer to the physical environment such as distractions in a terminal room or to the occasional breakdowns experienced by the computer system.<sup>71</sup>

The studies have identified one variable, however, that consistently produces differences between CAI and traditional methods, namely the time spent learning the material.<sup>72</sup> Time is considered to be a valuable resource within a student's course of legal instruction.<sup>73</sup> With CAI, not only can students progress at their own pace, but it seems that in such situations students will actually acquire the necessary knowledge in less time than lecture methods require. The saving in time can be seen to be due to time spent learning as opposed to time spent waiting to ask a question, or time spent reviewing already learned material in the group setting of a lecture classroom. This saving in

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66. See Chambers & Sprecher, *supra* note 64, at 336; Clark, *supra* note 16, at 467-68; Edwards, Norton, Taylor, Weiss & Van Dusseldorp, *supra* note 64, at 148; Thomas, *supra* note 18, at 107.

67. Jamison, Suppes & Welles, *supra* note 63, at 55; Kulik, Kulik & Cohen, *supra* note 14, at 526.

68. See Leiblum, *Factors Sometimes Overlooked and Underestimated in the Selection and Success of CAI as An Instructional Medium*, AEDS J., Winter 1982, at 67, 69; Thomas, *supra* note 18, at 108. Course evaluations indicated a slightly more favorable attitude towards a CAI course than a comparable traditional method in Kulik, Kulik & Cohen, *supra* note 14, at 537. Professor Burris indicates that the vast majority of students felt positive about the exercises. R. BURRIS, *supra* note 65, at 403. See also Chambers & Sprecher, *supra* note 64, at 336; Dence, *supra* note 18, at 51; Thomas, *supra* note 18, at 108.

69. Clement, *Affective Considerations in Computer-Based Education*, 21 EDUC. TECH., April 1981, at 28. Professor Burris indicated that CAI provided new knowledge, feedback, and discussion with other students about the exercises. R. BURRIS, *supra* note 65, at 52. See also Burris & Park, *supra* note 5, at 22.

70. Milner & Wildberger, *supra* note 18, at 121.

71. Henn & Platt, *supra* note 23, at 435; Maggs & Morgan, *supra* note 22, at 152.

72. Clark, *supra* note 16, at 467-68; Edwards, Norton, Taylor, Weiss & Van Dusseldorp, *supra* note 64, at 149; Jamison, Suppes & Wells, *supra* note 63, at 51-53; Okey & Majer, *Individual and Small-Group Learning With Computer-Assisted Instruction*, 24 AUDIO-VISUAL COM. REV. 79 (1976). See also, Chambers & Sprecher, *supra* note 64, at 336; Dence, *supra* note 18, at 53; Kulik, Kulik & Cohen, *supra* note 14, at 537; Thomas, *supra* note 18, at 109.

73. It is noted that "the best techniques are those that make the most efficient use of the learners' time, energies, and talents." Keeton, *supra* note 18, at 5.

time may be even greater where there are multiple users at a single computer terminal.<sup>74</sup>

These general results with respect to higher and legal education can be expected to carry over to the simulated CAI experience, thereby allowing students to gain knowledge in less time than in typical classroom instruction. Students appear to learn knowledge of facts equally well from a variety of instructional modes. More specifically, the rewards and advantages of participating in live-client and simulation clinical program can now be enhanced further by allowing students to progress through the simulation at their own pace and in less time than the non-computer simulation.

As was mentioned earlier, most researchers have focused their studies on the question of whether CAI is better than traditional instruction. Recently, however, some reviewers of the literature<sup>75</sup> have stated that this is an invalid question to begin with. Indeed, the lack of significant differences between different technologies or media is not surprising once it is realized that the same kind of teaching operates more or less the same way with and without technological aids. Students learn equally well under various media. As one study noted "when only the least significant aspects of instruction are allowed to vary, nothing of interest could, and did, result."<sup>76</sup>

Salomon and Clark advocate, instead, that researchers investigate what effect a particular mode of instruction has, and how this interacts with different types of learners and different types of tasks.<sup>77</sup> In this case the research question becomes: "Are different kinds of CAI techniques, for example, branching

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74. See Landis, *supra* note 23, at 11 which reports that Professors Park & Keeton's students always worked in pairs. Most of the students indicated their ideal group size would be two. R. BURRIS, *supra* note 65, at 25. Professor Keeton in Burris suggested from his own experience that groups of two seem ideal. Keeton, *supra* note 18, at 6.

75. See Park & Burris, *supra* note 14. See also Salomon & Clark, *Reexamining the Methodology of Research on Media and Technology in Education*, 47 REV. OF EDUC. RESEARCH 99 (1977).

76. Park & Burris, *supra* note 14, at 7.

77. Learner variation consideration studies are referred to as aptitude by treatment interaction studies. It has been noted that "It is possible that for some learners the expensive CAI style is unnecessary or even dysfunctional." L. CRONBACH & R. SNOW, *APTITUDES AND INSTRUCTIONAL METHODS: A HANDBOOK FOR RESEARCH ON INTERACTIONS* 173 (1977). ATI research question structure has also been suggested by Dence, *supra* note 18, at 54. Individuals vary with respect to characteristics such as sex, age, year of school, grade point average, intelligence, SAT and ACT scores, and other measures of ability. Measures of learner personality characteristics include various locus of control and attribution measures, self-esteem instruments, task anxiety questionnaires, and various measures of cognitive style. See Gleason, *Microcomputers in Education: The State of the Art*, 21 EDUC. TECH., Mar. 1981, at 7; Steinberg, *Review of Student Control in Computer-Assisted Instruction*, 3 J. OF COMPUTER-BASED INSTRUCTION, Feb. 1977, at 84, 87.

Computer assisted instruction lessons can vary with respect to things like: CAI strategies (i.e. tutorial vs. simulation), different types and rates of feedback, different strategies for program development, different strategies of implementation (i.e. stand-alone vs. supplemental). See Gleason, *supra*. See also Burris, *The Authoring Process and Instructional Design*, in R. BURRIS, R. KEETON, C. LANDIS & R. PARK, *supra* note 18.

or graphics designs, better for different kinds of learners."<sup>78</sup> Much research analysis and evaluation is still required in this area of individual differences, and in the area of differences between and among various types of computer assisted instruction modules.

In summary, it appears that CAI is a form of instruction that accomplishes equal or slightly better cognitive learning than traditional forms and is a form of instruction that students react to favorably, particularly when computer terminals are functioning and are located within easy access of the students. More importantly, CAI does seem to have the advantage of reducing the time necessary to spend on certain instructional topics. Furthermore, simulation gaming CAI has the advantage of providing a decision making setting that might not otherwise be available to the students.

Future CAI research should focus on the best techniques to accomplish specific educational goals. Additionally, unique and intangible benefits to learners using CAI have not been properly addressed in past research efforts. One way to accomplish these research aims is to focus future research questions on the costs and benefits (whether tangible or intangible) of both traditional instruction and computer assisted instruction.<sup>79</sup>

## II. COMPUTER TECHNOLOGY DIFFERENCES

Computers inherently have certain advantages as an instructional medium. As is the case with nonautomated programmed instruction, the computer can individualize the lessons, promote active self-paced learning, and provide instantaneous feedback. Additionally, computers can uniquely store student responses, whether data or anonymous comment, which can then be made available to students to foster communication among instructors, between instructors and students, and among students.<sup>80</sup> Students are also free to choose the frequency and timing of a lesson. And the computer as discussed above can simulate complex experiences in less time than any other medium or make such experiences available when they might not otherwise be. The best use of computer assisted instruction should always take advantage of these unique capabilities whenever possible.<sup>81</sup>

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78. For an example of this type of research see Seidel, Wagner, Rosenblatt, Hillelsohn & Stelzer, *Learner Control of Instructional Sequencing Within an Adaptive Tutorial CAI Environment*, 7 *INSTRUCTIONAL SCI.* 37 (1978).

79. See, e.g., Kulik, Kulik & Cohen, *supra* note 14, at 539: "We do not know, therefore, whether computer-based teaching helped students develop a sense of confidence with computers, whether it contributed to faculty development, or whether it provided the groundwork for future innovations far more effective than anything now imagined."

80. Landis, *supra* note 23, at 11; Maggs, *supra* note 12, at 33.

81. See Leiblum, *Factors Sometimes Overlooked and Underestimated in the Selection and Success of CAI as an Instructional Medium*, *AEDS J.*, Winter 1982, at 67, 71-72, for a detailed list of these unique advantages which include, for example, the ability to speed up or compress time, accepting and storing student responses, generating classes of problems, branching or skipping, calculation, recording performance, information storage and retrieval, active response and feedback, and learner control over what to learn, when to learn it, and how fast to learn it. See also Forman, *supra* note 64, at 41.

While CAI has been used in varied educational and vocational settings over the past twenty years, it has not been implemented nearly as widely as had been expected.<sup>82</sup> Success is dependent on a lot of factors including cost,<sup>83</sup> access ease, and the quality of the courseware.<sup>84</sup> Other obstacles include the primitive state of the art particularly concerning authoring languages,<sup>85</sup> faculty attitudes and rewards,<sup>86</sup> transportability, and dissemination.<sup>87</sup> Past failures to implement CAI on a large scale, however, must be analyzed in light of today's new technologies which overcome many of these obstacles.

CAI, in the past, had been implemented only on time-shared computer systems.<sup>88</sup> These systems consisted of several terminals each of which was directly or indirectly (via telephone lines) connected to a mainframe or large scale computer. CAI programs as well as the student response data are stored at a central location where the mainframe computer is situated. In order to engage in CAI, a student would first have to find an available terminal, and then provide the necessary log-on protocol which consisted of two phases: (1) establishing telephone connection with the main computer, and (2) establishing a unique connection with the computer for accounting purposes by entering an identification account number and password. Once these two phases were completed successfully, the student could begin to use the specified CAI lessons by providing the lesson name or choosing the appropriate lesson from a menu of options.

The procedures outlined above are important to understand because they present the problems that hindered large scale use of CAI in classrooms, including law school classrooms. First, students needed to find a terminal. The

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82. See Dence, *supra* note 18, at 50. See also Forman, *supra* note 64, at 43.

83. For a discussion of cost disadvantages, see R. BURRIS, *supra* note 65, at 57. In general, most university budgets still cannot accommodate the costs of CAI. Gleason, *Microcomputers in Education: The State of the Art*, 21 *EDUC. TECH.*, Mar. 1981, at 7, 8. See also Chambers & Sprecher, *supra* note 66, at 333, 337; Forman, *supra* note 66, at 43; Maggs, *supra* note 11, at 35; Schoen & Hunt, *supra* note 66, at 73.

84. Chambers & Sprecher, *supra* note 66, at 338; Forman, *supra* note 64, at 43.

85. Chambers & Sprecher, *supra* note 64, at 333; Kearsley, *Some "Facts" About CAI: Trends 1970-1976*, 13 *J. EDUC. DATA PROCESSING* 1 (1976).

86. Chambers & Sprecher, *supra* note 64 at 338; Forman, *supra* note 64, at 43.

87. The past disadvantages of CAI have led Gee and Jackson to conclude:

Whether the purpose of such technology is to increase the "productivity" of the instructor by not requiring his presence during certain sessions or simply to improve the quality of instruction, it is not clear that computer-aided instruction, videotape recorders, or other innovations will allow law schools to accomplish more during the three years.

Gee & Jackson, *Current Studies of Legal Education: Findings and Recommendations*, 32 *J. LEGAL EDUC.* 471, 487 (1982). This conclusion is based on the Park and Burris article, *supra* note 14: "Similarly Park and Burris found that computer-assisted instruction (CAI) is still in gestation in legal education and it remains to be seen whether it will prove to be broadly effective." Gee & Jackson, *supra*, at 487.

88. One network of computer-based legal education is centered on the University of Minnesota computer system and distributed via EDUCOM. Another network has been running on the PLATO computer system developed at the University of Illinois and distributed by CDC. Maggs, *supra* note 12, at 34. See Maggs & Morgan, *supra* note 22, for a description of PLATO and some PLATO programs. For a discussion of the advantages of a time-shared network see R. BURRIS, *supra* note 65, at 56.

most common location for a terminal has always been the campus computer center which might mean a five to ten minute walk, if not more, for law students.<sup>89</sup>

Second, establishing communication with the mainframe computer depended on a variety of factors. For example, the central unit had to be "up" or running and the communication system had to be operating.<sup>90</sup> If for some reason the central processing unit or the computer system's communication system was not functioning properly, connection with a remote terminal was not possible. Access to the time shared mainframe also depended on the number of users or people using remote terminals already connected.<sup>91</sup> In addition, access to the main computer could be interrupted by malfunctioning phone lines, or cables that connect terminals to the main computer, although these were less likely to occur. Another problem of time-sharing is that the computer response time increases with additional users. Unfortunately, students trying to establish a connection have no way of knowing which of these possibilities is preventing communication with the mainframe computer, since the only symptom of an error is no action by the terminal.<sup>92</sup> All the foregoing can increase user frustration and detract from the students' receptivity to computer assisted instruction.

While the major problems of time-shared access occur during this connect phase, some students would also have problems establishing their appropriate account codes due to forgetting the account number and/or password, or due to system conventions such as passwords needing to be in capital letters only. These aspects of time-shared systems forced students to spend five to thirty minutes just to gain access to the lesson, and in other situations, to come back repeatedly until access could be obtained. Access could take almost as long as the lesson itself.

Limited or hindered access to time-sharing systems has proven to be a major student inconvenience, but costs were also more prohibitive than expected. If the instructor and students had ready access to preexisting time shared terminals provided by the computation centers of a large research university then the costs of CAI involved only development costs, and access costs. However,

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89. Maggs & Morgan, *supra* note 22, at 152.

The primary nature of the objections raised had to do with the room in which the initial test was conducted. It was far from the law school and is a large, always noisy room with the lighting such as to create a serious glare on the students' screens. Many of the early questionnaires said that they would have liked the system even more had there been terminals in the typing room in the law library.

*Id.*

90. See Burris, *Computer-Assisted Teaching* in LEGAL EDUC. AND LAWYER COMPETENCY 149 (F. Dutille ed. 1981).

91. Each time-sharing system has its own limits with respect to the maximum numbers of users connected at any one time. Late morning and afternoons are often the heaviest usage times and therefore increase the likelihood of not establishing a connection due to too many other users.

92. See R. BURRIS, *supra* note 65, at 17, 27, 37, 58 for a description of terminal access difficulties. See also Park, *How Can the Law Professor Best Use Computer-Aided Exercises?*, in R. BURRIS, R. KEETON, C. LANDIS & R. PARK, *supra* note 18, at 13.

many colleges and universities would first need to acquire terminals (at costs from \$1,000 to \$3,000, and \$6,000 for a PLATO terminal) and then establish telephone access with a main computer. If the main computer center was not within a local telephone exchange, the costs of computer access increased tremendously due to long distance telephone charges with estimates of \$4.00 to \$18.00 per hour depending on network, computer, and royalty charges.<sup>93</sup> As a result, time-shared access to CAI lessons tend to be offered at large institutions that had ready access already available or could afford the CAI development and time-shared access costs. This is equally true in legal education. In law, the Minnesota EDUCOM and Illinois PLATO users totalled over twenty-five institutions;<sup>94</sup> however, this is a small number when considered in light of the more than 170 accredited American law schools.<sup>95</sup> These costs have led the Center for Computer Assisted Legal Instruction to abandon the networking system in favor of making the lessons available via a number of different microcomputers.

The microcomputer provides access to CAI lessons without using a main computer. Each microcomputer and its peripherals is its own computer system which needs only to be plugged into an outlet and turned on. Microcomputers are comparable in acquisition costs to a terminal,<sup>96</sup> but they do not accrue either computer access costs, or telephone long distance costs. Therefore the costs of CAI on the microcomputer are reduced to machine, maintenance, and development costs.<sup>97</sup> Perhaps more important than the cost savings, microcomputers eliminate the inconvenience of gaining access to the main computer. Students need only insert a floppy diskette (a program and data storage medium) into the microcomputer disk drive, which reads the programs and data, and turn on the machine. Access may be prevented if the machine actually malfunctions, in which case students merely transfer their diskette to the next machine. Currently, microcomputers have a good reputation for reliability and durability and this will no doubt increase over time. For these two reasons, reduced costs and improved access to lessons, the microcomputer promises to provide a better future for CAI and specifically for simulated legal training.<sup>98</sup>

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93. Costs are discussed in R. BURRIS, *supra* note 65, at 60.

94. See Landis, *supra* note 23, at 8 for a list of EDUCOM participants. See Munro & Noah, *supra* note 23, at 588-89 for a list of CAI users on PLATO & EDUCOM. See R. BURRIS, *supra* note 65, at 19 for a more recent list of EDUCOM participants.

95. As of 1981 there were 172 law schools accredited by The American Bar Association, 139 of which were members of the Association of American Law Schools. ABA, A REVIEW OF LEGAL EDUCATION IN THE UNITED STATES: FALL 1980-1981 2 (1981).

96. A typical Apple IIe system with 64K, one drive, and a monitor costs approximately \$1,900. A typical IBM PC 64K, one drive, and a monitor costs approximately \$2,500.

97. Microcomputers offer the lowest cost CAI systems. The savings are particularly striking when you compare the five to ten percent annual increase in faculty salaries with the five to thirteen percent annual decrease in CAI costs. This is said to be coupled with a ten percent increase in performance. Chambers & Sprecher, *supra* note 64, at 337.

98. See Burris & Park, *supra* note 5, at 22. Once installed in law schools, microcomputers will have additional uses. For a discussion of actual, potential, and projected uses of the computer in education, see Forman, *supra* note 64, at 43-45. Other uses to which microcomputers can

Microcomputers also offer the potential to ease the problems of authoring CAI programs. Authoring languages and easy to use operating system interfaces reduces the amount of learning necessary before authoring can take place. Because microcomputer authoring languages such as PILOT are easier to learn than the more complex languages such as Pascal and BASIC, and because file handling and computer access instructions have been minimized on microcomputers, it takes less time and less skill to author CAI.<sup>99</sup> Today on the microcomputer, particularly now that the microcomputer has appeared in the home, the instructor without a mathematical or computer background is capable of producing courseware, albeit limited courseware.

As mentioned above,<sup>100</sup> two additional obstacles to successful CAI are resistant faculty attitudes and limitations with respect to transportability and dissemination of courseware. Negative faculty attitudes are due in part to lack of familiarity with computer technology and are exacerbated by the absence of financial and, more importantly, academic rewards which are generally reserved for traditional scholarship.<sup>101</sup> Increased exposure to and use of microcomputer applications, such as word processing, data base management, and electronic spread sheets will go a long way toward increasing faculty receptivity. The Center for Computer-Assisted Legal Instruction is actively engaged in solving the problems of dissemination and transportability.<sup>102</sup> Among other things, the Center has adapted available legal CAI for use on most microcomputers. The Center is playing a significant role in encouraging CAI implementations in law schools.

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be adapted include word processing, maintaining grading records, maintaining bibliographies. This helps lower the cost of CAI by spreading the cost among a number of uses. Even further advantages are gained by another technology, the videodisc. Professor Roger Kirt has developed a program utilizing videodisc as a means for simulating trial tactics and evidence problems. The project is significant for a number of reasons. First, it uses the computer for simulation. Second, it connects two new technological developments. The only disadvantage is the cost. Development is even more costly than for microcomputer software by itself. See Burris & Park, *supra* note 5, at 22. The program was demonstrated at the January 1982 Meeting of the Association of American Law Schools, Cincinnati, Ohio.

99. See *infra* note 121.

100. See *supra* text accompanying notes 85-87.

101. See Chambers & Sprecher, *supra* note 64, at 338. See also Korn, *supra* note 11, at 476.

102. The Center for Computer Assisted Legal Instruction which operates out of the University of Minnesota, provides a central clearing house for CAI in law.

The Center's stated objectives include:

1. To establish standards and conventions applied to subject matter content.
2. To seek authors and support for the development of additional computer-based exercise.
3. To encourage and to sponsor research and development projects for advancing the quality, effectiveness and use of computer-based instruction in law.
4. To provide information to users and interested others about Center and Board supported activities and other computer-based activities relevant to legal education; and
5. To establish relationships with agencies, publishers and vendors that facilitate the Center's programs.

Memorandum from The Center for Computer-Assisted Legal Instruction (June 30, 1982).

## III. INSTRUCTIONAL DESIGN

While microcomputers have reduced the hardware costs of CAI and improved access for learners, courseware production is still labor intensive and incurs its own large share of the costs of CAI. It has been estimated that it requires from 50 to 500 hours of program preparation to produce and test a one hour lesson.<sup>103</sup> As a result, within the last three to five years, there have been greater efforts to provide computer courseware developers with sound instructional design guidelines for learner-and-computer interactions.<sup>104</sup> Origins for such guidelines come from general systems theory and the systems approach.<sup>105</sup> The systems approach can be applied at varying levels of instruction, such as an individual module of instruction, an entire course, an instructional program, or an instructional system. The systems approach to complex and adaptive system design encompasses the following essential components:

- Problem Definition
- Defining Alternative Solutions
- Design of the system
- Pilot Implementation
- Evaluation
- Revision
- Documentation<sup>106</sup>

The first component, problem definition, encompasses much of educational technology's efforts towards emphasizing the importance of developing goals and objectives. At one level, goals are derived from an analysis of the knowledge and skills which are necessary for a learner to acquire in order to function in a given environment.<sup>107</sup> The legal profession's concerns with respect to lawyering skills and knowing how to practice law are examples of broad goals that are defined by the needs of the outside environment. At times, a needs analysis is undertaken in order to assure that the appropriate

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103. R. BURKE, CAI SOURCEBOOK 25 (1982); Chambers & Sprecher, *supra* note 64, at 337; Magidson, *Issue Overview: Trends in Computer Assisted Instruction*, 18 EDUC. TECH., Apr. 1978, at 5; Kearsley, *Authoring Systems in Computer Based Education*, 25 COM. OF THE ACM 429, 430 (1982).

104. See, e.g., Caldwell, *Guidelines for Developing Basic Skills Instructional Materials for Use with Microcomputer Technology*, 20 EDUC. TECH., Oct. 1980, at 7. See also R. BURKE, *supra* note 103; Gagne, Wager & Rojas, *Planning & Authoring Computer Assisted Instruction Lessons*, 21 EDUC. TECH., Sept. 1981, at 17; Roblyer, *When is it Good Courseware? Problems in Developing Standards for Microcomputer Courseware*, 21 EDUC. TECH., Oct. 1981, at 47.

105. For General Systems Theory and the Systems Approach, see C. CHURCHMAN, *THE SYSTEMS APPROACH* (1968); R. EMERY, *SYSTEMS THINKING* (1969). For adaptations to education, see B. BANATHY, *INSTRUCTIONAL SYSTEMS* (1968); Hannum & Briggs, *How Does Instructional Systems Design Differ From Traditional Instruction?*, 22 EDUC. TECH., Jan. 1982, at 9.

106. For a discussion of systems analysis structure, see R. GAGNÉ & L. BRIGGS, *PRINCIPLES OF INSTRUCTIONAL DESIGN* (2d ed. 1979); R. KAUFMAN, *EDUCATIONAL SYSTEM PLANNING* (1972); Briggs, *System Design in Instruction* in H. MITZEL, 4 *ENCYCLOPEDIA OF EDUCATIONAL RESEARCH* 1851 (5th ed. 1982).

107. Hannum & Briggs, *supra* note 105, at 10.



goals are being met. Once goals are specified, objectives can be derived and stated in terms of student performance whenever possible.<sup>108</sup> That is, objectives describe what the learner and not the teacher is expected to accomplish. These objectives need to be evaluated in light of the learners entering competencies<sup>109</sup> since not all students bring the same experience and knowledge to the classroom.

An important and often overlooked component of the systems approach to courseware design is the second systems design component of defining the alternative solutions with respect to instructional strategies and media in education.<sup>110</sup> CAI is only one strategy, and is not necessarily an appropriate one in all cases or for all learners. One of the attempts of this paper has been to indicate why for certain instructional goals, the combination of simulation gaming as a strategy and CAI as a medium of instruction is indeed an excellent solution. In addition, the use of media within CAI such as graphics, sound, and videodisc needs to be considered and evaluated in light of their unique attributes.

Design is the third component of the systems approach to authoring courseware. Design entails planning the CAI lesson on paper before implementing a pilot version. Such plans are far easier to comprehend and modify on paper than on computer. Techniques such as storyboarding allow the author to plan each frame on a sheet of paper in order to design the screen layout as well as interactions between frames and the overall structure of all the frames. A spatial and temporal outline can and should be developed before computer programming begins.<sup>111</sup>

At this point it is useful to consider some design guidelines that have appeared in the literature over the last twenty years. First, it is desirable that the learner be informed of the objectives.<sup>112</sup> Learning is facilitated when knowledge of what is to be learned is clearly specified. Second, courseware design can facilitate learning by using certain features of CAI such as branching and feedback. Branching allows students of varying backgrounds and competencies to progress in different sequences, and at a different pace.<sup>113</sup>

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108. See R. MAGER, *PREPARING INSTRUCTIONAL OBJECTIVES* (2d ed. 1975); D. TYLER, *BASIC PRINCIPLES OF CURRICULUM AND INSTRUCTION* (1949).

One of the main advantages in using a simulation in the law school setting is to confront the student with problem-solving on a concrete basis rather than using the more abstract case method. The use of a concrete situation not only involves the student to a higher degree, it also puts the student in the position of making tactical and strategic decisions in addition to legal analysis.

109. D. AUSUBEL, J. NOVAK & H. HANESIAN, *EDUCATIONAL PSYCHOLOGY: A COGNITIVE VIEW* (2d ed. 1978); R. GAGNE, *THE CONDITIONS OF LEARNING* (3d ed. 1977); Hannum & Briggs, *supra* note 105, at 10.

110. W. SCHRAMM, *BIG MEDIA, LITTLE MEDIA* (1977); Hannum & Briggs, *supra* note 105; Jamison, Suppes & Wells, *The Effectiveness of Alternative Instructional Media: A Survey*, 44 *REV. OF EDUC. RESEARCH* 1 (1974).

111. See Hannum & Briggs, *supra* note 105.

112. Caldwell, *supra* note 104.

113. For an example, see *supra* note 17.

The student should be able to advance or skip ahead within a lesson, and to exit the lesson whenever necessary.<sup>114</sup> Before beginning a lesson, a student could take a diagnostic test to allow for a more accurate assessment of the particular path or entry point an individual learner should take. The content structure and sequencing of a CAI lesson obviously must be carefully analyzed and prepared in order to be able to allow for these *learner control* features.

Feedback and reinforcement allow the learner to progress towards the designated objectives. Just as systems design requires adequate evaluations in order to assess progress toward goals, students require adequate evaluation of feedback in order to assess their progress towards their lesson objectives. Feedback can consist of informing students how well they are doing or how much they have left to do. Student responses, which are most often used as the basis for providing feedback, can take several forms and a computer program can be designed to accept one or more. The two design alternatives—the constructed response (which consists of actual word or sentence responses), and multiple choice format responses—require the student to enter only one of several options.<sup>115</sup> When responses are correct, the program might provide feedback and reinforcement in the form of a single word such as “good” or “excellent” or, more elaborately, indicate why the response is correct. Incorrect responses can be prompted towards the correct response.<sup>116</sup> Under no circumstance should the student be allowed to be caught in a closed loop where only the correct answer allows progress towards the next step. Once planning of the design and the actual computer programming of the CAI lesson has been completed, implementation can begin. A pilot or preliminary version is always recommended since changes are to be anticipated.

The fifth component of system design is evaluation. Systems are not static. Change is expected and the purpose of evaluation is to provide a good basis for making changes. Both formative and summative evaluations accomplish this purpose. Formative evaluation might consist of the instructor observing students as they proceed through a module. In order to ascertain whether they are learning in accordance with the instructor’s objectives<sup>117</sup> the instruc-

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114. Caldwell, *supra* note 104, at 8. Glaser, *Components of a Psychology of Instruction: Toward a Science of Design*, 46 REV. EDUC. RESEARCH 1 (1976); Tennyson & Rothen, *Management of Computer-Based Instruction: Design of an Adaptive Control Strategy*, J. OF COMPUTER-BASED INSTRUCTION, Feb. 1979, at 63, 67.

115. A statement that would require a constructed response might be “Give me an example of a tort.” The student can be expected to provide responses such as conversion, battery, assault, trespass, and others. Misspellings and extraneous words have to be taken into consideration. On the other hand the multiple choice format forces the student to respond in a set pattern. The above statement could be asked as a question as follows: “Which item below does not represent a tort?” The choices would be specified and preceded with a number which the student then enters. These numbers are far more limited in student generated variations, so that error checking is reduced tremendously. See Burke’s chapter on “CAI Frame Protocols” for examples. R. BURKE, *supra* note 103, at 67. See also Burris & Park, *supra* note 5; at 20.

116. Caldwell, *supra* note 104, at 10.

117. For example, CAI can be used to bring “each member of the class up to a minimum level of competence before class discussion of the topic.” Burris & Park, *supra* note 5, at 20.

tor may be able to observe the difficulties students experience while interacting with the machine. Summative evaluation is more likely to consist of using a form such as a course evaluation form. Either way, instructors can make use of the evaluation to enhance and revise their module. This testing or evaluation component is one that can reasonably be expected to take place at least two and probably several times before producing a final lesson version.

The last component, documentation, is crucial particularly when the complexities of a computer system are involved. Instructional modules on a computer can easily become complex enough to warrant extensive documentation for use by others. Guidelines for producing documentation for CAI lessons can be found elsewhere.<sup>118</sup>

As the foregoing discussion indicates, developing and implementing CAI courseware can become quite complex. Such large scale involvements are often assumed to be attempted only by a team of specialists which might include learning researchers, instructional designers, evaluators, content specialists, and computer programmers.<sup>119</sup> However, depending on the size of the initial venture, one can often reduce the team to two specialists, for example the content specialist and the programmer/designer.<sup>120</sup> As long as evaluation and revision are assumed to be a continuing function, progress can be made over time, in part due to courseware authoring languages, such as PILOT, that facilitate initial attempts at CAI.<sup>121</sup> For more complex or large scale projects, however, professional results do require a team effort and standard, fully developed programming languages.<sup>122</sup>

### CONCLUSION

Computer assisted instruction made its appearance in education at a time when new and continuing problems were plaguing the educational system. The early and mid-1960's were years in which the problems created by the population explosion, the information explosion, the increasing demand for higher education, and the teacher shortage reached a peak proportion that encouraged many funding agencies to initiate CAI and other educational technologies as a potential panacea.

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118. Kearsley & Hunks, *Documentation in Computer-Based Instruction*, 13 ACM SIGCUE BULL. 3 (Jan. 1979).

119. R. BURRIS, R. KEETON, C. LANDIS & R. PARK, *supra* note 18, at 49.

120. See Trainor, *The "Plato" Computer Tutor: Education in The Office*, NAT'L L.J., May 4, 1981, at 21.

121. PILOT is an authoring language for CAI developed at the University of California, San Francisco by Dr. John Starkweather. PILOT can save an author time. PILOT lessons can be written with a substantial time savings over using BASIC. Kearsley, *supra* note 103, at 430. However the tradeoff for ease of use is the fact that it is more limited. There is no single ideal language for all authoring purposes. R. BURKE, *supra* note 103, at 20. See also Hazen, *Computer Assisted Instruction on the Apple*, 22 EDUC. TECH., Nov. 1982, at 20. There are other educator's authoring languages, such as TUTOR, which have not been modified for microcomputer use.

122. See, e.g., Chambers & Sprecher, *supra* note 64, at 338.

As some of these problems declined in significance, and as early implementation of CAI brought out the disadvantages of CAI, the question of effectiveness began to take on greater prominence. Slowly, as the trend toward accountability in education increased, the question of educational effectiveness also became one of cost-effectiveness.<sup>123</sup> Accordingly, evaluation of CAI projects has taken on ever increasing importance.

CAI can be potentially much more effective in those uses of instruction for which there is essentially no other competitive method for accomplishing the same results. Simulation gaming is an excellent example. Computers become a practical alternative when they are needed to provide realistic training in the workings of a system that is otherwise unavailable or prohibitively costly. Computers provide the opportunity to explore real-world phenomena in which a mistake could lead to harm, either physical, economic, or personal. When the simulation also incorporates the manipulation of large amounts of data, then the computer provides the added advantage of computational power. Computer assisted instruction also provides intangible benefits for instruction such as the possibility of providing individualized and interactive learning situations. In spite of these benefits, the high initial capital investment of CAI is still a major obstacle to widespread educational use of technological advances.<sup>124</sup> Other obstacles that have been reported include the lack of professional rewards or incentives, the lack of centralized maintenance and distribution, the lack of good quality courseware, and the difficulties encountered in accessing time-shared CAI.<sup>125</sup>

Microcomputers significantly reduce the problems of ease of access, the costs of hardware, and time-shared telephone communication. However, the problem of developing good CAI courseware still remains. Good computerized simulations take time and effort. Hopefully the benefits provided by CAI simulated legal training will outweigh the costs in the long run, particularly when compared to the existing alternatives of clinical education programs. While simulation CAI, like simulation in general, cannot be expected to replace clinical programs, it can serve as a very useful supplement to clinical education. Similarly, CAI should not be viewed as a replacement for traditional methods of legal instruction which must remain the most substantial part of any quality legal education.

When an individual or institution does decide to make a commitment to the benefits offered by simulations, it is well advised to keep in mind the lessons learned from past experience with simulation, with CAI, and with respect to instructional design. As this Article has pointed out, simulations, whether on the computer or not, are more expensive and difficult to design than many other forms of instruction such as lectures or tutorial CAI.

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123. Maggs, *supra* note 12, at 35. See *supra* text accompanying notes 83-87.

124. CAI courseware development costs do involve high capital investments, yet microcomputer costs are not as great as time-shared access costs for most institutions and in general compare very favorably with the costs of acquiring and maintaining a law school library.

125. Milner & Wildberger, *supra* note 18, at 119.

Microcomputers and authoring languages now allow individual instructors to program their own courseware. Such individual efforts, however, may not readily be transported into other classes unless additional care is given with a view to universal adaptability which can only be accomplished through a team effort. Furthermore, legal reasoning programs are still beyond the capacity of most instructors to generate without programming assistance.

Past experiences have indicated that CAI can be expected to accomplish equivalent or better learning of concepts than traditional instruction at a reduction in the time that the student and instructor spend on a certain topic. Additionally, simulation CAI provides types of learning that are not available in the traditional classroom. Attitudes of the students towards both course content and the computer can be expected to be favorable.

Because of the more complicated nature of simulation CAI design, it is useful to keep in mind certain instructional design guidelines. Instructors need to be clear about goals and objectives of the simulated experiences as they proceed through the design of a lesson module or modules. Since student reactions cannot always be anticipated, the simulation project should allow for testing pilot versions of the simulation on a few students in order to observe and assess student reactions or problems.

A distribution system (production and dissemination) now exists so that lessons need not be considered an unfruitful venture for the interested instructor. Both the Center for Computer Assisted Legal Instruction<sup>126</sup> and the potential publishers in the legal field promise to distribute and update courseware as it is developed.<sup>127</sup> The advantages of networking are also available to microcomputers and can be expected to be a standard feature in the near future. Finally, CAI is expected to be cost-effective by the mid 1980's.<sup>128</sup> Considering all these points, perhaps it is time to begin initiating legal training simulation gaming on microcomputers in order to fulfill Professor Harbaugh's mandate: "legal education has yet to create the 'unharmable client,' one who responds and submits to the legal and tactical choices of fledgling lawyers."<sup>129</sup>

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126. See *supra* note 102.

127. Publishers in other disciplines have already moved toward the development of CAI, and legal publishers can be expected to follow soon. Only centralized institutions such as the Center for Computer Assisted Legal Instruction or publishing houses are capable of keeping up with the distribution of updated materials. Landis, *supra* note 23, at 14.

128. Chambers & Sprecher, *supra* note 64, at 340.

129. Harbough, *supra* note 26, at 4.