DOCUMENT RESUME

ED 320 550 IR 014 466

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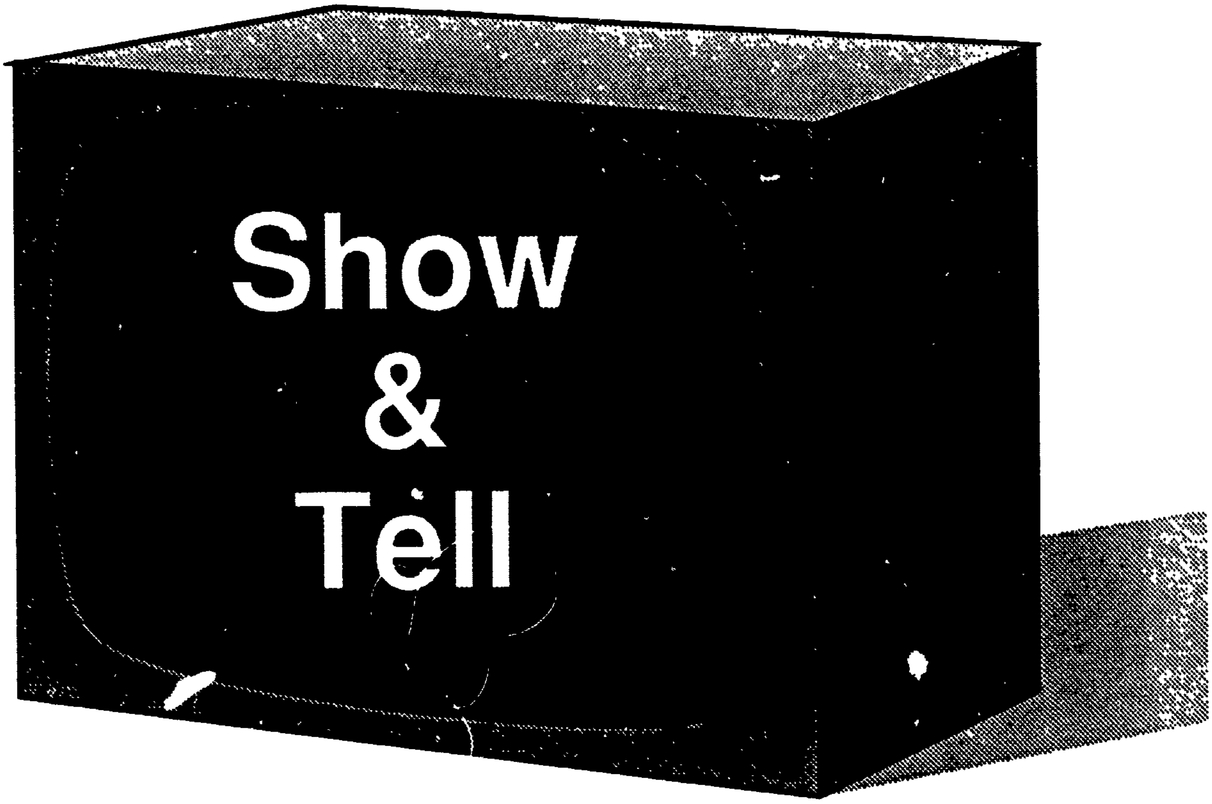
TITLE Show & Tell. Proceedings of the Ontario Universities' Conference (1st, Guelph, Canada, May 1987).
INSTITUTION Guelph Univ. (Ontario).
PUB DATE May 87
NOTE 217p.; For the proceedings of the 1988 conference, see IR 014 467.
PUB TYPE Collected Works - Conference Proceedings (021) -- Reports - Descriptive (141)

EDRS PRICE MF01/PC09 Plus Postage.
DESCRIPTORS Authoring Aids (Programing); *Computer Assisted Instruction; *Computer Graphics; Computer Literacy; Databases; *Expert Systems; Foreign Countries; Higher Education; *Information Networks; *Information Technology; Interactive Video; Media Selection; *Teleconferencing
IDENTIFIERS Canada; *Computer Mediated Communication; Ontario

ABSTRACT

Twenty-three conference papers focus on the use of information technology in Ontario's technical colleges and universities: "The Analytic Criticism Module--Authorial Structures & Design" (P. Beam); "Computing by Design" (R. D. Brown & J. D. Milliken); "Engineers and Computers" (P. S. Chisholm, M. Iwaniw, and G. Hayward); "Designing the CAL Screen: Problems and Processes" (R. Edmonds); "A Computer Aided Instruction in Dynamics" (H. Farazdaghi); "A Computer Assisted Curriculum Planning Program" (H. Farazdaghi , "RAPPI--Communications Networking in the Classroom" (L. Hazzan); "RAPPI--Open Door" (C. Hudel); "Computer Conferencing Systems: Educational Communications Facilitators" (C. S. Hunter); "Interactive Computer Art" (M. LeBlanc); "GEO-VITAL: Computer Enhanced Teaching in Geology" (I. P. Martini and S. Sadura); "Intentional Socialization and Computer-Mediated Communication" (E. K. McCreary & J. Ord); "Issues in the Development of Intelligent Tutoring Systems" (M. McLeish & K. Langton); "Which Objectives, Which Technologies? A Decision-Making Process" (C. Nash); "Library Instructional Module" (G. Pal, L. Rourke, and H. Salmon); "Computer-Assisted Language Learning (CALL) at the University of Guelph" (D. M. Paramskas); "Computer Literacy: A Practical Approach" (L. Pearce); "The EOP: Graphics & Teleconferencing" (J. Raymond); "Horticultural Production Systems Planning and Analysis" (J. W. Riekels); "The Impact of Interactive Video Teaching" (H. Schmidt); "The Use of the Veterinary Medical Information Management System (VMIMS) Database in Teaching" (T. Stirtzinger); "A Computer Science Summer Camp" (D. A. Swayne, J. VanDuren, and M. M. Shepherd); and "A Prototype Expert System for Teaching Brain/Behaviour Relationships" (M. Szwarc, S. Bandyopadhyay, G. Lasker, and D. Reynolds). References are provided in each of the papers. (GL)



papers from the conference

May 1987

UNIVERSITY of GUELPH

Preface

The 1st Ontario Universities's SHOW and TELL was an attempt, held at the University of Guelph during May 1987, to bring together those faculty using Information technology to augment their courses and both tell as well as show others what worked and what didn't.

The conference consisted of a series of 4 or 5 ten minute presentations followed by an equal period during which individuals were able to demonstrate their applications. In this manner a general description was complemented by a poster type demonstration for those interested in a particular area or application.

The present volume is an attempt to move these rather informal presentations into a generally more reflective and scholarly format yet maintain the spirited and useful information exchange that the SHOW and TELL has so far engendered.

I wish to thank both the authors and the staff of the Information Technology Support Group of the Office of Educational Practice at the University of Guelph for their effort in compiling this volume. They, the authors and staff, whose continued interest and support of the free exchange of information are leading to the effective and efficient application of Information Technology in the university setting. They deserve the credit for any success the Show and Tell or this volume might enjoy.

Thom Herrmann
Coordinator

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THE ANALYTIC CRITICISM MODULE (ACM) - AUTHORIAL STRUCTURES & DESIGN

This module, the ACM, has been produced under the auspices of the Computers-in-Education Committee of the Ministry of Education and has been written in C to operate on the UNISYS ICON. It requires both colour facilities and the Window Manager routine to function.

THE ACM STRUCTURE IN THE CONTEXT OF ICON SYSTEMS & NETWORKING:

The ACM's purpose is to permit teachers, particularly in language studies, to create very detailed, interactive lessons in computer-aided learning through a series of screen displays, menus and system commands, without being required to do any programming or database construction within the module. We believe that this is a major advancement in making teacher-specific CAL available in a congenial and comprehensible format. The tool described in this paper is in prototype and we commence testing it in schools in September of 1987. The guiding pedagogy has been to place a subject expert behind the left shoulder of a student in the examination of a short text or document. The passage may be of the instructor's choosing and may be of any length, though all our experience has been that brief texts, because of the depth in which they can be examined and explicated, be undertaken initially.

Because of the pre-eminence of the text in this learning model, it is virtually impossible to not have some or all of it on the screen, in a central location, at any given point. The student (or instructor in the lesson structure) is constantly indicating some aspect of the passage and making a comment or query about it. The teacher does so by a series of pre-defined questions and suggestions which make up the module's options and by responses to student choices or questions. The student makes selections from the passage, choices among topics and definitions and adds comments to a file which the instructor reads subsequently and from which he

or she can respond to the student, incorporate answers for an entire class and make modifications to the lesson, where such are warranted.

The creation module is the first of four, linked structures. In it the teacher prepares a comprehensive explication of any facets of a text on which comment is deemed necessary. It, in turn, generates a user module which resembles, as closely as possible, the appearance and sequences of the creation unit, to enable both instructor and user to look at the same formats by the same commands. There is an obvious advantage for both parties in close resemblances between what the teacher makes and what students actually see in the resulting lesson. Behind this premise lies our hope that students will be drawn in as aids and assistants in the creation process and in amplification and expansion of all aspects of a given lesson; where they are familiar with the format and the patterns of commands and devices, they will be the more practically prepared for this educational step, the more the creation design approximates the lesson structures on which they have been trained. A third component of component of the ACM, seldom seen by users, is the "datafile", the structure of teacher lessons, comments, choices and questions, as well as the large libraries of theory and help which can be linked to individual aspects of the lesson. These can be involved, modified, expanded and re-ordered by the instructor. The ACM runs under the Ministry's AMBIANCE program which establishes teacher and student accounts within a class and operates the installation, availability modifications to lessons within a given school's ICON system. The teacher is able to specify conditions within the ACM module to enable the user to collect information - pieces of text, definitions, patterns which develop within the passage - and to store these in personal accounts within the "AMBIANCE" system for future use in assignments, essays or study. This third structure, AMBIANCE, is the system version the class and the instructor may send messages, examples of student work, progress reports, announcements or lesson

instructions to all users through it. Reciprocally, groups of students may be organized through it in turn to carry out modifications and new developments on the lesson itself.

The largest structure of the four is "edan", the Ministry's computer communications network, linking 100 Ontario schools and research units via phone lines and datapac throughout the province. Within it the RBCS system permits teachers (and students) to store, create, exchange, and modify information, and CAL materials in particular. As this network develops and expands, it will be increasingly possible to exchange large, compiled lessons among institutions. At this level in the available technology, CAL of the kind described herein becomes increasingly efficient for two reasons. In the obvious case, the time and effort required to prepare lessons of the detail required by the ACM can be rewarded by the reciprocity of useful materials from other teachers, in other schools; once this process has begun, along with entire lessons being available in any school with ICON facilities, teachers will be able to utilize "parts" of lessons - the kinds of internal CAL mini-modules with applications to a number of lessons in a particular subject area. For instance, an inter-active module which explains "metrics", provides examples by user choice and then permits the student to try to correctly identify stresses and meter from a model which is then assessed and responded to by the system, may have application in a lesson on metrics, as a subjunct to the teaching of a Shakespearean sonnet and to work in linguistics. Once created by an instructor or user-group, this small lesson can be incorporated in larger modules by being copied from a "library" of language materials made available to any instructor by computer networking or by the simple process of copying it onto a floppy disk. By this process CAL takes on a richness of depth and resources not achievable by an individual teacher's effort, no matter the degree of that person's commitment. All CAL lessons in this format can be easily copied and can be modified by the ACM

in any location to adapt them to the particular needs of an instructor and a course.

THE INSTRUCTOR MODULE OF THE ACM:

Because the early versions of the ACM will be unfamiliar to teachers in both the theory and terminology of critical analysis and in the processes and techniques of operating the module, we have attempted to develop the HELP functions in detail and in some syncronicity to each other. They are easily accessible from any location in the program by the use of an appropriate icon on each screen. To test the creation unit's functions and to provide an initial model from which novice instructors can commence work, we have developed a detailed analysis of Thomas Hardy's "Afterwards", a twenty-line piece of verse. New users are encouraged to consult it for both models of how to approach a passage - what questions and information to use, as well as what topics and techniques to employ and for some insight into the critical theory behind parts of the module's design. No one is obliged to use any of the theory or specific literary topics provided or use any order of presentation other than one congenial to each developer's insights and emphases but the lesson shows a number of subjects and methods and at least suggests some ways of approaching a text.

We have begun development of a library of technical and literary terms which will be available to all users as a kind of "lexicon" from which they may draw materials for inclusion in a particular lesson or to which they may refer their student users for more extensive reading. Definitions within it - as those within an on-line dictionary in the near future - may be modified as they are brought into specific lessson modules to render them more appropriate to particular contexts. An author may omit tangential references, add germain examples or comments and link the inlesson definitions to inter-active "sublessons". For example, an instructor

might include a sonnet as an optional example in the literary definition of the term, make references to other sources as bibliography and then give the user the option to go to a selftest of the concept of a sonnet in which meter, line length and rhyme scheme could be assessed by the user's correct identification of each characteristic, all from a small program within the lesson itself. Such an extensive definition can be easily transferred from the lesson in which it had been developed to the library and thence to any other designer who might have use for it in any lesson. We hope in this way to assist new instructors in the future and, because the development process thoroughly executed can be an extensive one, to reduce repetitious aspects of it - the re-entry of common definitions, for example - by having them easily available for all users. Larger lessons can be exchanged by instructors' agreements and this will render development time even more effective as users in a number of locations come to benefit from a variety of analyses on different subjects shared in common among their creators. Teachers will then see large benefits for their individual efforts by such exchanges and students will have a variety of materials from which to learn and, we hope early in the process, to which to contribute.

Computer-aided lessons can be very specific, focussing on one or more subjects -- meter, for instance. They can also incorporate a wide range of critical devices and perspectives and, obviously, they become increasingly complex as comprehensiveness is attempted. One of our major recommendations is that they should be started on a modest base and then be built in light of experience, student reactions and perceived needs. In this sense, optimal efficiency will be achieved by teachers using texts with which they are familiar and which they have taught before. To discover what possible answers come to users' minds, one needs to mark several sets of papers on a given topic. Within the ranges of responses it becomes clear that two or three perspectives or opinions occur frequently and these

can be anticipated and responded to in advance so it is possible to give both directions and answers to most users as well as to provide directions to new topics as extensions of what they express in their answers. Of course not all questions and responses can be anticipated so users must be assured at an early stage that their responses can be dealt with by the instructor at a point in the near future. This is accomplished via the comment facility from which the user can communicate with the instructor and, under certain circumstances, other people working within the module. A function key invokes the editor, the user comments, at whatever length, and the resulting material, with a marker of its location within the topics and screens of the lesson, is sent to the instructor account for appropriate action. The long-term good effects of this process are threefold: the lesson is improved over time as user performance and comments point to weaknesses and strengths to be modified or enhanced. As well, users participate in the learning process and, depending on the degree of use of the device, they create an environment more of a tutorial than a lesson in isolation or a dialogue. Many student comments prove to be useful responses in their own right and can be incorporated in the larger lesson as optional perspectives or as fully integrated parts of the ranges of answers to other users' questions and performance. It is my strong hope that students will be drawn in time to be full participants in the creation aspects of the lesson, coming to develop many of the detailed support programs and facets of the main work. For instance, a student who comes to see grammatical links among patterns within a text can go on to develop these in full detail from an instructor's limited range of examples; further extensions can incorporate inter-active questions from a user about other grammar-related concerns and larger structures of grammar of general use to a number of modules on language. These in turn can be transferred, in whole or in part, to be modified and adapted into other lessons, on the same or on remote CAL systems.

It has been my experience that students, given definable projects from topics of particular interest to them, benefit from the atmosphere of personally directed learning in the material itself; they must conceptualize a topic, limit its dimensions, get and evaluate material and express it in a comprehensive form to appeal to many users. They learn about both the format of expression - the integration of ideas into spaces and sequences - and the system on which the work is displayed. The effect of performing real instruction seems to be a tonic to motivation, particularly as we have been able to have students explain what they are attempting to other students.

USES FOR THE ACM: Ranges of subject matter.

Initially we had conceived of preparing a single, very complete module to teach users the major categories and types within analytic criticism, using as our only text Thomas Hardy's Afterwards, a poem of some twenty lines in five sentence-stanzas. As we came to devise the necessary editors, messaging systems, libraries and movement and checking tools, it became apparent that, with a prodigious effort, we could turn over to users a very flexible and expansive CAL creation system. In effect, what we had to provide for ourselves as authors could be packaged as a set of creation programs to permit any instructor to perform similar operations on any text. If this were so, then, presumably, any instructor, using any text, could perform similar operations on any subject. Auto mechanics, with a strong integration of graphics functions, would be as achievable in this search and question format as analytic criticism of literary texts in English. We have moved most thoroughly on our subject matter, of course, but we have also become intrigued with other potential uses and plan to explore several, particularly in the teaching of business-related materials in the near future. In the complete expression of the ACM, as we conceive it, an interested instructor will be provided with the following:

- the ability to turn over to students within the ICON/Ambience environment a stand-alone facility for learning analytic criticism. This will include the module of Afterwards, as a fairly complex exposition of critical theory, a tutorial session which takes a novice instructor across the major critical points and system devices through a short passage entitled TO A FISH OF THE BROOK.

- Complete lexicon files for its vocabulary, grammar and semantic expressions for all words in the passage.

- A set of some twenty topics among which the user may browse, with appropriate references, based on user performance, to other, related topics and a set of inter-active sub-lessons from which the user can assess his or her understanding of the topic under consideration.

This is completed by an extensive series of help files which define and discuss the various topics which, together, make up the theory and application of analytic criticism.

Using just this module, the teacher may -

- turn students immediately to the practice of criticism by merely requiring them to work through the module on Afterwards by themselves, using only the questions and aids of the module.

- work through the module with the students as a class project by a combination of conventional and CAL lessons.

- require the students to complete their analyses from either mode by a formal essay on the features of the passage.

- commence work on a class or instructor lesson on another passage, using the theory/topic links provided by the system by invoking the lesson structure provided as a template within the ACM. Here the instructor may select from among the fifty passages available within the ACM or may enter a text of personal choice against which all the options of the lesson creation unit may then be employed.

- use the ACM process to either modify the critical theory files individually to reflect the instructor's personal view of Afterwards or select among them to incorporate desirable points and areas of the theory into the instructor's lesson on a new passage.

- employ the structure of the ACM to create entirely new theory on Afterwards or any other passage of the instructor's choosing.

- apply the ACM structure to an entirely different subject, using the topic function to create an entire lesson on the operation of a turret lathe or alternate strategies for re-fighting the Battle of Waterloo.

In all these conditions instructors may invoke existing libraries of terms, definitions, information trees and devices as they exist in the database or as they are created by individuals or classes to respond to specific situations. Existing bases can be modified, expanded and adapted to new subjects so that a lexicon of Middle English terms created for a module on the Canterbury Tales may be copied and incorporated to run in a lesson on Medieval law, with appropriate additions for that subject matter.

The MENU screen offers the following choices:

1) Create Lesson (Teacher Module)

2) List Existing Lessons

3) Critical Technical Overviews

4) Run Lesson (Student Module)

5) Selections Of Text

6) Quit

Of these the most important is the Lesson Creation option. Presuming that the instructor has found in the list of available passages a text of preference (the alternative is to enter a selection from the editor), the creation unit is now prepared to begin computer-aided learning materials preparation. For beginning instructors, the process need not be complex. Presuming that the text is one to be studied in conventional classroom discussions, the initial questions may well be those the teacher would use to open the subject. Here, by the selection of topic, the instructor may choose to prepare material within one of the areas of analytic theory structured by the ACM. SETTING, for instance, would include ancillary files which are automatically linked by the Help and Define icons to explanatory materials available to the use· throughout both that topic and the lesson. Should the instructor wish to modify these or to create a topic not included among those of analytic theory, the theory files must be accessed and modified or else be replaced with appropriate new materials of the instructor's preference. Where no such materials are created, no structure is invoked by the system to link the user to assistance beyond that of the module's operational Help feature itself. Oncethe topic has been selected or devised, the instructor enters question mode, asking as many questions as seem appropriate to the topic, leading the user by these to an understanding of the topic and its relevance to the text - much in the pattern of

lessons with which the teacher is familiar. After the question has been entered, the instructor is prompted to select those elements of text which answer it. These may be selected in any order, as words or phrases, and may be modified at any point in the process; however, once the series of right/wrong answers has been set, the question is established and can be changed only by a new question being designed to replace it in its entirety. With the selection of each right or wrong term, the instructor may make a statement about why that term is correct (or not). This statement is read by the user only after the question has been attempted and the answer has been displayed within the text itself, at which point the user may select any parts of the answer - right or wrong - to receive the instructor's explanation of why that selection is appropriate or not. The student may check all significant terms in the passage in this way, commenting to the instructor at the end of each to indicate agreement or to continue the discussion. Student choices can be surveyed to look for patterns useful in the re-defining of the lesson and the honing of the questions.

In the topic and question creation workspace the instructor can be as thorough as time, subject and inclination permit. Audience sophistication, the uses to which the lesson will be put and the individual's sense of the need for comprehensiveness determine just how much effort is required to begin profitable use of the module by students. We anticipate that instructors will require time and experience to develop effective techniques for interrogation and commentary so we offer models, examples and advice at both the topic and question levels. The final stage of preparation is the comment prepared by the instructor to conclude the series of questions on a particular topic - this is the summation of the directed argument made by the patterns of questions and answers. Here the instructor brings together the cumulative points and relates them to both the theme of the passage and other topics. The structure of the ACM has been kept intentionally non-hierarchical. This

places a consequent responsibility upon the instructor to add as much sequencing and form as are requisite for the topic. Here too, we feel that instructors will achieve their best personal levels of teaching from a minimum of organization imposed upon them by the system itself for non-pedagogic reasons.

Tracking or the surveillance of student oerformance, has been minimized, though we may add more extensive records keeping in later versions. At present students receive, along with the on-screen display of correct-wrong-missed, a numerical list in the lower right corner of the text display at the point in the lesson where the question responses are assessed by the system: 9/ 3/ 5. Instructorsmay set quantitative or qualitative ranges of user performance at which to respond with appropriate encouragement and directions as a user receives the system response to a question. Because the student has thought closely in developing an answer, these may be the most effective locations to make relational and thematic points. Here too, the emphasis is on the instructor's decisions and abilities to direct, rather than the system's rigidity of structure to enforce. We feel a single sequence or order of process may not be necessary or appropriate to the material or the natural learning sequence for all users. The final level of instructor's choice is the ORDER LESSON option which permits the instructor to re-arrange the sequences of both the questions and the commentaries which accompany them. Here too the materials can be modified and erased in response to both student patterns of performance and subsequent inspiration on the part of the instructor. One enters this area from the Lesson line and movement is made by menu selection of the appropriate files. This area can be accessed only from the instructor mode, obviously.

LIBRARIES

Many of the topics in analytic criticism have elements of language which will

apply to virtually every text selection - common definitions within grammar, literary convention, historical linguistics, to name a few. Here we have developed the concept of a library by creating what are, in effect, small lexicons specific to each subject. Initially these may be definitions of grammatical terr ɹr instance. The instructor accesses these and selects the appropriate materials to include in the in-text definition of a word. In this way instructors' efforts are saved and lessons reveal a similarity in their background materials, though each author may modify any term from a library and, in fact, may add elements to any library. In the future these may come to include graphics, movement and even sound; for the moment, they can include interactive examples and user self-tests in concepts like "meter" for instance. They are added to the module via the DEFINE icon in any appropriate "topic".

IN CONCLUSION

How innovative instructors may become will depend on their perceptions of what they are doing, as well as on the flexibility and clarity of the module itself. Our efforts have been directed simultaneously to its design, features, relationships and the creation of materials to serve as examples and models. I strongly suspect that we have been oblivious to many opportunities for inovative expression as we have concentrated on design of the active parts for instructor use. Mindful of this, we are most anxious to have the ACM in beta test for final distribution in a teaching environment in early September so instructors and students can validate its educational uses.

COMPUTING BY DESIGN

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This is a record of observations about the use of computers in the teaching programs of the School of Landscape Architecture, University of Guelph. In many ways it is representative of experiences elsewhere in instruction programs in the design field. In comparison to programs of a more scientific orientation, for example, landscape architecture was slow in integrating computing into day-to-day instruction. A number of reasons for this may be cited. Among these:

(1) Early computing activities focussed heavily on 'number crunching'. While landscape architects do deal with statistics and some civil engineering, these activities are not central to design. Therefore, no pressing need was felt by either faculty or students to 'plunge into the electronic age' at a time when many others did so.

(2) The area of landscape planning involved an early thrust into exploration of computing in landscape architecture as mapping and geographic information systems became available. The Harvard 'Symap' program was, perhaps, the first use of computing seen to be central to the work of some landscape architects. This, though, involved only those instructors and students with a special interest in such work and the main stream of the profession (and the School) continued to rely solely on traditional teaching/learning techniques.

(3) While early costs for computing were small and heavily subsidized by the University, budgets at the School level were increasingly restrictive and priorities were placed elsewhere by a faculty who were generally unfamiliar with and intimidated by the 'main frame' and 'FORTRAN' and 'WATFOR' and the jargon which had grown up around the intense computer users.

(4) Hand-drawn images have been the primary design tool for centuries. There appears to be some subtle connection between the mind, hand and drawing of the designer that the computer tends to interfere with, despite the very powerful and useful Computer Aided Design (CAD) systems now available. Designers gain much manipulation capability with these systems but lose the open-ended freedom of exploration afforded by a soft pencil and a large sheet of paper.

Recent advances in hardware and particularly software have made computers much more available and desirable for designers than ever before. Economics also comes into play - as soon as one

office has a computer system that allows practitioners to produce drawings more quickly and inexpensively, then the pressure is on others to become computerized as well. Our students now realize that they must possess computer skills when they graduate with a landscape architecture degree if they are to be employable in the profession.

We still have problems, however, with students' aversion to numbers, their perception that computers are rigid, stupid machines, and their concern about the loss of hand drawn graphics (which tends to be a large part of the magic in many students' designs).

This sets up a contradiction between what the students know that they need to learn, and what they would rather learn. Therefore we are faced with somehow introducing students to computer use when, as yet, most of them would rather put their energies into learning the "magic" of hand-drawn graphics.

We start with a deliberate ploy. Our site engineering course is used to introduce students to computers for the first time. Students tend to have an aversion to this course anyway because it requires them to use numbers. But the course is made much more palatable by introducing students to very friendly computer programs which do the several types of engineering calculations needed. Students are 'tricked' into using the computer as a calculator without worrying about the fact that it is a computer.

Everybody gains from this. The students learn more site engineering because they can practice solving each problem several times to make sure they have the best solution. These are problems with no 'right' answer, but 'better' and 'best' answers and the speed of the computer allows them to experiment with input variables and to test the results over and over again. Students used to solve a problem once, and hand it in (right or wrong) due to the amount of time invested in calculations. Now they explore many solutions and select the most appropriate one. Much more practice is gained and incidentally, students learn how to turn on the machines and use them in a rudimentary way, without the usual nervousness or fear of "the computer".

Once the students have come to accept computers as friendly calculators we then ease them into computer graphics. We have paint programs that are very easy to turn on and use, and students only have to learn one new skill - how to move the mouse around and make the pencil on the screen draw. It is a lot of fun for them. We treat it like a game and they take turns drawing 'things' on the screen. They laugh at each other's lack of skill and quickly gain a very positive attitude towards computer graphics. They still don't need to know anything about computers or even printers. They simply photograph their pictures off the screen, a skill that they are already comfortable with and enjoy.

Soon they are creating text slides for presentations, quick graphics, or just trying things out in their spare time, exploring abstract ideas and the computer's capabilities.

Students usually become aware at this point that word processing can make their life easier. The teaching program requires a lot of group work and usually one student in the group knows how to type and wants to try out, or has already learned, word processing. Soon the whole group is in the computer room working on computers, but thinking 'very sophisticated typewriter'. They begin to see the power of the computer to cut and paste. Our students are notorious for cutting and pasting by hand until their report is just right. Again they use the computer as a tool and they don't see it as an intimidating machine.

From the faculty standpoint this is all very positive. Reports are clean, with no erasures, no spelling mistakes, are well formatted and on time... a delight to read and evaluate. Students are producing the best work possible without the time and other limitations of having someone else type it for them.

As always, though, software that is very good for one thing is generally not very good for others. Students soon see that they cannot use the paint programs, for example, to generate good 'hard-line' graphics. This is when they are ready to move on to something less 'friendly' but more useful in their education.

They are now quite comfortable, through 'osmotic learning', with floppy disks, saving files and other operations, all learned in a non-threatening manner. We then introduce them to the most powerful microcomputer software available to landscape architects - CADD. We tell them these programs are less friendly, but much more flexible, that they can do virtually anything they want given sufficient practice time and knowledge. We have found that students can expect to spend about 40 hours of computer time with CADD to get really comfortable with it and then off they go. We help them get started, keep the manuals nearby and give them a project which gradually introduces them to the many drafting tools available in the software.

After this point, they are very comfortable with computer use. They are learning much of the jargon, mainly through simply hearing it used by others, and are beginning to help the newer students get started. This is an important process, almost a tradition in other activities in the School and it is beginning to happen with computing. Many of the technical skill that students learn in the school have always been learned from other students, (quick and dirty graphic techniques, how to cut and paste, how to fix up a drawing when you have accidentally sprayed it with black paint instead of fixative or spilled coffee on a corner and so on). Now information on computers is beginning to be passed along in much the same way.

There is great potential for computer use in landscape architectural design education. The advantages clearly outweigh the disadvantages.

Problems still exist, however, including:
(1) how to encourage other faculty, particularly ones who are older, and more established in their ways, to use the computer in everyday teaching, and

(2) how to fund sufficient numbers of computers to allow access by all students.

Some of the disadvantages of computer use are:
(1) Students sometimes run computer procedures because they are available and not because they require them which leads to what we call 'analysis paralysis'.

(2) Computers tend to be inflexible, going against the nature of a designer who tends to want much greater flexibility in design tools.

(3) The start-up time to get design students involved is very high, with some Computer-Aided Design and Drafting (CADD) programs requiring a minimum of 40 hours of familiarization time.

Computer use offers the students many advantages in their design education. Some of them are:
(1) They can explore many ideas very quickly.

(2) They are not 'stuck' with a solution because of a large amount of time committed to it.

(3) They can explore the implications of a change in their design without having to redraw everything by hand.

(4) The computer allows interaction whereby the student can iterate to resolve a problem most effectively.

(5) The quality of the finished product, is often increased through computer-generated output.

(6) The computer allows students to extract layers from their designs and look at patterns in isolation. For example they can evaluate the pattern of just the roadways, or just the trees, or just the drainage.

AT bottom, we have found that the best way to make designers computer literate is to 'ease' them into computer use without them having to ever think 'computer' or about FORTRAN, or MAINFRAMES, or even about very many numbers. They learn to think of it as a fast calculator, a smart typewriter, a colorful image maker and finally a very handy design and graphics tool.

ENGINEERS AND COMPUTERS

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The examination of computers and their applications can take place in the general context of information technology; alternatively, there is an on-going examination of computers and their applications that relates to specific fields of industrial practice such as architecture, communications, engineering, library science and medicine.

Our article refers to contemporary engineering practice. Our objective is to propose that teaching/learning about information technology can lead to personal learning outcomes that are more durable than the technology itself. Our proposal incorporates four relationships between engineers and computers that occur in contemporary engineering practice, and which are cast in the form of a general learning objective about information technology for undergraduate engineering students. Student experience with the objective is described in terms of curriculum content, and some examples of computer applications in engineering practice are given.

The content is intended to show that the learning outcomes wanted are personal in nature. Further, personal ability at analysis, application, synthesis and optimization, among others, is separate from the medium of information technology that contributes to its learning. Finally, in operational terms, the abilities have the general form of information processing that can be applied independently to new information as it is encountered.

1. Four Relationships

The first, and most pervasive, relationship between engineers and computers is due to computation content in engineering practice. The microcomputer is the current engineering computational aid, having replaced the programmable calculator and its antecedents, the slide-rule and logarithm table.

Next, the computer helps the individual at learning how to learn. This abstract relationship entails experiments with translation, interpretation, and extrapolation of information to discover(learn) which principles are required to identify(learn) relationship between variables or perhaps recognize(learn) trends in data that are otherwise not immediately evident.

The third relationship is set in the context of mathematical modelling (imitation) of real engineering systems. Modelling is rich in learning content, as it helps the designer to learn about the necessary relationships between the parts of a system which enable the system to operate in the way intended. Modelling is a simulation of system operation, and it is essential in learning the admissible ranges of system element parameters for design of real systems.

The fourth relationship is determined by the use of computers as parts of engineering systems. As components in control systems, computers continuously monitor the operation of aircraft, breweries, petroleum refineries, traffic control systems and many other familiar examples. Beyond their immediate control function, they help the designer to learn about the operation of real systems and contribute to new information required for learning how to improve upon existing designs.

Instruction about the preceding relationships is organized according to the following general learning objective.

2. General Learning Objective

Learning about the four relationships between engineers and computers can be assessed by observation of student performance in response to relevant assignments. More specifically, observable student behaviour together with objective results or products from student behaviour, provide a basis for evaluation of learning. Thus the following general learning objective is stated in behavioral terms and comprises five parts.

a) Who is required to perform?

Teaching/learning about engineers and computers is continued through semesters 1 to 8 inclusive. All undergraduate engineering students are continuously encouraged to develop independent learning ability within the curriculum structure described in Section 3.

b) What performance is required?

All students are required to independently program the solution to problems assigned in different subjects (statics, design, economics, etc.) using a high level computer language. They are also required to run the programs and evaluate the results. This task incorporates both original programming by the student and the use of distributed or "off-the-shelf" software.

c) What constitutes an acceptable response?

Criteria for evaluation of student performance differ among courses. In general, evaluation is directed at measurement of independability in the following:

- verbal and written (printer) communication;
- analysis and synthesis;

- modelling of engineering systems;
- production of new knowledge from information processing;
- evaluation of personal work; and
- use of computers as components of engineering systems.

d)Curriculum and constraints?

Curriculum design provides a progression from formative through summative learning about relationships between engineers and computers. This progression is described in Section 3 by relating learning outcomes to different points in the curriculum.

e)What facilities are required for the student to perform?

Facilities provided to assist learning are described in Section 4.

3. Learning Sequence and Curriculum

Our purpose in the School of Engineering is to train engineers in the use of the tools that he/she will need to fulfil his/her job - design. Traditionally, these tools have been the T-square, or a transit, or a handbook. Today, the computer is one of the most important tools that an engineer uses. Upon graduating, the student should be both familiar and comfortable with a mainframe and micro-computing environment.

The Engineering program runs for four years. The first year provides an introduction to computing; the second year provides applications. Year Three goes into analysis, and introduces design and synthesis/optimization, while Year Four provides practical experience with design and synthesis at the summative level of learning.

a) YEAR 1

The first year program includes an introduction to the computing environment at the School of Engineering. The micro-computer lab, which is

available to all engineering students, is equipped with 15 IBM PC's, and 20 carrels with power supplies for portable computers. Peripherals include printers, plotters, and modems, all networked through their serial ports. There are also two terminals to the mainframe installation on campus.

By the end of Semester One, the student has been required to use the word-processing, BASIC programming, and plotting capabilities in this lab. As well, they have been supplied with TCoSy accounts to introduce them to computer conferencing, and special accounts on the mainframe WATFIV utility. By the end of Semester Two, the student is expected to have written and run simple BASIC programmes, and to have used off-the-shelf software in this environment.

b) YEAR 2

During the second year, the student learns the three major applications of the micro-computer within the engineering discipline: acquisition and control, computation, and presentation. The data acquisition and control function of the computer is used in the materials science course, where the laboratory equipment is in the process of being instrumented. Data will be acquired, manipulated, and displayed in the lab during the course of the experiment. The "number-crunching" abilities of the computer are put to use in the numerical methods course, where the student develops a library of his/her own programmes, which can be used subsequently whenever numerical analysis is required. The presentation aspect is addressed in the design course, which requires professional quality reports, and the implicit use of the computer's word-processing capabilities. By the end of Semester Four, the student should be familiar with and have personal experience with these three applications of the computer.

c) YEAR 3

Year Three deals with analysis, and the student learns how the computer can aid in engineering design. This process involves four steps:

1. presentation of the theory of some physical phenomenon;
2. illustration of the theory using "manual" examples;
3. presentation of a computer model or simulation of the phenomenon, which is verified by repeating the examples of Step 2 on the computer; and
4. the accepted use of the computer model.

It is also in Year Three that the student learns to regard the computer as hardware; i.e., as another component of the system that the engineer is designing or using. In the micro-processor course, the student is supplied with a micro-processor, and learns to assemble a control circuit using that processor and to programme it in machine code to perform a particular task.

At the end of Semester Six, the student should regard the computer, whether in its software or hardware aspect, as just another engineering tool, which can be incorporated into the design process.

d) YEAR 4

Year Four involves synthesis and design, and the student is expected to design a system using the tools and scientific principles learned previously. The use of off-the-shelf software is accepted as a matter of course. The entire process culminates in Systems Design, where the student does data acquisition, numerical analysis, word processing, and produces display documents for presentation. As well, the projects selected usually involve the hardware aspect of the computer with a microprocessor

incorporated into the design itself.

By the end of Semester Eight, the student is expected to have a complete acceptance of the computer as simply another engineering tool with which to accomplish the simulation, control, and presentation of design.

4) Computers as Parts of Engineering Systems

a) Computer Courses

In addition to using computers for engineering computations and simulation, students may incorporate computers into the systems they design. In measuring instruments, non-linearities and noise may be removed by computation. In control systems, the computer senses upsets to the process, calculates the appropriate corrective action and carries out that action. This latter operation imposes more stringent constraints on the computer than those imposed by data processing tasks. The most significant constraint is the computer response time - disturbances must be controlled as they occur; if the response is not fast enough, the system may fail catastrophically. Two courses in the engineering curriculum at the University of Guelph address these applications of computers specifically.

In their third year, students take a course in microcomputer fundamentals. In this course, the inner workings of computers are examined and interface circuits to sensors are designed. The students are required to build the interface circuits in the laboratory and to write the software required to operate them. Each laboratory work station consists of a Radio Shack Colour Computer with 16K bytes of memory. A custom-made interface board is installed in each computer and is connected to the students' circuits which are built on a plug-in prototyping board. A Radio Shack Editor/Assembler cartridge is installed on each custom board to provide a

good programming environment for the students. This computer system is less expensive and easier for the students to use than most of the single board computers.

The software for the individual projects is written by the students in Assembly language. Although this language is rather complex, it gives the user complete control of the computer. The students gain some appreciation for the capabilities of small computers and are exposed to a different type of language.

In their final year, engineering students may take an elective design course which examines advanced control theory and digital control systems. The implementation of controllers based on this more advanced theory may be feasible only if computers are used. This is particularly true when the controller must adjust several parameters simultaneously. Computer control systems are also very versatile: only the software need be changed to completely alter the type of controller implemented.

This versatility is well-used in the laboratory part of the course. The students are required to write a control program in PASCAL and test it on a simulated process. Then they must modify the program to implement classical PID controllers as well as controllers designed by Z-transform techniques. Each work station consists of a Radio Shack Colour Computer with 64K bytes of memory and two floppy disc drives. This computer was chosen because a multitasking operating system, OS-9, was available. An analog interface (Byte Craft Limited, Waterloo, Ont.) is connected to the RS-232 serial port. This interface may be used with any computer with a standard serial port.

b) Teaching Equipment

One development project being carried out by the School of Engineering

is an instrument system for the Materials Science and Soil Mechanics laboratories. Here, experimental data is collected by a central computer and relayed to display stations at eacn of the experiments. This allows the students to see plots of the data develop as the experiment progresses.

The central computer is an Amiga A-1000 with a Daytronics 9010 data acquisition system. The display stations are Radio Shack Colour Computers. The project requires the development of a local area network to transfer commands and data between the central computer and the display stations. The hardware has been built for approximately $10 per station. The software, however, is expensive. A considerable amount of time has been spent on the project and more is required. One rule of thumb states that software costs about $65 per line of documented, debugged code. This is not far from the truth.

5.Summary

The four relationships between engineers and computers are concrete and provide a structure for learning and using information technology. Together, these relationships present an interface between the person and the computer system which is rich in opportunities for learning at the enhanced rates and precision of electronic information processing which is not achievable by human processing. More generally, the interface provides a learning environment for the practice of personal abilities that is not available elsewhere. Further enhancement of the learning environment will result as teaching methods change and new systems are developed.

Designing the CAL Screen:

Problems and Processes

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Abstract

As real-life students meet real-life Computer Assisted Learning, the importance of quality, interpretable graphics becomes more and more apparent. Although they work in an essentially visual medium, most CAL developers do not have professional visual design training. As a result, solutions to instructional design problems seldom take full advantage of the delivery medium's visual nature.

In order to realize this neglected potential more fully, a number of strategies are available. The visual disciplines, such as graphic design, illustration and animation have several processes which can be utilized. By borrowing these techniques, the developer can streamline the design process and make graphics production both more predictable and of higher quality. The use of production tools such as grids and storyboards, the appropriate use of colour and rendering techniques will therefore be discussed, and strategies for implementation shown.

This paper will survey how design procedures from related visual fields may be adapted to the benefit of the Computer Assisted Learning developer, and suggest that utilizing these methods may also feed back into the instructional design process, resulting in a better exploitation of the delivery medium.

Problem: Designing the CAL Screen

In everyday living, the human senses process the enormous amount of information transmitted by sensory stimuli. When working at a CAL terminal, the user's senses are also inundated with stimuli, but this time, some of them are specifically designed by the CAL author. In trying to make sense of the environment and draw some meaning from the sensory parade, the user tends to classify these stimuli into two groups: the important, which are generally referred to as signals, and the unimportant, or noise. Noise interferes with the reception of signals, and can often render a signal indecipherable. Instructional content must reside in that portion of the stimuli judged to be signals. Too frequently, the manner in which the content is presented results in it being perceived as noise; thereby not only concealing its own content, but also camouflaging adjacent material.

When a user is unable to copy with poor design, they may exhibit a variety of psychological responses such as the following (Foley and Wallace 1974).

Confusion: Detail overwhelms the perceived structure. Meaningful relationships are difficult to ascertain, and the conceptual model cannot be established.

Frustration: Results from an inability to easily convey one's intentions to the computer. It is heightened if an unexpected response cannot be undone or what really took place be determined.

Panic: Panic may be induced by unexpectedly long system delays. The usual response in this situation is to bang the key repeatedly, with the eventual result that some function is performed several times.

Boredom: This results from improper pacing and overly simplistic tasks.

These reactions frequently lead to physical responses (Eason 1979; Stewart; 1976) such as abandonment of the system; the system is rejected and some other source of information is relied upon. Another is incomplete use of the system, when only the tasks easiest to perform or most beneficial are employed. Historically, this is the most common reaction.

One organization surveyed its computer users, asking them what they looked for in the design of screens. The results follow:

1. A clean, orderly, clutter-free appearance
2. An obvious indication of what is being shown and what should be done with it.
3. Expected information where it should be.
4. A clear indication of what relates to what.
5. Plain, simple English
6. A simple way of finding what is in the system and how to get it out.
7. A clear indication of when an action could make a permanent change in the data or system operation.

Of these requests, the first four listed are all problems which require an exclusively graphic solution, and implementing the final three certainly involves a strong graphic component. The design of screens for any CRT then is a critical process, and that is especially true for CAL screens. Regular data entry screens can be learned in time by the experienced user, but the CAL screen may only be seen once by the student. One chance then, to separate the signal from the noise. One chance to discover the content and attempt to absorb or respond to it. And that one chance is so easily jeopardized by poor design.

The purpose of this paper is to introduce some techniques which have previously assisted visual designers in reaching good design solutions. For the CAL developer, this can only serve as a brief introduction to these topics. It is to be hoped that a better dialogue may then result between developers and visual designers.

Some of these processes are given with guidelines for use. It must be emphasized that these techniques can not only benefit the look of the finished product, but may also assist in the process of its development. Sound graphic procedures can contribute to budget and scheduling consistency, realistic expectations of CAL module size and improved communication between developer and designers.

We will be looking at four practices that can affect the design of the CAL screen: use of a grid, storyboard technique, the use of colour, and rendering.

Process: The Grid

There is a simple test for good screen design. When looking at the screen, can the viewer generally identify all the elements without reading? Do the parts of the screen have an identity independent of the text? This may seem to be difficult criteria to satisfy. And yet consider the front page of a newspaper. The reader knows where to look for the weather, can identify the headline and its following story and is able to locate the index for the remainder of the paper. This can be done with any newspaper, on any day.

This regularity and predictability is achieved through the strict use of a design grid. In graphic design, a grid is a template which sets the top, bottom, and side margins as well as the margins between columns of text or the space around pictures.

The grid establishes proportions on a page or on a screen. It gives order to information presented in a series, whether in magazines, newspapers, television or CAL. A grid becomes a consistent guide for the layout of a series of frames, because it is a style template giving the freedom to design quickly. The grid emphasizes predictability and decreases the number of variables involved in screen layout. It creates "windows of expectation" for the viewer, and hierarchies of importance in the material. The viewer soon knows where to look for necessary information. In CAL, where the designer frequently must keep track of screen overlays in all sizes and locations, the grid is an indispensible guide to the parameters involved in designing and placing these partial screens.

Most people working on CAL screen design do not have a graphic

design background, and thus are not fully aware of the many uses to which a grid may be put. More frequently, they are unconsciously influenced by the design formats used on television. TV uses an approach commonly known as "TV centred", that is the text content is almost always centred on the screen and kept well in from the edges of the screen.

This format convention results from physical restraints imposed by the early television picture tube and by idiosyncratic receivers. The early tubes were more circular in shape, but even as they have gradually evolved into the current rectangle, the area of sharpest focus (and therefore the logical place for text) has remained the centre of the screen. As the quality of television picture tubes improves, this convention is increasingly without technical merit, but remains a design habit.

Television producers also have to worry about cutoff; that is not all home TV sets show all of the broadcast image. A so-called "safe area" is a centred rectangle, measuring two-thirds of the width of the screen by two-thirds of the height.

The design convention of "TV centred" that developed around these two criteria is very much a part of our general visual vocabulary. Most people who sit down to design for a CRT (which does, after all, resemble a TV set) will automatically centre the text and keep it well in from the edge of screen. They have unknowingly employed a "TV centred" approach, and will insist that "it just looks right". This type of unconsciously learned design criteria must be recognized if a suitable CAL design solution is to be developed.

It must be added that this centred design approach can be a good choice under some circumstances. Care should be taken, however, that it be a specifically chosen solution, and not a result of cultural conditioning. If, for example, we were to attempt to recreate the functionality of the front page of the newspaper using a TV centred approach, we would most likely fail. Only a grid structure can support that kind of deep positional symbolism.

As general guidelines, we may say that a grid is well employed when a more "magazine-like" approach is needed; a strong integration of text and graphics is required; there are many possible screens; and there is a great deal of branching. The TV centred approach may be more appropriate in a game or simulation; when the content is mostly pictorial, with little text; when there are fewer screens; and if there is less branching.

Process: The Storyboard

A device commonly used in the CAL field is one borrowed from animation and film: the storyboard. In those industries, the

storyboard is used to plan precisely the complex sequences of action. It comes as a surprise to many moviegoers that virtually all the details of scenery, motion, camera path, and lighting are worked out months in advance of the actual filming. Alfred Hitchcock was famous for the complexity of the storyboards on which he planned his films. He went so far as to say that the filming and editing were quite boring, since the real creativity occurred during the storyboard stage.

Since within CAL, a well-conceived storyboard is a device used for both proposals and for production, the developer, in deciding on the storyboard format, must make some crucial tradeoffs between flexibility and accuracy. The storyboard must be flexible for design development and accurate enough for production purposes. The medium in which the storyboard is composed must be adaptable, easy to use, flexible, communicative and presentable. Usually, a storyboard is just precise enough to act as a vehicle for a proposal to the funding agency, and should really be called a presentation board. It is seldom reworked or tightened after the initial proposal and underdeveloped design ideas are thereby perpetuated.

But the storyboard can function as much more than a proposal device. As in the film industry, it is a communication device between programmers and designers; between the developer and designers; between instructional designer and content expert; and between the developer and funding agency.

The storyboard itself should be faithful to the objectives of the instructional design, and should be carefully composed in black and white first. If the design works, visually and pedagogically in monochrome, it will work in colour. Most CAL developers storyboard using traditional graphic methods, such as drafting tools, pencil and pen on paper, with a format drafted out and xeroxed for multiple use. This method is relatively easy, but subject to wishful thinking. It is always a temptation to believe that your content will easily fit on the target frame, even though a cursory character count would reveal that the planned screen is overcrowded.

Another storyboarding method has proved to be more successful. Ironically, the best device for visually planning computer assisted learning material is a computer. To be more specific, a capable graphics computer is the best storyboard tool. This graphics computer must have certain characteristics. It must have a resolution equal to or greater than the target machine, good quality printer output and easy-to-use graphics software, including both paint and vector drawing.

With a system such as this, it is possible to map a CAL delivery system's screen and constraints onto another computer's screen. All this is possible, of course, as long as the one being mapped

onto has the superior graphic capabilities. For example, it is relatively easy to map the ICON screen onto the Macintosh screen, but not to map the ICON onto the VIC 20. As mentioned, the storyboarding computer must have a resolution higher than or equal to the CAL delivery system.

In the accompanying diagrams (Fig 1-3), the basic text grid of the ICON delivery system was mapped onto the screen of the Apple Macintosh using Macdraw software. We can see how the text grid for the ICON's system fonts (Fig 1) underlies all the decisions made in laying out the following screens of this module. When composing the screens on the Macintosh, the background can either display, or hide, this text grid. Please note that the column headings shown (small uppercase letterforms) are customized graphic files, not system fonts.

Storyboarding on a graphics system such as this makes possible pixel-for-pixel accuracy. The size and volume of text can be reliably selected, and what you storyboard accurately reflects what you can achieve. Revisions are much easier and therefore more likely to be made. This ease of revision helps resolve the tradeoff between accuracy and flexibility. With a storyboard created on a graphic computer, you are less severely penalized for choosing a specific design direction than you would be were the storyboard composed using traditional graphic tools. As well, a storyboard created on a graphic computer can make for quality presentations and good, accurate communication.

In the CAL development process, the extraction of content from the content specialist, and the instructional redesign of that material into a deliverable form, is a lengthy process. Usually, the developer knows the target machine in advance but may then wish to format the material for multiple delivery systems. Or it may develop that the intended delivery system is to be technologically modified or completely changed.

It is easier to adapt to these changes with a storyboard that is faithful to the objectives of the instructional design and in a technologically flexible format. For these reasons alone, the practice of storyboarding on a graphics computer should be encouraged. With this method, the content is easily retained within the storyboard, and reformatting this material for another delivery mechanism is a far less painful process.

Process: Using Colour

The crude colour capability of most CAL workstations is frequently criticized. Most developers decry the number of hues available on the common delivery systems.

The colour capacity of upcoming delivery systems is being

improved greatly. In the computer graphics field, we have seen significant decreases in the cost of high end graphics systems. A typical setup, featuring an 8 bit frame buffer allowing 256 concurrent colours out of a total of 16.7 million has, in five years, dropped from over $125,000 to around $15,000. This kind of capability is becoming more common on machines which can serve as CAL workstations.

However, learning to compose with colour takes a visual designer many years of training; these skills are neither immediately acquired, nor enhanced, by contact with a powerful colour graphics machine. Learning to design for this level of colour ability, and to profitably employ the potentially powerful results, become important. This is a problem area, even for those well versed in colour theory. All artists and designers are familiar with subtractive or reflective colour, but few have experience with the properties of additive colour transmitted by the CRT. It is a new skill to learn and a new medium in which to compose.

For the CAL developer, the appropriate use of colour holds some wonderful possibilities. It also has some terrible pitfalls. In order to reach the former and avoid the latter, we can look at some general guidelines for the use of colour in screen design.

Simply stated, colour in CRT displays has two main functions: to differentiate and to draw the users's attention. Colour as a distinguishing mechanism can be used for these purposes:

1. To relate things, while ensuring that the similarities are intended.
2. To separate things, as long as the differences are planned.
3. To form groups and categories. Be certain that articles visually grouped by colour have a functional relationship.
4. To assist reading specific text information.

The designer may utilize colour to draw the user's attention for the following reasons:

1. To allow focusing. This involves directing the user, not visually forcing him. Try to employ harmonious colours for the basic palette.
2. To illustrate and identify. Consider the colour's symbolism and make sure that the visual code implicit in the use of that colour is known and relevant.
3. To entertain. Be very careful; overuse soon becomes boring and forgettable.
4. To move the user's eyes to the location of choice.

Just as there guidelines to the appropriate use of colour, there are cautions associated with its inappropriate use. Do not use

colour because it's there, for then it is gratuitous. Do not use a colour because you like it. Your favourite hue may not be the same one the user would choose to look at all day. Above all, do not use colour if it doesn't work; poor use of colour is much worse than no colour at all. Choosing not to use colour can often be the best choice. A texture or hatch pattern may be a much better technique to employ.

Always design in black and white first. If the design is monochrome, it will then work in colour. Everything in a screen design should be identifiable without use of a specific colour. Besides, the user may be colour blind. In one survey in the United States, 8 per cent of males and 0.4 per cent of females were found to be colour deficient in some form. When choosing a colour, consider the following:

1. Consistency, to permit the accurate formation of groups and categories.
2. Compatibility with the viewer's expectations, to permit the user to identify.
3. The degree of relevance to the subject matter.
4. The frequency of use of colour. Excessive colour on one frame can interfere with its intended use on subsequent screens. Choose subdued colours as the viewer will tire of these much less quickly.
5. Discriminability, to avoid confusion and assist perception.

The legibility of text on a computer screen has been the subject of much study. Insufficient or excessive contrast between the copy and the background can be detrimental. Through practice, it has been found that the most distinct body text is approximately 75 per cent more or less brilliant than the background. In other words, on a black screen, the easiest-to-read text would be a light grey, about 75 per cent of the way from black to white. On a white screen, the best legibility would be achieved with dark grey text, about 75 per cent of the distance from white to black. This is not an absolute rule. Because the human eye responds selectively to different wavelengths of light, different on-screen colours will vary in their adherence to this guideline.

In most circumstances, limit your palette to eight colours. Too many on-screen at once can prove very confusing. If you have access to more than eight colours at once, just choose your palette well and restrict the total number seen at any one time. Remember that colour's power to communicate is also its ability to confuse.

Process: Rendering

When an object is represented graphically on any medium, whether it be on a television, in a magazine, or on a computer screen,

the viewer of that image seldom compares it with the actual original object. An image of an object is, after all, two-dimensional rather than three-dimensional, occupies a different visual angle than did the original, and is surrounded by environmental stimuli of a different character.

What happens instead is that the image is evaluated and placed in context by comparing it to something in the memories of the viewer. The image is seen as a separate entity in its own right and the viewer seldom confuses it with reality. The graphic representation is not, after all, a copy or reproduction of the object. The function of a graphic is simply to suggest the appearance of the original. This prompts an association between the graphic representation now on the screen, or page, and the memory of the reference object. This distinction, that a graphic is, in most cases, a reference to memory, is an important one to keep in mind whenever considering the use of a "lifelike" illustration.

Even in cases where the illustration is of something not previously seen and the viewer has no reference object in his or her memory, a good graphic representation refers to conventions of depiction which relate to retained memories. Memory then, plays a significant role in the evaluation of that image, and care must be taken not to jolt that expectation.

Within the CAL environment, rendering is profitably employed in several ways. First, when the viewer is unlikely to have seen the object previously and needs a mental snapshot for later comparison. Secondly, when the information to be transferred is technical and specific, and object identification is necessary. Rendering can be useful if there is little animation involved; rendered objects have a solidity that inhibits the suspension of belief required by animation. A fourth instance occurs when the viewer may be able to see the object currently and make a direct comparison between the on-screen image and the object. Rendering should only be attempted when the visual designer and the delivery technology are up to the task. For example, it would be counterproductive to render the muscles of the heart at work; a rendering pales in comparison to the real thing. A task like this would be better done graphically.

Rendering is useful to make a game or simulation "lifelike". Rendering lends legitimacy to an image; it is often as being "real". More properly, it is often assumed that a "real" reference object must exist. Now, some games or simulations are better left with more abstract imagery; it all depends on the instructional design objectives. Overall, render when the object exists and a very specific visual reference to it is necessary.

There are many instances when rendering is an unsuitable approach. Rendering is unprofitably employed when the object

depicted had general cultural and conceptual references, i.e. a house. It should also be avoided when the graphic is an analogy or a part of a conceptual model. Rendering is inappropriate when the quality of the illustration interferes with the lesson flow or when there is animation. The rendering should not be used to impress the viewer. The rendered image carries meaning with it which should not be abused.

The rendered image is readily interpretable and it legitimizes its subject matter by lending an air of reality. The designer must be sure that he wants to impart this type of concrete interpretation to the viewer.

Summary

In this brief survey, we have seen that poor screen design can result in the incomplete use of a CAL delivery system, and that clarifying the screen is mostly a graphic task. There are several processes which can assist in this endeavour. Where applicable, the designer should employ grids for clarity and positional symbolism. Storyboarding, preferably with a graphics computer, should be in an accurate and flexible format. A quality storyboard retains the content should the delivery medium change. Colour is best used selectively, knowing that its power to communicate is also an ability to confuse. Realistic renderings can legitimize your subject matter, but care must be taken to ensure that the resulting interpretation is desirable.

A COMPUTER AIDED INSTRUCTION IN DYNAMICS, (CAID)

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ABSTRACT

A computer aided instruction program is developed for particle kinematics to be used as a tutorial help for engineering students. The language employed for the program development is Prolog, an artificial intelligence language, which provides flexibility for information processing and facilitates further expansion of the program into other areas of dynamics.

The program provides information on classification of the subject area, the logical relationship of the subdivisions, and examples with three levels of help for each, during the tutorial session.

INTRODUCTION

The Computer Aided Instruction in Dynamics (CAID) is aimed at providing a tutorial guide for the study of dynamics as the first or introductory course. As a nucleus for this project an attempt is made to develop a computer program which can utilize modules of data and rules, and therefore be flexible and easily expandable as the project grows. The subject area covered by the present program is particle kinematics, and the language employed is Prolog, (MPROLOG release 2.1, 1986), with:

a) the capability of list processing for convenience in classification of information, and
b) modularity in data presentation for flexibility in expansion of the program.

Although the program is text-independent, and its coverage is compatible with those of the major text books, it utilizes examples from problems presented in " VECTOR MECHANICS FOR ENGINEERS" by Beer and Johnston, one of the leading textbooks in the field.

ANALYSIS OF KNOWLEDGE DOMAIN

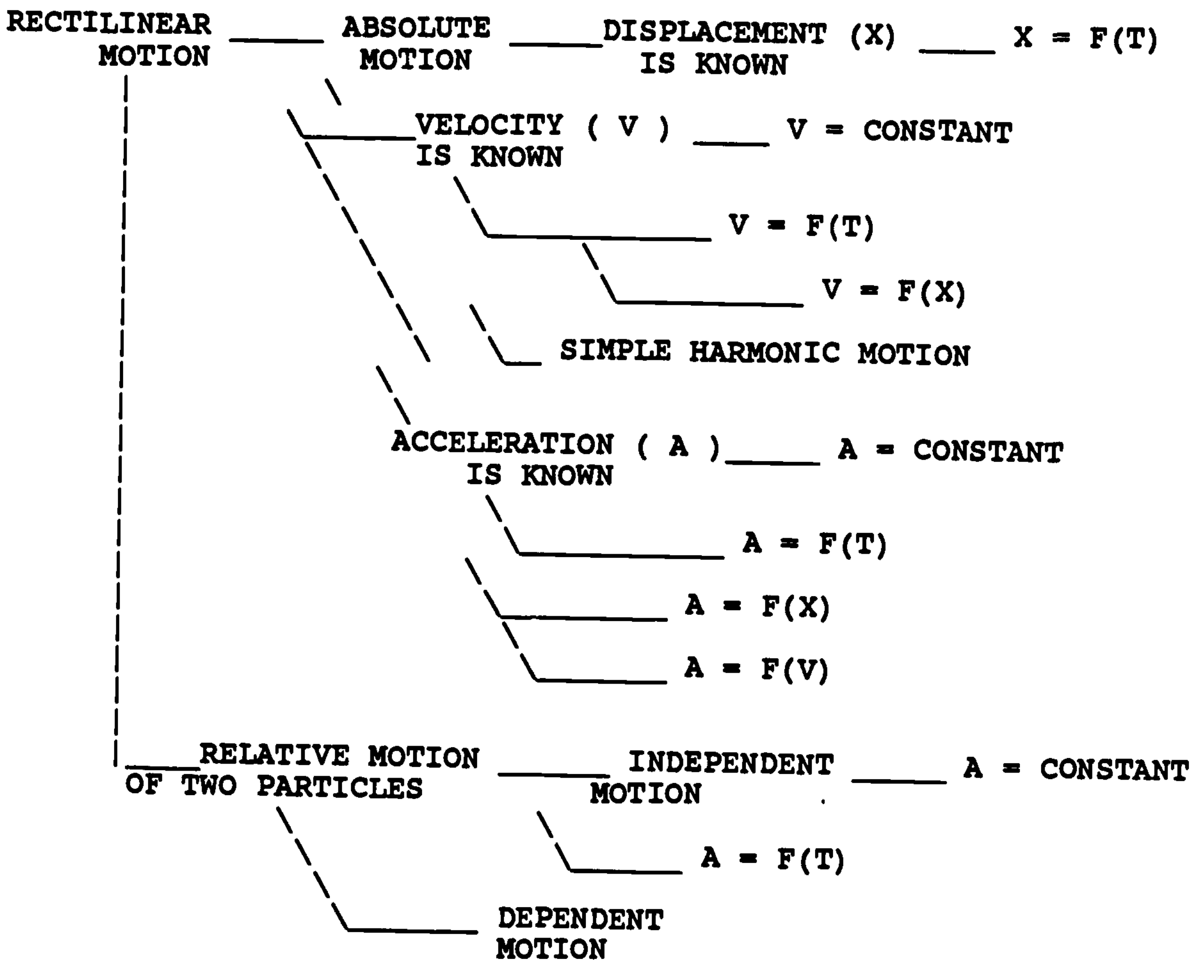
The area of kinematics covers the motion of bodies without regard to their size. This area is divided into two sections:

1- Rectilinear motion of particles,
2- Curvilinear motion of particles.

The method of problem solving is based on the nature of motion which may be either absolute or relative, the information which may be available for a given variable, and how that variable is related to others variables. Section one is subdivided, based on the above criteria, into either absolute or relative motions. For

the absolute motion, three possible cases are considered, depending on which one of the three variables, displacement, velocity, or acceleration are known; and whether they are constants, functions of time, F(T), or one variable is dependent on another one. A rather different but appropriate classification is also made for relative motion. the tree structure resulting from this analysis for both absolute and relative motions are presented in Fig. 1.

Fig. 1. The Classification and Tree Structure of Knowledge in Rectilinear Motion of Particles



Similar analysis for classification of domain is made for curvilinear motion of particles, considering that, in this case, the coordinate system through which the motion is defined determines the direction of the analysis and problem solving. Three coordinate systems are considered, and the motion is analyzed according to Fig. 2.

Fig. 2. The tree structure of domain in curvilinear motion of particles.

```
 CURVILINEAR_______RECTANGULAR________DISPLACEMENT   _____   X  =
F(T)
   MOTION       COORDINATES          IS KNOWN       Y = F(T)
  |              \                \
  |               \                \______POSITION
  |                \                    VECTOR IS KNOWN
  |                 \
  |                  \_________  PROJECTILE  MOTION
  |                   \
  |                RELATIVE MOTION ____ V=CONSTANT
  |                             \
  |                              \______ A=CONSTANT
  |                            \
  |                             \___ KNOWN RELATIVE
  |                              \    VELOCITY
  |                               \
  |                                \_KNOWN RELATIVE
  |                                ACCELERATION
  |
  |__________NORMAL &   ________ TANGENTIAL ACCELERATION = 0
  |     TANGENTIAL
  |     COORDINATES
  |        \
  |         \ _______FIND Vrel. & Arel
  |          \
  |           \______FIND RADIUS OF CURVATURE
  |            \
  |             \____CENTRAL FORCE MOTION
  |
  |_______RADIAL &   _______ ANALYSIS OF ANGULAR & RECTILINEAR
  |
  |    TRANSVERSE            VELOCITIES & ACCELERATIONS
  |    COORDINATES
  |          \
  |       \
  |        \_______MOTION ALONG A SPIRAL___ A IS KNOWN
  |         \                   \
  |          \                   \__  V IS KNOWN
  |           \
  |            \
  |             \__MOTION ALONG A PARABOLA
  |                  OR A CIRCLE
  |
  |__________MOTION IN THREE DIMENSIONS
```

THE STRUCTURE AND FUNCTION OF COMPUTER PROGRAM

The computer program consists of three separate modules covering screen selection menu, knowledge base rules, and data base facts respectively. Although the knowledge is presented in a general form which makes it possible to be used independent of any specific text, examples which are used in the program are taken from the 4th edition of "Vector Mechanics for Engineers", by Beer and Johnston, published by McGraw-Hill, 1984. This treatment provides an extra opportunity for the student to, if necessary, have a commonly available text for further consultations.

The program menu provides information for selection of the areas covered (chapters, at present kinematics of particle), sections (rectilinear and curvilinear motion), and the subsections shown in knowledge tree structure. Furthermore, two text specific types of information are also included in the menu which are the type of units (SI metric, or US), and problem numbers related to branch in the tree. Solution may be available for some problems. In most cases there are up to three levels of help for a problem, leading to the final answer. Inquiries can be made at any given level of the tree; for a problem number, areas covered in a section or subsection, problems related to those areas, or hints for solving an example problem available for a certain area. For example, an inquiry about problems on RADIAL & TRANSVERSE COORDINATES, ANALYSIS OF ANGULAR & RECTILINEAR VELOCITIES & ACCELERATIONS will result in a list of problem numbers with specific information on each problem, and an indication that problem 11.147 is provided with a solution. It is also possible to get a list of problems, for example, with SI units for a particular section. When a solution is provided it is assumed that the user is seeking general advice for solving the problem. Therefore, information is given according to the number of steps required in solving the problem, but not more than three steps, the last of which contains the answer to the problem.

A COMPUTER ASSISTED CURRICULUM PLANNING PROGRAM

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ABSTRACT.
A Computer Assisted Curriculum Planning (CACP) program is developed, to provide both general guide, and case-specific information for course selection in different semesters. The data concerning courses and their pre-requisites, and the rules governing the course selection are considered separately in different modules. An artificial intelligence language, Prolog (MPROLOG, Release 2.1), with list processing capability, is used in program development. The student's course file is compared with the course requirements of the academic program, and recommendations are made on the basis of course offerings in a semester, course pre-requisites, or corequisites.

INTRODUCTION.
The computer assisted curriculum planning (CACP) program is developed to help students in their course selection and program planning for different semesters of their studies. The objective of the program has been to minimize the time spent by students on the extraction of information from the university calendar, departmental guides, and other hard copy materials which are available to them.

The program is not meant to replace academic counselling, but it is expected that, by increasing efficiency, more attention can be diverted into other areas and components of academic counselling which can be more productive and fruitful. However, one major function of the program is to provide counselling assistance in academic program planning outside the office and work hours. The School of Engineering in Guelph has extensive computer facilities, including a network of microcomputers specified for free use of undergraduate students. These computers must not be used by graduate students and faculty, nor should any laboratory work be assigned to this facility. Students have access to the computer room without any restrictions. Furthermore, students are encouraged to have their own personal computers, and therefore, they are able to communicate with the undergraduate microcomputer network. Under these conditions it is felt that the Computer Assisted Curriculum Planning Program could be of significant help in providing the students with the required expert information on course selection without time restriction.

THE PROGRAMMING LANGUAGE:
Because of the diversity of courses, their prerequisites, co-requisites, and the rules governing course selection in an academic major, a program of this nature, may require a considerable amount of comparison between a large number of symbolic lists. However, such comparisons may not be best handled by the common procedural computer languages. Therefore, to avoid such limitations the language used here for program development has been PROLOG (MPROLOG Release 2.1), an artificial intelligence language which, because of its list processing features, can increase the efficiencies of both its programming and its application. Furthermore, as the rules of the program can be kept separate from the data base, future expansions or modifications to the program can be achieved with minimum alterations to the appropriate modules. This aspect is of particular significance, considering the dynamic nature of academic programs which should respond to the needs of the society in a rapidly changing technological age.

"CACP" is at present directed toward the requirements of the students in B.Sc.Agr. Mechanization major. However, the program may serve as either a base, or a model in development of curriculum guide for other academic majors. The program is composed of a number of facts, which make the data base, and rules, which govern the course selection as follows:

FACTS:
The course requirements of the major are divided into two groups, as follows:

1- Core courses, which are to be taken by all students;
2- Optional courses with some degree of flexibility for different students.

The core courses for 1987-88 academic year of the Agricultural Mechanization major are shown in Table 1.

Table 1.The Core Courses for Major in Agricultural Mechanization

01-140	Agriculture & Food System I
01-150	Agriculture & Food System II
01-160	Agriculture & Food System III
01-200	Agriculture & Food System IV
02-222	Financial Accounting
02-223	Management Accounting
02-331	Operations Management
OR	
02-432	Financial Management
05-270	Mechanics
05-271	Graphics & Communication
05-272	Energy & energy Conversion
05-372	Materials of Construction
05-373	Fluids & Fluid Systems
05-374	Farm Buildings
05-375	Irrigation & Drainage
05-470	Electricity, Instrumentation & Controls
05-471	Mechanization Systems
05-473	Farm Mechanization
17-104	Botany
19-100	Fundamental Chemistry I
19-179	Organic Chemistry
27-120	Introduction to Computing in Agriculture
36-121	Introduction to Economics
37-109	Writing for Scientists
63-108	Elements of Calculus I
65-100	Microbiology I
76-108	Introductory Physics for Life Sciences
89-200	Statistical Methods I
92-102	Animal Kingdom

The program core courses are subdivided into "fundamental and basic sciences", "agriculture", "mechanization", "economics and business management". The "optional" or elective courses are grouped into "free electives" and "restricted" electives and the latter is further subdivided into "social science and

humanities", "agriculture", and "engineering" electives. The tree structure of this classification is shown in Figure 1.

Fig.1. The classification tree structure of Agricultural Mechanization courses.

```
course requirements__core courses_ ___fundamental &
        \                   \        basic sciences
         \                 \
          \              \ ____agriculture
           \              \
          \                \ ____mechanization
           \                \
            \                \ ____ag._economics and
             \                      management
              \
               \optional
                courses______free electives
                 \
                  \ _____restricted
                       electives_____agriculture
                            \
                             \___social science &
                              \    humanities
                               \
                                \__engineering
```

RULES:

The rules and regulations governing the program may be classified as follows:

a- Entrance course requirements:

The following grade 13 or Ontario Academic Course (OAC) subjects are required for entry to the program:

1- One credit in mathematics;
2- Two credits from biology, chemistry, physics, and mathematics,
3- Two additional credits.

b- Order of course selection:

1-A course without prerequisites or co-requisites may be taken at any time.
2-A course with prerequisite may be taken if the prerequisites of that course are taken in previous semesters.
3-Corequisites of a course must be taken either in the same semester as the course if they are taken for the first time otherwise, they can also be treated as prerequisites.

c- Minor programs:

Minors in Agricultural Business and in Animal and Poultry Science are offered to students of B.Sc.(Agr.) Agricultural Mechanization Program. The minors require the completion of five or six courses in addition to the core courses required by the Agricultural Mechanization program.

d- Restricted Elective Courses:

1- Agriculture: Students must choose a three course sequence from one the following groups according to a course list:

a-Animal and Poultry Science
b-Soil Science
c-Crop Science
d-horticultural Science

2- Social Science & Humanities: A total of three courses must be taken from humanities and social sciences with at least one course from each area.

3- Engineering: Students must take at least one course from a given list of Engineering courses.

The program is designed to provide either a general or a case specific advice for students. The general help covers the cases for the students who enter the program in the fall semester, with no failures. A total of five courses per semester are considered as the normal course load for general recommendations. The prerequisites for core courses and some restricted electives are considered in the program, but such conditions for free electives and courses in the areas of agriculture, social science and humanities, because of their diversity, are not considered at present. However, if a list of electives which are most commonly taken by students is prepared, the additional conditions with regards to course prerequisites can be easily incorporated into the program.

In the general recommendations, the student can inquire, through the menu, about the recommended courses from each area or altogether, for each semester. For example an inquiry about the courses for the third semester will provide the following response:

27_120, 65_100, 01_200, 05_274, one_eng_elective,

and for the fourth semester:

89_200, 02_222, 05,272, 05_271, 37_109.

While a similar inquiry about only the fundamental and basic science courses for the third semester will be answered as follows:

27_120, 65_100.

Course recommendations, for each semester, are made on the basis of required courses which are offered and their order of priority. The difference between the number of required courses and the normal semester course load is assigned to restricted and free electives, in a manner to make the graduation possible in eight semesters. The program can also identify any other group of courses for each semester as shown in the example.

In the case-specific situations, the background of the student first should be written to a file, which will be read by the program. The number of courses desired for the semester will be asked from the student. Recommendations in this case are based on the courses which are offered in the semester for which the pre-requisites are already in the records of student file. The order of priority of courses are core courses first and optional courses second. Corequisites, if present, will have priority over other courses in the same rank.

The program is being expanded to cover the requirements of individual students with the same major and different possible minor programs from other departments. The program can be used as a model for other academic programs and disciplines.

RAPPI - COMMUNICATIONS NETWORKING IN THE CLASSROOM

Linda Hazzan
Project "Open Door"
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INTRODUCTION

In December, 1986, in an attempt to create a structured learning environment in which both students and teachers might work, Project OPEN-DOOR was begun. With financial assistance from the Department of Communications in Ottawa and the Ministry of Education in Ontario, the RAPPI/OPENDOOR project links together approximately 80 elementary, secondary and vocational schools across Canada, Italy, France and the U.K. and allows them to communicate in a conferencing environment. The conferencing system -- called RAPPI -- allows students from diverse regional, language and cultural backgrounds to share ideas and information, enhance communication and language skills and develop technical expertise with a new computer system. Schools participate for a small fee and have unlimited access for the school year.

As a research project, RAPPI was created to answer several questions pertaining to computer telecommunications and computer-aided learning in the classroom: First, is a computer terminal a successful and adaptable medium for the transfer of ideas; second, can a networked conferencing system with the complexity and technical advancement to send a thought, idea, or even a picture across the globe, be operated by an eight year old child?

Furthermore, what features of the system aid or deter the user; third, and perhaps most important to an educator, what is the effectiveness of a mail/conferencing system like RAPPI as a viable and adaptable educational tool?

To answer these questions, it is necessary to study and assess some of the pedagogic and technical factors which determine success or failure for many schools. Surveys of the schools involved, and our observation of activity in the educational conferences on the system over the past several months have revealed many of the achievements and setbacks experienced by a lot of the schools. More importantly, however, has been the on-going development of computer networking and telecommunication techniques as teachers and students utilize the system, and realize its potential as an effective educational tool in the classroom.

ON-LINE CONFERENCING IN THE CLASSROOM
OPEN-DOOR

As a conference, OPEN-DOOR pairs schools with similar language and scholastic interests and provides a specific area in which to create and develop interactive classroom projects. At present, forty-six schools participate in conference OPEN DOOR and, as the following list illustrates, the physical distance between the schools is often quite vast:

Bedford J.H. (N.S.)	&	Quebec H.S. (QUE)
Lycee E Fermi (ITALY)	&	Ecole J.H. LeClerc (QUE)
Lycee E Fermi (ITALY)	&	Ecole Secondaire Charlebois (ONT)
Lycee A.B. Sabin (ITALY)	&	College Saint Maurice (QUE)
St. Jerome's High (ONT)	&	Liceo Scientifico (ITALY)
Sooke Elementary (B.C.)	&	Christie Junior (ONT)
Queensbury E.S. (B.C.)	&	Sauris Consolidated (PEI)
"Les Genets" (FRANCE)	&	South Hull (QUE)
Philemon Wright (QUE)	&	New Westminster S.S. (B.C.)
Salisbury (ALBERTA)	&	South Wirral (U.K.)
Cloverdale E.S. (B.C.)	&	Riverview Junior High (N.S.)
Bishop Pinkham (ALBERTA)	&	Mosslands High (U.K.)
Woodfield Road (ONT)	&	Saltcoats School (SASK)
Jonathan (QUE)	&	Illeville sur Montfort (FRANCE)
Serres-Castet (FRANCE)	&	Ecole Jean de Brebeuf (QUE)
Guillaume Couture (QUE)	&	Ecole Paul Jean Toulet(FRANCE)
Jacques Buteux (QUE)	&	Cleveland Elementary (B.C.)
LaSalle H.S.(QUE)	&	Lycee A.B. Sabin (ITALY)
Lord Strathcona (ONT)	&	James W. Hennigan School (USA)
Rockway Mennonite (ONT)	&	Teignmouth High School (U.K)
New Westminster S.S (BC)	&	Burleigh Secondary (U.K.)
Dartmouth School (N.S.)	&	Dartmouth School (U.K.)

These schools have undertaken a wide variety of projects ranging from historical and geographic studies to cultural and language exchanges. In most cases, aspects of their country -- climate, location, historical landmarks and events, and cultural pasttimes -- are detailed by the students as each learns of the other's world. Students get to know each other by name, and projects often develop between small groups within each classroom. Enthusiasm for and commitment to these projects is evident throughout the conference and, as seen below, some students often find new ways to ask questions and exchange information.

6417/9. Jonathan School Montreal, Que. Fri. Mar. 27/87
"RE-BONJOUR" LES AMIS DE LA FRANCE.
Voici vos derniers indices.
La derniere fois nous etions rendus sur le fleuve St.-Laurent.
A present vous allez chercher une ile assez grosse et tres popleuse.

Le nom de cette ile a huite (8) lettres. La premiere lettre est "M", la quatrieme lettre est "T" et la derniere lettre est "L".

Bonhomme Pendu

```
 _______
  |  |
  |  |
  |
  |    M _ _ T _ _ _ L
__|__
```

Si vous avez trouvez l'ile en question, vous devriez voir les villes
qui suivent: Outremont, Westmount, Verdun, LaSalle, St-Leonard, Lachine, Dorval, Pointe-Claire, Anjou, Pointe-Aux-Trembles et St-Laurent.
Et bien entendu,
Sophie Banville, Noelle Graton Tretreault

P.S. -- Nous attendons toujour VOS indices pour nous permettre de trouver Illeville-Sur-Montfort.

Other interesting and creative discussions have also been developed in conference OPEN-DOOR. Philemen Wright Regional High School in Hull, Quebec, and New Westminster Secondary School in New Westminster, B.C., for example, have begun a "Confederation Debate" in which the students assume the roles of key figures in the debate over Confederation in 1867; through a series of responses within the discussion, Sir John A. Macdonald, George Cartier, and even some noted Americans try to sway British Columbia in its decision to join Confederation.

6255/6. Philomen Wright Hull, Que Thu Mar 12/87
To the Rt. Hon. John A Macdonald We are growing increasingly irritated with your fedearl fumbling. We are assumed of positive treatment by Cartier and your associates: We receive nothing! Member of your Cabinet are off in the foot hills of New York skiing. We feel a week's lapse is desirable at this juncture. Perhaps you will contemplate the consequences of B.C. joining the U.S. during this interlude. We trust that when we resume dissisions, you will be in a position to offer us firm terms.
Yours sincerely
Governor Musgrave

6255/7. New Westminster New Westminster, B.C. Mon Mar 16/87
JOIN! JOIN! JOIN!...Wonderful people of British Columbia WE LOVE YOU!!! WE love the air in Victoria! Join the wonderful United States of America TODAY! It's a kaleidescope of discovery and imagination! A delight to the senses. We are the land of Mickey and Minnie, opportunity, and indoor toilets. You're missing all of the fun! Don't succumb to those sillywillies in Canada! come

join the party! Get with it, dudes! Life in the fast wagontrack! OK!! so, we're special! And you can be too! Be the best that you can be! Alors, les petits especes de cul-cul la praline, on va se joindre au centre du monde, ou on va rester enterre dans notre cerceuil Brittannique? 'Mon Doux! SO!!! We're decided, right? By this time next week, you can be a state
love(and I mean that),
Arnold (Mr. Party) Benedict

St. Jeromes High School in Kitchener, Ontario has been paired with Liceo Scientifico in Bologna, Italy for over a year and has attempted communication in Italian, French and English. In addition, they have had the opportunity to study the history and geography of both Canada and Italy, and to learn more about Italian and European culture. Just recently the two Roman Catholic schools have begun a project to discuss the history of separate schools in both countries, and to study the implications of the new private and public funding issues in Ontario:

6241/13. St. Jerome's H.S. Kitchener, Ont. Wed. Apr. 15/87
I am happy that the students from Italy are sending news of sports. I know that my students will be fascinated but I am going to start messages in this discussion about a topic of local historical interest.

The schools in our province are going to be fully funded by the government by the end of next year. This means that even though all students of this schcol are of one religion, that is, Roman Catholic, they will be funded equally with students of other religions. This is the first time that this will have happened and it is a very hot issue locally. Anyway, I am gettig ahead of mayself and my students. They will be in tomorrow with their research and their questions about who pays your bills.
Thanks for all of the great communication. The students will be thrilled. Mary Beam

Other conferences have been created which utilize the system in a wide variety of ways, all with varying results. The majority of schools have used the conferencing environment to exchange cultural information in an informal social structure.

SCHOOL-TO-SCHOOL -- "My worm died, but my cat is alive"
In conferences like SCHOOL-TO-SCHOOL, electronic "pen pal-ing" allows students to read and exchange letters which detail the contrasting lifestyles of children across the country and overseas:

From Pinewood Elementary School Cranbrook, B.C.
Hi, my name is Craig. What do you do in your spare time? Do you have a dog, cat, snake or worm? Well I do! Well, I let my snake go on November 7 86:11:07. It scared my mom. My worm died but my cat is alive and so is my dog. The colour of my cat is black with white spots and the my dog is black. Oh I am 10 years old

P.S. -- Please write back
from Craig.

From Blewitt Elementary Nelson, B.C.
My name is Brad Berikoff. I go to Blewitt Elementary School. My favourite thing about Blewitt is the girls. Can you tell me about Pinewood Elementary?

From Christie School Toronto, Ontario
Hi Sarah, it's Paul from Christie School. I am 11 years old. My hobbies are swimming, baseball, tennis, hockey. I have a big brother John. He is 16 years old. He is very strong.
He benchpresses me 30 times a day. Please write back about you and your family. Yours Truly,
Paul

EXPLORER/MOTION
Some conferences are purely information exchanges. Conference Explorer, for example, created by and for students in Grades 4 and 5, combines learning and fun by challenging students' knowledge of a wide range of Canadian trivia. MOTION was created to raise awareness of the Rick Hansen "Man in Motion" tour, and to share reactions to, and support for, wheel-chair atheletes and those who suffer from spinal cord injuries:

5868/4. Christie School Toronto, Ontario Thurs. Nov. 6/87
Dear People,
I think Rick Hanson is doing a good deed to the world. I mean riding all across the world. I really like what he is doing for us. By riding across the world he has proven that physically challenged people can do anything other people can do.
Maybe people will think different about disabled people.
Paul Sousa
Christie School, Toronto

WRITING/REWRITING -- "Harry the Flying Horse"
The system has also been used to promote communications skills. Writing/Rewriting, and several discussions in conference School-to-School, have elementary and secondary school students from different areas of the country working together on-line to write, edit and expand short stories. Teachers oversee the

writing and editing, but allow the students to incorporate their own changes. The introduction to conference WRITING/REWRITING outlines the usefulness of such exercises to students:

6331. Introduction to Conference Writing/Rewriting
The idea of this conference is for a student to post a ROUGH draft of a creative piece of writing. A designated student in the other school will rewrite the piece and then post the result.

It is based on the theory that students learn to write better through cooperation. By analyzing and revising each other's work, students are able to develop their writing skills and, in time, become better writers.

Teachers also like to encourage the collaborative style of writing at the elementary school level; however, rather than individual students trading pieces of work back and forth, whole classes of students write only part of a story -- a chapter or section -- and then post it for another class to read and continue. Harry the Flying Horse is just one of these "works-in-progress" which have been written by two grade 2 classes -- one in Sooke and one in Cranbrook, B.C. The following are two passages from that story:

5913/27 Sooke School Sooke, B.C. Thu. Jan 29/87
Harry the flying horse went to a race course. He had yellow eyes and purple wings. He also had blue horseshoes. One side of him was green and one side was pink. He went to the race-course in the afternoon.

The problem was he kept tripping over his hair. He fell down and he got up again. He was about 3 cms away from the finish line, he jumped up into the air and when he landed he got tangled in the reins.

Written by: Denise, Jennifer, Billy, Juergen, Shawn (Div. 10) We are looking forward to your class adding another chapter to the story.

5913/28. Pinewood E.S. Cranbrook, B.C. Mon. Feb. 2/87
While Harry was getting untangled, the other horses in the race passed him. He was very sad. He flew away to a distant meadow to cry. While he was crying, Freddy Fox came along.

"Why are you crying?" asked Freddy.
"Because I lost the race", said Harry. He wanted to become friends with Freddy.

They played together a long time in the meadow. They played football, dodgeball and tag. Harry was the best at tag because he flew in the air just when Freddy was going to catch him.

Because Freddy wanted to fly, Harry said he would help him build a pair of wings.

Written by: Andrea, Scott, Brandy, Tanya, Brent, Amy, Lucas & Lottie. Grade 2 Pinewood Elementary School.

HUMAN AND TECHNICAL FACTORS

Creating the environment for learning is only the first step in effectively untilizing a system like RAPPI. Many schools begin with great enthusiasm, but are hindered by technical and administrative obstacles. Problems with equipment, difficulty obtaining phone lines for modem connections, financial restrictions and time constraints are just some of the numerous setbacks which prove frustrating and demoralizing for teachers. As the following feedback from one teacher new to the system illustrates, patience and commitment are important elements in the learning and implementation of a system like RAPPI:

It has taken me a lot of time to figure out how this system works. In fact, we have spent the last few evenings trying to get this message to you. I think that in time we will be able to make better use of the system.

I now see why so many schools are actually inactive. This will take a lot of learning.

Many schools quickly overcome these obstacles only to find that the school with which they have been paired has not; so, anxious to begin their joint projects, they are often forced to delay, or even abandon, good projects because of an inactive or uncommitted partner.

Most schools are understanding and patient when faced with these difficulties, and will be supportive when problems and confusion arise. The following two messages -- addressed to RAPPI manager -- illustrate this point:

To: RAPPI MANAGER
From: Ken Cressman
Hi there. This is Ken Cressman. I put a response in [discussion] 6294. Hopefully, someone will answer soon. We'd also like to start talking to someone overseas (as would everybody, I suspect).

Did you hear about the sick bumblebee who kept doing his work while ill? Of course he spread disease as he staggered about his duties. The so-called "Blight of the Fumble-bee".

To: RAPPI MANAGER
From: Kevin Kroeker
Hello guys. I'm still trying to determine if and who we are paired with in OPEN-DOOR. Titles of the conference list us with NOTRE-DAME (no country specified), we have a list that says

we are paired with RIDDLESTON HIGH in the U.K., and I got a message from Ray (who saw my response in the OPEN-DOOR discussion between us and NOTRE DAME) indicating that he had three schools in mind that might be a good match for us.
The essence of this message is "HELP!"
Thanks much, Rockway Mennonite.

Interestingly, the majority of the existing difficulties are problems which teachers, not students, are having. Feedback from many schools suggests that the students who use the system -- from grade two to grade thirteen -- are enthusiastic and highly motivated about the projects undertaken.

Many of these organizational, technical and administrative difficulties can and will be overcome. However, the motivation of individual schools, and the degree of creativity, innovation and skill with which the system is used intelligently as an educational tool, can only come with the exchange of ideas between teachers, and the development of new telecommunications techniques in the classroom. (Here, too, the conferencing system can become an easy, inexpensive way to exchange information not only between students, but also between teachers.)

PRESENT AND FUTURE BENEFITS OF RAPPI
A global networking system has obvious educational benefits as geographic, cultural and historical information is exchanged. To learn about France from an atlas or a text book is worthwhile, but to open the classroom to a country by actually communicating with those who live there is an extraordinary experience for a student.

Unfortunately, the excitement over such technological capabilities has meant that many teachers have used it only as a glorified mailing system. Personal messages from one student to another are fun and interesting for the two involved in the exchange; however, the fact that the conferencing environment allows more than one person to read and respond to input means that such limited exchange does not put the system to its best possible use. Quickly the network becomes limited in scope, and the pen pal style of exchanging lifestyle and cultural interests becomes a narrow use of the technology.

LANGUAGE SKILLS -- The French Immersion Experience
With bilingual and French immersion schools spread across the country, the need for effective studies in that language has increased in English-speaking schools. Many French immersion teachers have found that students from English-speaking backgrounds have little opportunity to utilize and practise their newly-acquired skills in their communities; they never use their skills from class in any other context. Thus, a sort of

"classroom French" develops where students converse only with their teachers and fellow classmates in an artificial atmosphere.

The linking of these students to native French speakers across the country and in Europe, means students are motivated to learn new vocabulary, develop their writing skills, and improve their command of their second language through contacts with interesting new peers. These students are not only motivated by the challenge and excitement of a new medium, but are also learning from each other in other areas of the curriculum (history, geography, etc.).

There are also many students who come from various ethnic backgrounds and speak their native language at home, yet never have the opportunity to use or learn it formally. Thus, their written skills in their "heritage language" are often lacking; many children are verbally fluent in languages like Italian, Portuguese and German, yet have virtually no written ability in that language. Many schools do not offer formal training in these languages and, therefore, there is no classroom facility to develop the child's second language skills.

Once again, the ability to link a student to a native speaker of a heritage language in another school, region or country allows a teacher to expand the classroom and to draw on resources not available locally. A system like RAPPI can give a student a dozen teachers and abundant opportunities to learn and develop new second language skills. Although projects such as these have yet to be developed and implemented on RAPPI, several schools have shown an interest in developing these "heritage language" skills with their students.

WRITING SKILLS

Teachers often find it difficult to motivate students to develop spelling and grammar skills. Ditto sheets and spelling drills are often tedious for both students and teachers, yet it is certainly agreed that these skills are important and necessary. Still, they are very often not stressed in order to promote creative written expression: Too much red on a page discourages spontaneity.

Systems designed for networked communications, and especially for computer conferencing, are ideal for encouraging these skills without one being denied in order to promote the other. As was illustrated earlier, projects like Writing/Rewriting encourage students to share ideas, and to write in a collaborative, cooperative atmosphere. In addition, students rather than teachers can be made to edit and comment upon their peers' work. Thus, students are often motivated to "perfect" their final drafts, knowing that they will be "published" and available for many eyes to see. Stories like Harry the Flying Horse go through

many drafts, from initial creative expression -- with many imaginative ideas and a corresponding number of grammatical and spelling errors -- to the final draft, published in a conference called (for example) Library, where student can see both their own work, and the work of their peers. Students will learn the necessary technical skills because they care about and understand the need for such precision.

COMMUNICATIONS SKILLS

Very closely connected with writing skills are communications skills. The ability to convey a thought or feeling in writing, without confusion or misunderstanding, is an ability which must be learned and exercised. In an age of computer communications, such an ability takes extra stress where one's communication is denied the expression of body language or intonation. The written word can easily become ambiguous, vague or even offensive in such circumstances so "exchange" teaches care and thought in the words of a message.

It is important to realize that what is said and what is meant can often be widely divergent. Seemingly innocent mail messages, with humour as their intent, are often miscontrued. One child who received a mail message written all in capital letters and with many exclamation marks replied to the sender, "I know, I know. Stop yelling at me."

Thus, a new kind of "computer etiquette" must be learned which is dependent upon the development of both writing and communications skills. In doing so -- in learning to communicate using the written word -- students at all levels will come to understand the practical importance of style, and to be aware of tone and audience as they write.

CONCLUSION

The potential for conferencing systems like RAPPI is vast and far-reaching, and the excitement over this technology is now beginning to grow. The involvement of schools in projects like RAPPI/OPEN-DOOR can be a vital part of computer education in the classroom as a wide variety of technical and creative skills are developed, and new ideas and experiences cultivated. The RAPPI/OPEN-DOOR project has been successful in coupling advanced computer technology with the imagination, creativity and expertise of both teachers and students, and has, in effect, opened elementary and secondary school classrooms to the world.

RAPPI - OPEN DOOR

Chris Hudel
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HISTORY

Rappi is a research project begun in 1985 by the Inter-Provincial Association for Telematics (IPAT) to exchange educational ideas and technology among schools in Canada, Italy, France, Great Britain and the USA.

Rappi's premise is that computer networking, by linking students in an interactive, inviting atmosphere with their counterparts in different backgrounds and cultures, will benefit all users in both education and technology. It has been my experience that suggestion and guidance, rather than direct prompts and orders, help students more quickly relate to one another -- primarily because they communicate on a level of their own understanding, not that of their teachers'.

Rappi's "home base" for the more than ninety-five sites around the world is the MTS-General Computer System at the University of British Columbia (UBC) in Canada. It is "overseen" by three people; Roger Hart, in Victoria, B.C. acts as our systems mentor and resolves the knottier technical problems. Linda Hazzan, an English Co-op student at the University of Waterloo, links schools and manages the bulk of user correspondence and enquiries for the "OPEN-DOOR" project within Rappi. I am a Computer Science/English Co-op student at St. Jerome's Collegiate in Kitchener and I handle most technical difficulties and other administrative tasks such as creating accounts, distributing funds and allocating disk space.

PRESENT

In accordance with our philosophy, Rappi attempts an unintimidating, unpretentious structure by three interactive pieces of software. The $MESSAGESYSTEM, a private electronic mail network, is designed for private contacts between teachers and site administrators. More general is *USERDIRECTORY which keeps a database of Rappi participants categorized by user-id, name and site information. The third, the *FORUM conferencing program -- the hub of Rappi's activity -- provides a public conference format for open, easily accessed discussions by teachers, students, and classes in each school. The topics, created by both teachers and students together, range over broad areas of educational concern including such subjects as early Canadian history, computers in the classroom, and creative story writing.

$MESSAGESYSTEM

For our needs, the $MESSAGESYSTEM is the most vital part of Rappi. Through it, we perform the bulk of our work. We use it as a global mail system to announce changes or give general information. One of the interesting advantages of a "global-send" option has been our implementation of the "Pet of the Week Award". Each week we announce an individual (or school) which has made an exemplary contribution to Rappi and we dedicate a joke in that group's honour. It is in this electronic post-office, that we give and receive help and suggestions on a personal basis.

*USERDIRECTORY

The *USERDIRECTORY allows any user to search for another user based on his name -- either full, short, or nick -- or user-id.

```
-+---------
 |
 | User types: *find bornon
 | Response:    "Gerald (G) Bornon", Owner=IPB1
 |          Busphone:    + 33 (35) 91 24 89 in France
 |          Busaddress:   Ecole Mixte Les Genets
 |                   Rue Andre Marie
 |                   Sainte Austreberthe
 |                   76570 par Pavilly, France
 | User types: *find id=ipcf
 | Response:    "Danielle Boutet", Owner=IPCF
 |          Busphone:    613-731-7212
 |          Busaddress:   Ecole secondaire Charlebois
 |                   Departement d'informatique
 |                   2525 Alta Vista drive
 |                   ottawa
 |                   ontario
 +---------
-
```

From an administrative viewpoint, however, a problem exists. Since the information has to be manually entered by the user, preferably at the time of first signing-on, -- though this takes only five minutes and is initialized by one command -- users hesitate or decline to do this, with resulting omissions and lapses. To date, only a little more than half of Rappi participants have entered information fully, despite constant reminders and persuasion.

*FORUM

Within the *FORUM conferencing program lies the heart of Rappi. Conferences, titles, discussions, and responses are the descending levels of the conferencing structure. Their order and role is best understood by analogy to a newspaper. Rappi is the complete "newspaper". Within it there are many

sections, here called "conferences". These correspond, more or less, to "activities" or large topics. Within each section of a newspaper there are headlines, articles and editorials. Similarly, within each conference, there are titles, discussions and responses.

The applications of the conferencing level are far reaching and are limited only by the users' interests and imaginations. For example, in the MOTION conference, students discuss Rick Hansen's Man-in-Motion world tour for spinal-cord research. From this conference, the students have learned of his daily difficulties in the sub-arctic temperatures across Ontario and Manitoba and the isolation of the Prairies. As well, the students have learned what spinal-cord research is, and have gained an appreciation for disble persons. For instance, this sentiment is clear in a student's remarks:

```
+---------
|
|     5868/4. Marilyn George  12:40 Thu Nov 6/86  14 lines
|
|        Dear people:
|           I think Rick Hansen is
|           doing a good deed to the world.
|           I mean riding all across the world.
|           I really like what he is doing for us.
|           By riding across the world he has
|           proven that physically challenged
|           people can do anything other people
|           can do.
|          Maybe people will think different
|           about disabled people.
|              Paul.Sousa
|              Christie School
|              Toronto
|
+---------
```

(Man-in-Motion has been suggested by us as a topic of of Canadian (and world) concern. It is an "open" conference and invites comment from all schools and participants.)

"OPEN-DOOR"
Since January, Rappi has stressed an innovative project titled "OPEN-DOOR", which involves twinning two schools, usually remote from each other, sharing a common point of interest, into a conference where they discuss educational topics of appeal to each. All users of Rappi may "read" these discussions, but only the paired schools' students may

contribute to them. Other readers may contact the conference supervisor-teachers and request to add a comment or suggestion for the subject to take, but the conference topic remains with these two schools for development and interaction.

It was my intuition that a little more than 10% of the paired schools would actually achieve an on-going discussion. Amazingly, paired schools are continuing their commentaries at about a 75% rate of success. We have, however, been disappointed by the time taken or required by several schools to get "on-line"; this has ranged as high as three to five weeks, despite our efforts to aid them administratively. During these delays the "twin" has frequently become impatient and some of the students' initial enthusiasm has waved.

Through the research project of "OPEN-DOOR" it is our long-range hope that a cultural exchange of information may occur among schools from Canada, Great Britain, France, and Italy. Such an exchange has occurred and is evident in the discussions between St. Jerome's High School, in Kitchener, Ontario and Lycee E Fermi in Italy. After the students have discussed more current topics such as fashion, music and recreation, they settled for a major educational issue. In this case, strangely as it may seem, discussing governmental policy regarding education -- in particular, full-funding for minority schools.

+---------

6241/13. MARY BEAM 13:16 Wed Apr 15/87 18 lines

Hi there, I'm so sorry that we have been gone for so long. I am now going to do something that is not good for a conference, but I am going to take two paths in this conference. I am happy that the students from Italy are sending news of sports. I know that my students will be fascinated but I am also going to start messages in this conference about a topic of local historic interest. The schools in our province are going to be fully funded by the government by the end of next year. This means that even though all students of this school are of one religion, that is, Roman Catholic, they will be funded equally with students of other religions. This is the first time that this will have happened and it is a very hot issue locally. Anyway, I am getting ahead of myself and the students. They will be in tomorrow with their research and their questions about who pays your bills. Thanks for all of the great communication. The students will be thrilled. Mary Beam

+---------

Another specific and successful example of the "OPEN-DOOR" project lies within the pairing between Pinewood Elementary and Sooke Elementary schools in British Columbia. The two schools have developed an interactive on-line story-writing section using the structure of the conference. Each school has taken turns creating a "chapter" of a "story". Within the past four months the two schools mutually produced three books, mostly fiction and fantasy, dealing with unusual characters such as flying horses and ghosts. On average, each book is the collective work of twelve to eighteen students, between the ages of eight and twelve years old. Ten more books are currently under production!

> Funny Farm Hotel
>
> Once upon a hot summer day,in the middle of July,there was this "happy" married couple going to a hotel for their 10th anniversary. They had tried to get into many expensive hotels but they were all full .Too bad.So George insisted that they go to this one BROKEN down so called hotel all alone on one long street saying that it wasn't all that bad.
>
> At first they looked at each other in disgust because hanging from the sign were 12 heads cut off by the neck.But they were desperate.So they went up to the door and knocked at the purple door .Nobody answered so they walked in. And to their surprise they saw several weird people. A very old person approached them with a nametag around her wrinkled neck...

"ADMINISTRATIVE"
Rappi shares the MTS-General Computing system at UBC with, among other users, two other educational networking projects sponsored by that province and the University of British Columbia; School's Network and Kids-to-Kids, which operate much as Rappi, but on a smaller, local scale. Also, Rappi shares participants with other projects, such as the seventy-five school EDAN project operated by TVO under the sponsorship of the Ministry of Education of Ontario and the TIME'S NETWORK in Great Britain. Because of Rappi's phenomenal expansion, and service to these various other tasks, we are occasionally limited by the MTS-G system at UBC. The main problem occurs while UBC is upgrading and backing-up their system. It is scheduled from between 4:00 - 7:00 A.M. P.S.T. which coincides with one of the best times for us to call, between 7:00 - 10:00 A.M. E.S.T.

From September of 1986, Rappi's participant list has grown nearly three-fold and we anticipate a total participant list of over one hundred and twenty-five schools by June 15th, the closing of Rappi for the summer months. Rappi is currently funded by the Department of COmmunications in Ottawa and the Ministry of Education for Ontario which pay for the computer-time, DATAPAC connection fees and some personal costs. Because Rappi is 'free' to all its participants -- the only expenses being ones of time, participation, and a terminal/modem configuration -- we receive a great number of inquiries and participants. Unfortunately, possibly because it is free, many users are not as actively involved in the project as they would be if there were a cost. Because of this, records of active, inactive and "slumbering" schools are hard to maintain. On occasion, we will pair two schools in the OPEN-DOOR project on the basis of their stated interests, only to find subsequently that they have difficulty speaking the same language, or that we've paired a senior secondary school with an elementary one and the sophistication of the one works against the other.

FUTURE

If we were to conceive an enhanced educational network or could be granted a 'wish-list' for the future, these are areas that would require development. First, we would like to introduce digitized graphic and sound images as enhancements to the discussions. By doing this, the images of sight and sound may help to convey a complicated thought or idea. Second, it is out hope to further develop the $MESSAGESYSTEM into a separate conferencing system, where a group of individuals can talk among themselves as if they were participating in a teleconference, similar to COMPUSERVE's CB-Radio option.

There is, however, one major stumbling block to overcome; terminal configuration. Because Rappi is international, not all users can ever be presumed to use the same terminal. While most participants use APPLE, COMMODORE, IBM, or ICON systems, there is not one unified system for Rappi and this makes graphic and sound presentations impossible at present.

In the fall, when Rappi commences for another school year, it is our hope to institute a better form of organization for the Rappi Administrators. First, we would like to make the *USERDIRECTORY mandatory on the first sign-on to keep our records current. Second, it is our desire to formulate a standard of telecommunication among the participants to enable some full-screen editing and limited graphic transfers.

We fully anticipate Rappi to maintain an active participant list of slightly over two hundred. Overall, Rappi will be introduced to more rural areas and will include such conferences as Constructive Essay Writing, Computer Aided Learning and will run other educational pieces of software.

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GUELPH, Ontario,
Canada, N1G 2W1.

COMPUTER CONFERENCING SYSTEMS:
Educational Communications Facilitators

Computer conferencing systems -- such as the University of Guelph's CoSy system -- provide the instructor with numerous ways of enriching the educational process through the use of current information technology. In a very real sense, computer conferencing provides the instructor and his class with a meetingplace that has no physical or temporal boundaries. It also enables the student and instructor to build an on-going, dynamic database of course-related material that is constantly available and constantly current. Beyond these obvious advantages, though, the most pedagogically useful aspect of computer conferencing is the way in which it facilitates communication and interaction both between instructor and student and between students in the course. Through the use of computer conferencing, the instructor has the opportunity to maintain a much closer, much more direct, and much more pedagogically efficient contact with students while the students not only have that same contact with the instructor but also with each other. Through computer conferencing one can truly achieve the boundary-less classroom.

The CoSy system is composed of three component subsystems: a MAIL facility, a CONVERSATION facility, and a CONFERENCE facility. The MAIL system functions as a standard electronic mail system, enabling the user to send and receive mail message to and from other users of the system. MAIL enables the user to send confidential messages to a single user or list of users on the system. MAIL can also be filed and retained for future reference. The CONVERSATION facility permits any number of users to engage in a single-topic, linear discussion of a particular issue or problem. The CONVERSATION originator establishes the ground rules for the particular conversation and then creates a list of members. Each member of the conversation can then read from and write to the conversation. Conversation messages can also be filed or can be transferred either to mail messages or to the conferencing system. The CONFERENCE system expands on the capabilities of the CONVERSATION system to provide a multi-topic continuing discussion of a variety of related topics linked by a central concern. Conferences can be open to all users of the system, or closed and therefore available only to invited participants. Conferences, further, can structure a discussion in a particular way since one has two ways of writing to a conference. One can also search a conference for occurrences of particular words and phrases. MAIL, CONVERSATION, CONFERENCE: the

three facilities of the system enable an instructor to facilitate intercommunication in a group or class to a remarkable degree.
System application:

The CoSy MAIL system can be used in three basic ways. It can act as an electronic alternative to office hours in that it provides a direct, one-to-one communication between instructor and student. By using the MAIL facilities of CoSy, a student can contact an instructor at any time and can receive comments and counselling virtually any time of the day or night. CoSy MAIL can also be used to submit and to receive assignments. At any stage in the composition process, the student can transfer an assignment to the instructor as a mail message and receive prompt and thorough commentary by the same route. Mail logs will clearly date-stamp the files, thereby removing any argument about the time at which the assignment was submitted or the fact that it was or was not sent or received. Finally, and most importantly, CoSy MAIL provides a way for the student to remain in direct and constant contact with his or her peers. Through CoSy MAIL, students can continue the discussion that was started in a face-to-face class, or can go on to discuss matters that only receive their initial impetus from the classroom material. CoSy MAIL, then, is a facility that goes a long way toward enabling us to build the boundary-less classroom. Yet MAIL is just one of three facilities that are available.

The CoSy CONVERSATION system, similarly, provides a means of communication; but whereas the mail system is designed for one-to-one communication, the CONVERSATION provides the user with an ideal multi-party brain-storming area. Students will set up conversations on the system in order to develop seminars. The originator will enroll the other members of the seminar team and then open the conversation with a comment about the seminar topic. The group will then discuss the topic at will, signing on whenever they are able and contributing what they are able. The final product of the deliberations can then be downloaded from the system to a micro for word processing and hard copy production or can be edited in the CoSy system and then transferred to the CONFERENCE system for the general class audience. As well as a seminar developer, the CONVERSATION mode also functions well for brief discussions among a small group of interested participants. Students who were engaging in a debate in the face-to-face class meetings have been known to then set up conversations to continue the debate after the class ends. Not of interest to the class as a whole, the topic of the conversation is still of interest to the individuals involved. Often too, one find that the conversation gradually produces a focussed thesis that can then be turned into a full-blown essay on the topic. The problem with the CONVERSATION mode, though, is that it cannot be subdivided into topics. It is singular in focus and linear in organization. While these factors are no drawback for uses such as seminar development, they are somewhat limiting if one wishes

to explore the various ramifications of a topic. As a result one finds that, often, participants in a conversation will eventually transform that conversation into a full-blown conference.

The CONFERENCE mode provides the electronic adjunct to the face-to-face class meeting. Originated by the instructor, the course conference becomes a repository for course-related materials and discussion. Topics can be established to parallel the content divisions of the course and/or to answer particular needs. A course in Renaissance Literature, for instance, may have a topic for each section on the syllabus as well as topics for assignments, examinations, and general discussion.[1] General announcements of interest to the class can be posted in the conference; lecture notes and other material related to course content can be posted; questions keyed to lectures or to course material can form the basis for discussion; sample essays and assignments from students can provide both a talking point and a means of improving student writing. Also, too, the conference provides an on-going, dynamic data base of course-related materials. Comments and questions from students can be used to develop a series of "helpful hints" messages. Comments from individual students -- received either in the conference or in mail messages -- can be used to form the basis for a number of tutorial strategies; questions and comments can be used as a means of altering and revising the course for future use. Generally speaking, the CONFERENCE facility enables the instructor to "cover the course content" fairly rapidly, so that more time is available for discussion and communication, the basic factors in education.

System potential:
The remarks above suggest some of the ways in which a computer conferencing system like CoSy can be used to facilitate the educational process. What has been discovered in using the system at the University of Guelph is that while the CONFERENCE and CONVERSATION modules would seem to be the most important from an instructor's point of view, it is the MAIL system that has been most effective as a pedagogic tool. Students use the MAIL system as a way of contacting their instructors; but more often than not, they are using it to contact their peers and to use the system as a way of carrying on a one-to-one discussion of a critical issue. Potentially, then, the MAIL system seems to have the greatest promise, in that the electronic message-swapping that goes on seems to act as a stimulus to the learning process.

Preliminary experience would seem to indicate that both the CONVERSATION and the CONFERENCE systems would be better used if one were to stop using them as substitutes for the printed text and begin to use them for their interactive potential. Using the conference as a repository for lecture notes is a poor use of the facility; using the conference as a repository of key discussion questions, on the other hand, seems to work extremely well.

Using the conference as a repository for trial examination questions, and then using the answers to those questions as a way of clarifying the pedagogical goals of the course also proves extremely useful and pedagogically efficacious.

The potential uses of computer conferencing in education are limited, in fact, only by the imagination of the educators. As Murray Turoff and Starr Roxanne Hiltz have shown,[2] the possibilities for on-line education are vast. What it is going to take to realize the potential of such systems is the active participation of individuals who are not afraid to imagine worlds we have never seen before: classrooms without textbooks, electronic blackboards, remote access education. We are going to need people who have a sound grasp of the principles of pedagogy and a willingness to embrace the possibilities of the new technologies to take us farther than we have ever dreamed of going. The possibilities are there.

Conclusions

Computer conferencing systems provide the student with a means of being in touch with instructor and peers 24 hours a day, seven days a week. Because the conference is always there, the student is not constrained, either by class hour or office hour, to be in a particular place at a particular time. Rather, student and instructor can meet on the system at their individual convenience. The instructor can send and receive mail messages, participate in conversations, and read and write material to the conference system whether (s)he is on campus or miles away. The student can sign on to the system whenever it is convenient and make contributions. Experience shows, though, that what makes CoSy the ideal boundary-less classroom is the fact that it provides for the student and the instructor a free form, fully-available communications system whereby contact can be maintained at any time. Access to the learning tools is one of the major requirements of a pedagogical system: CoSy provides that access.[3]

NOTES

[1] A "common room" topic in the course conference is often a very useful item, since it provides a place for students to discuss general course-related concerns in a free and open manner.

[2] See in particular Starr Roxanne HILTZ and Murray TUROFF, The Network Nation : Human Communication Via Computer (Reading, MA; Don Mills, Ont. : Addison-Wesley Pub. Co., 1978) and Starr Roxanne HILTZ, Online communities : a case study of the office of the future (Norwood, NJ : Ablex, 1984).

[3] For information on the University of Guelph's CoSy system, call the CoSy Development Team at 519-824-4120, ext. 3775. A history of the early development of the system is available in Judith C. Van Duren, Development and Early Applications of Cosy at the University of Guelph. (M.A. Thesis) GUELPH: School of Graduate Studies, University of Guelph, 1986. Reference material on the system is available in M. Brochet, et al., CoSy Computer Conferencing System Reference Manual. Guelph: CoSy Systems Group, Institute of Computer Science, University of Guelph, 1986, and in CoSy Computer Conferencing System User's Guide: Version 3.1. Guelph: CoSy Systems Group, Institute of Computer Science, University of Guelph, 1985.

Interactive Computer Art
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Interactive Computer Art was devised to give Arts students (Fine Art, English, History and Philosophy majors) an introduction to information design. The creative arts are very much concerned with design-- Fine Arts students are familiar with visual design and visual thought. Writers design with words. Interactive Computer Art enables creative students from several disciplines to work in a new media made possible by the microcomputer. This new media is a combination of graphics, text and time, held together by the instrument (the computer). It is therefore possible, using the computer, to express ideas in different ways.

The class projects are designed with 'process' in mind. Where the student ends up is less important than the design strategy used to get there. This document is an account of the first offering of Interactive Computer Art, offered by the Department of Fine Art as an intensive 6-week session. Classes were set for Monday to Thursday, 6pm to 9pm, for the six weeks. Computer time was available during the daytime.

Funds for the course were supplied by the Department of Continuing Education, and computer facilities, support and classroom space was provided by the Instructional Technology Support Group, Office for Educational Practice.

Space was made available for 10 students, but 8 were finally admitted. Despite the advertising done in the History, Philosophy and English departments, only one non-Fine Art major applied. All were in their final (4th) year of study.

PROJECT ONE EVALUATION

OBJECTIVE:
To learn how to use the VITAL Frame Creator;
To learn how NAPLPS pages are constructed.
To learn how to edit the created pages.

RESOURCES:
3 hours Instructional Technology Support Group (ITSG) help
9 hours total class time
4 VITAL workstations during class time (including one workstation equipped with digitising tablet)
2 VITAL workstations (for sign-out during office hours)

PROJECT SCHEDULE:
August 8:
ITSG staff gave a demonstration on the VITAL Frame Creator and

gave each student a copy of the Tutorial exercise which consisted of a sailboat drawing composed of lines, arcs, polygons, fill patterns and text. The students were required to pair up into groups of two and complete the exercise by the end of the class.

August 9, 13 (group 1), August 14, 15 (group 2):
Magazine Advertisement (two day project); to convert a magazine advertisement into a NAPLPS page, taking into consideration the decrease in resolution, aspect ratio, and colour range available in VITAL over the paper copy.

Project Results:
Most students found the Frame Creator quite straightforward (all had a Fine Art background). Some were able to finish within the 6 hours of class time. Most required out-of-class time on the equipment. Two were able to complete 2 pages, though they deliberately chose very simple graphics for the first image.

The problems encountered:
Num Lock Key:
All students had problems with the Num Lock key when they chose to use the text editor. If the Num Lock was 'on' (and there is no way of knowing if it is on or off when using the IBM-PC) use of the keypad for cursor movement resulted in the overstriking of text with numbers.

Typing:
Students who are not typists were slower to learn the system.

Two Screens:
Many students seemed to be confused by the two display screens and the keyboard. It took several hours for some students to learn where to look for the necessary information.

Tablet:
The graphics tablet was very useful in some cases, but occasional failures in the operation of the tablet caused mis-entry and frustration for the user. In one such case, the computer was turned off and re-booted-- the tablet's operation improved significantly. (It could be that the software driver for the tablet is becoming corrupted during use over a 12-hour day).

Recommendations:
1/ All students should receive s short lecture on NAPLPS drawing strategies to prepare them for the Magazine Advertisement project.
2/ All workstations should be equipped with a non-keyboard entry device. At least one should be an 'absolute-positioning' device like a tablet. The others could be mouse-equipped.
3/ Other frame-creation software should be employed which makes use of a pointing device other than the keypad and uses one, rather than two display screens.

PROJECT TWO EVALUATION:

OBJECTIVE:
Working in groups of four, each group will create an interactive module in VITAL based on the story of the Three Little Pigs. The module will be able to successfully guide the participant through three different versions of the story.

RESOURCES:
3 hours ITSG staff help
21 hours class time per group
4 VITAL workstations during class time (including one workstation equipped with digitising tablet)
2 VITAL workstations (for sign-out during office hours)

PROJECT SCHEDULE:
July 9 (Group 2) July 14 (Group 1)
Three Little Pigs Story
Each group was instructed to 'brainstorm' to create three versions of the story. One member of the group was assigned the role of 'moderator' and 'secretary'.
Group 2's experience on this day was very fruitful, with remarkable cohesion between participants. The assigned work was completed within the session.
Group 1's interaction was more complex. The only male student in this group had some very specific ideas about how the module should run, and had done much preparatory work to support his ideas. The three females felt perhaps a little intimidated by this, and as a result the atmosphere for creative thought was ruined. It was decided unanimously between the instructor and group members that Rudy should create a module on his own, but that all group members should share graphics.
The three stories were not completed in the alloted three hours by this group.
From this point on, the instructor referred to the new groupings as "The Gang of Four", "The Gang of Three" and "The Gang of One."

July 13 (Gang of Four) July 15 (Gang of Three, Gang of One)
Storyboard
Using ITSG Storyboard forms, each VITAL frame was sketched in to give visual substance to the three stories.
For the most part, this session went straightforwardly, but the Gang of Three continued to lag behind.

July 20: VITAL Reference Tutorial Session
ITSG staff provided help in explaining how to create a reference module in VITAL, using the Tutorial Manual for hands-on training. This session ran successfully until it was discovered that one of the later versions of VITAL which was in use had an altered menu structure from that described in the Tutorial Manual. Confidence in the system was lost at this point among some students.

July 21-30 (All groups)

Frame Creation/Flowcharts
During this period, the Gang of Four alternated with the other two groups for computer access. At times when computers were not available, stories were revised, flowcharts were completed and other forms of project management were practised.
Internally, each group had its own way of assigning computer graphics work to its members:
The Gang of Four decided, in the interest of consistency, to have the same artist do all the wolves, another do all the pigs, and the other two artists tackle backgrounds. As can be seen in the VITAL module, this strategy was surprisingly successful.
The Gang of Three decided to apportion the work according to story, so that in this VITAL module each story has a different 'look.'

July 30
Routing the Module
It became apparent on this day that the project would not be completed in time for the Open House on the 5th of August. Routing took place for only those frames which could be linked to provide contiguous areas within the modules. Any 'dead ends' were covered by an "Under Construction" frame.

August 4
Testing and Debugging
Final revisions were made on the provisional modules.

August 5
Open House
This day was provided to show faculty and students the work-in-progress from 3:30pm to 8:00pm. At that time the doors were closed, pizza and wine was delivered and each group presented its module to the class for constructive criticism. Spelling and grammar mistakes were identified, and suggestions were made to clarify text, graphics and meaning.
The date for the Open House was fixed by external factors: Regular Spring Semester classes finish at this time, and what few administrators and faculty who were on campus were likely to disappear within the week.

OTHER ACTIVITIES from July 16 to August 13
Two Macintosh computers were made available with the programs "Guide" and "MacPaint." On July 16, all students were given a tutorial on the Macintosh and instructions on how to use MacPaint.
After a short time of play with MacPaint, the students were reassembled for instruction on the concept of hypertext and the use of the hypertext program "Guide."

The Guide Hypertext assignment consisted of a short text poem called "Mystery." The students were asked to find an interesting phrase or word in the poem, and then expand on it. In Hypertext this entails selecting the word or phrase and transforming it into a 'button.' The button can then hold an expanded text or graphics passage underneath itself. This augmented passage his hidden from the viewer until the button is clicked. In this way a single idea can be linked to other ideas in an intuitive manner.

Some students worked on the Mystery project, but because of pressures from the Three Little Pigs project, not everyone had time to make a contribution. Mystery was also featured at the Open House.

Some students managed to find time to work with a paint program on one of the PC's at ITSG called "Dr. Halo II." This mouse-driven program enabled the students to 'paint' on the screen using 256 colours and high resolution. Several pictures were produced using this program and were on display during the Open House.

August 13
Last Class day.
Groups were actually given until August 14 to hand in their Three Little Pigs modules.

ASSESSMENTS:
Individual evaluations were based on the level of understanding and utilization of the concepts dealt with in the course. Marks ranged from 74% to 80%. The highest mark was given to a double-major student in Fine Art/Philosophy.

The VITAL Modules

Gang of Four "Three Little Pigs Great Adventure":
This module was, in a large sense, designed like an interactive computer game. It began with an objective:
"How would you like to drink with a bunch of PIGS?"
It proceeded through three different temporal ranges: past, present and future.

The Past story put the participant in the wolf's shoes, with a crew of pigs about to mutiny.

The Present story switches first person to the pigs-- to IranGate hearings where the participant is asked questions by an intimidating wolf and no matter response is given the participant is accused of lying. The pigs escape custody by a remarkable fluke but are chased by the wolf to the White House, the Jungle House in Africa or the Sand House in Iran.

The Future story presents a situation where both wolf and pigs must co-operate to defuse the dreaded Hyperbomb. Depending on which wire is cut, the participant either saves the world (and gets a free beer with the authors) or the unthinkable happens. Because each group member created only partial elements of each frame, the pictures had to be assembled as multiple overlays before they could be loaded into the module. It was extraordinary that, except for one frame, all pictures came together as though all the parts were created at the same time. Careful planning and adherence to the storyboard aided in the assembly process.

Gang of Three "The Three Pigs"
This module was originally conceived as a takeoff on the murder mystery game 'Clue,' but borrows heavily from the popular evening soaps. As a result, it's a muddled mixture of pig sex, money and intrigue. In contrast to the ordered flow of "The Three Pigs Great Adventure," "The Three Pigs" sometimes jerks the viewer around the module for inexplicable reasons.

This group's lack of success may be attributed to the more individualistic temperaments involved. Because all three group members are dedicated artists (one of whom has chosen computer graphics as a career) the poor group performance did not appreciably alter individual marks.

Gang of One "Porkmeat"
This module is still not finished (it is being completed as of this writing) with much of the graphics missing. It is entertaining even without the pictures, however.
"Porkmeat" is the most interactive of all the works, with one decision every frame.

GENERAL COMMENTS
One of the problems with an intensive 6-week course is course conflicts with regular session classes. Final exams for the regular session often took time away from my students at the worst possible time. This would not have been so bad if the students were not working in groups, but there were evenings when work halted because one student in the group had an evening exam.

Absences due to sickness (in this case the flu) kept one student away for 6 hours of class time in two days. A regular session course is not so intensive, so fewer class hours would have been missed.

On the other hand, it was easier to borrow computer equipment for a six-week period than for the regular 13-week session.

EQUIPMENT AND SOFTWARE
The hardware performed well for the most part. A borrowed PC monitor died and had to be replaced late in the course.

VITAL, for all its quirks and inconsistencies, is a simple program which does what it is designed to do: provide authoring tools at the minimum of training cost. There were disappointments, however... I lost a student's Magazine Advertisement when I pressed a wrong key while loading files into a special module. The picture was destroyed without warning.

The Macintosh provided a 'break' for students who were relieved to be able to draw pictures without touching the keyboard. Most found the Mac's lack of colour to be compensated by its clarity and resolution.

INTERACTIVE COMPUTER ART-- conclusion

This course was a remarkable success. ICA helped Fine Art students to see past their familiar visual design training to the larger world of information design.

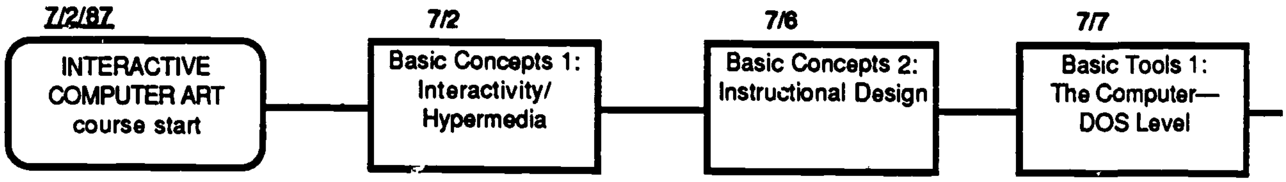
I believe many Arts students are born information designers. The university should offer a regular interdisciplinary course which deals with informational design. Not only would such a course be in line with the University of Guelph's expressed intent to provide leadership in information technology, but it would also provide practical preparation for a career in this field. (Sheridan College offers diploma courses in Instructional Design and its graduates report the highest placement and starting salary rate of any of its programs.)

One already-graduated student is currently shopping for computer graphics equipment. Three others are pursuing further studies with this instructor to work with VITAL or other more sophisticated authoring systems at ITSG.

Final say should be given to the students who completed the course. In answer to a questionnaire "Has this course changed your career expectations?" out of eight responses, one equivocated. The rest replied "YES."

A P P E N D I X

Interactive Computer Art 13-250



Course Goals:
Interactive Computer Art is an interdisciplinary course for undergraduates in Fine Art, English, History and Philosophy programs.

Students enrolled in the course use computers to creatively apply concepts and skills in:

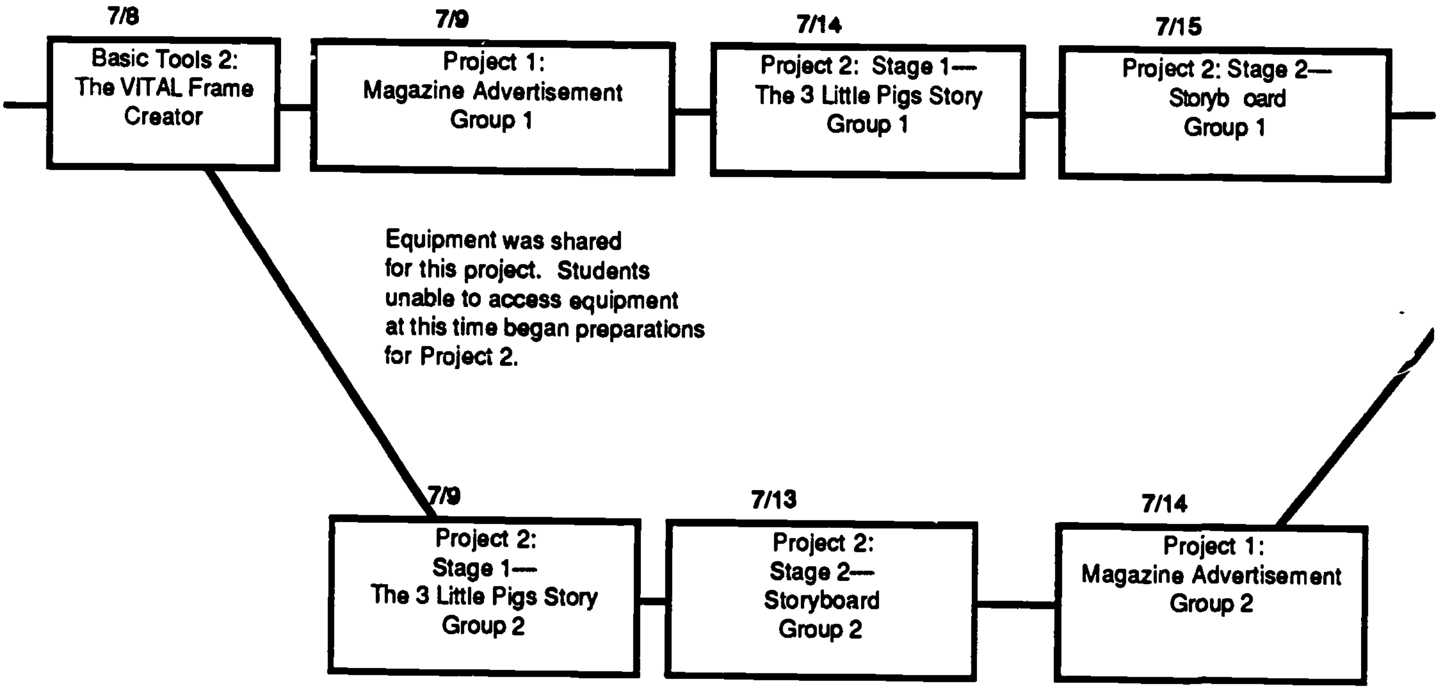
- Hypertext and Hypermedia
- Instructional Design
- Computer Graphics
- Information Technology

Tools:
Several sets of high- and low-technology tools are used:

- IBM-PC's running the course authoring system VITAL
- Apple Macintoshes running MacPaint and a hypermedia authoring program GUIDE.
- Storyboards
- Flowcharts

Project 1:
The class was split into two groups. While Group 2 works on another project, Group 1 began to 'convert' a magazine advertisement using the VITAL NAPLPS frame creator. Each student worked individually.

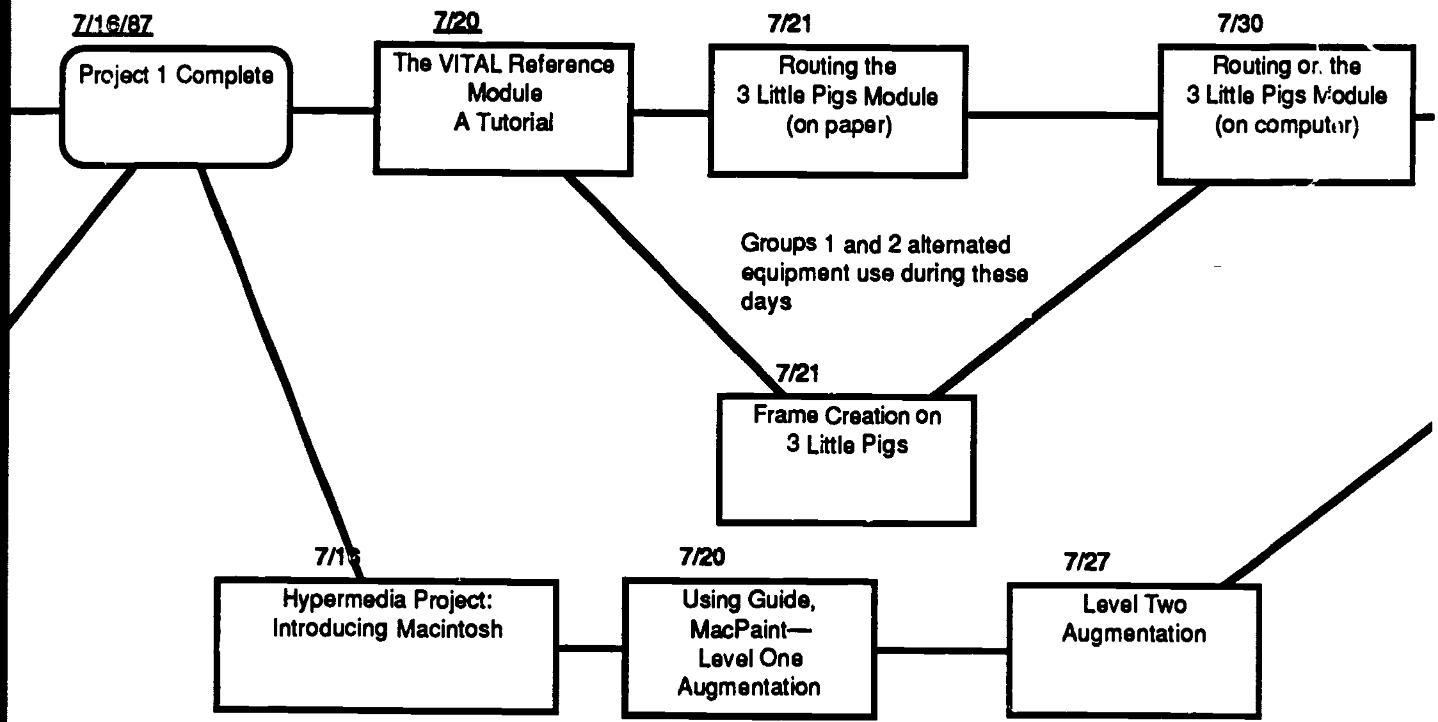
Project 2:
A group project: To create an interactive version of The Three Little Pigs.
Stage 1: Devise three different versions.
Stage 2: Storyboard each version.
Stage 3: Devise module routing for each page.
Stage 4: Implement in VITAL.



HyperMedia and Hypertext:
Hypertext is a term used to describe the ability to "read between" lines of text. A reader can select a particular word of interest and (as long as the author has provided for it) "open" it up to reveal an explantion or a clarification. Within this clarification window, tnere may be other words which have this ability. A reader can thus begin reading text on "electricity" and, through hypertext, end the session on a related subiect by following "threads" through an electronic database.

Hypermedia is an expansion of this concept to include pictures as well as text. GUIDE, a program for the Apple Macintosh, is used to create a class hypermedia work.

Hypermedia Project:
The instructor set up a short page of text in poetic form using the program called GUIDE for the Macintosh. Each student in the class was required to select a word or phrase and 'augment' it, using more text or a picture (or both). This augmentation was identified by the program as an italisized or highlighted word.
Work continued throughout the course to develop 'threads' of associations within the piece.

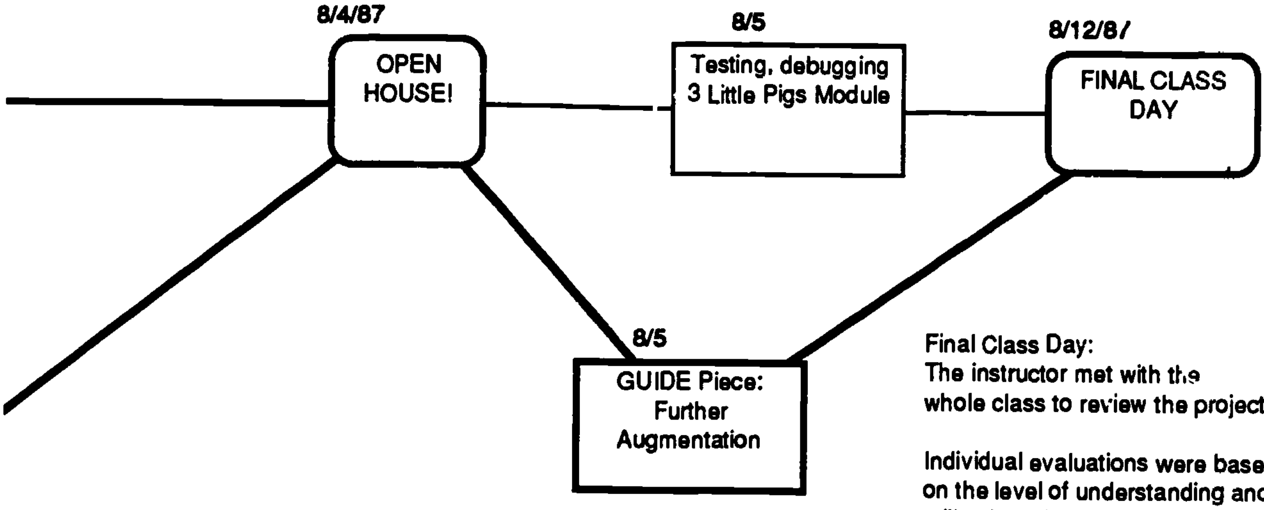


Instructional Design:
This is the term used to describe the process by which an information provider sets down goals, objectives and techniques for a project.

Instructional Design is used by educators, screenwriters and artists, albeit in different forms. For this class it is a formalization of a procedure with which most fine art students are already familiar.

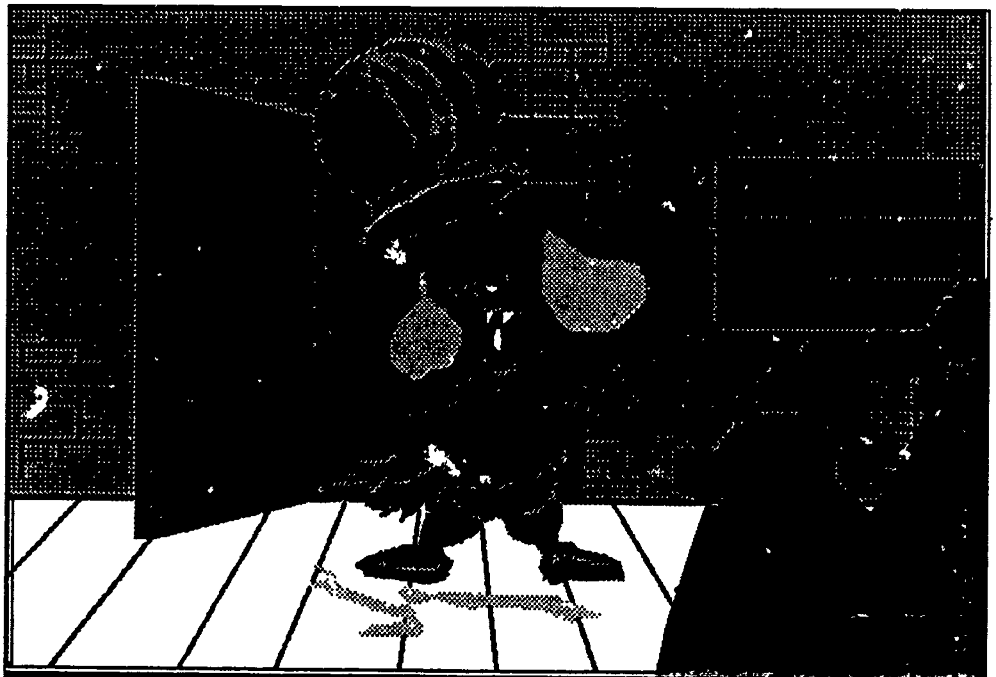
Open House, August 5:
This time was set aside to allow the students to show the University Community and other interested parties the work they've done so far, and for the instructor to evaluate current state of projects.

Project 3:
Students work individually on creating a small VITAL module which expands on the concept of "love".

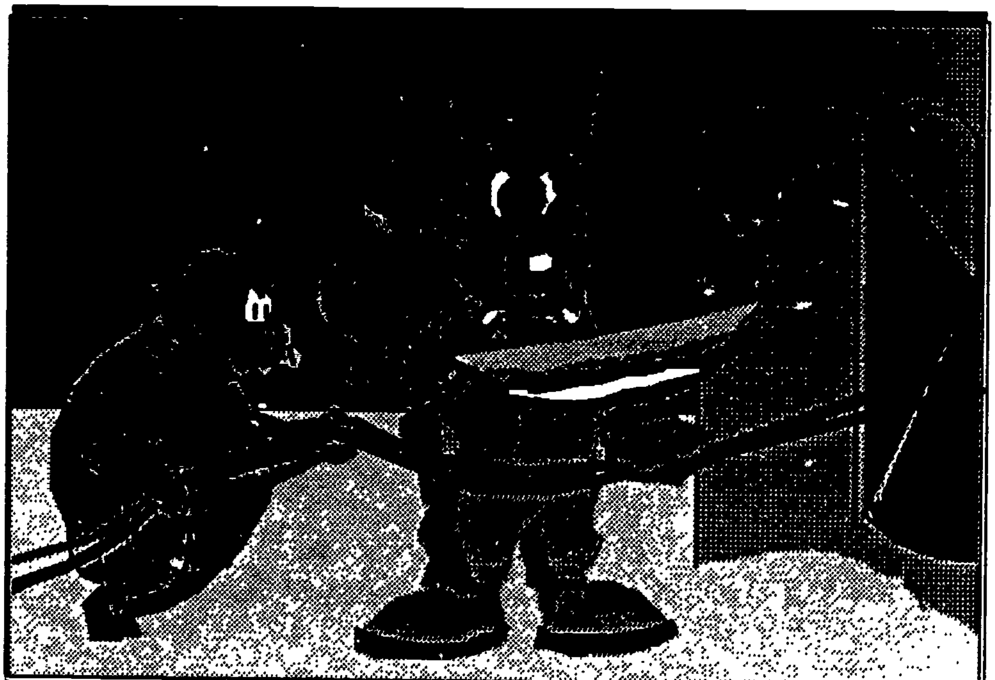


Final Class Day:
The instructor met with the whole class to review the projects.

Individual evaluations were based on the level of understanding and utilization of the concepts dealt with in the course.



OOPSY!   You are deep fried!!!



Now, let's figure out this wiring.

GEO-VITAL: A COMPUTER ENHANCED TEACHING IN GEOLOGY

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OBJECTIVE

The objective of this project was to generate a set of VITAL (VIDEOTEX) modules about geology, and make them available to be accessed by students at their convenience from as many stations (terminals) as possible. More than 10 stations are available throughout the University of Guelph, nine of them in the main library. Some students have adjusted their home computer to capture the modules through a modem. The information is transmitted from a centrally located IBM PC and clones equipped with hard disk and backup facilities.

REASONS FOR THE PROJECT

The project was started because at Guelph the lectures of the introductory geology course are offered simultaneously to two classes : one, Principles of Geology (46-100), has a laboratory and is designed for science students, and the second, Study of the Earth (46-104), has no laboratory and is primarily for arts students, although several science students take it as well. The combined enrolment of the two classes in the winter semester is about 160 students. The students have a varied background, making it difficult to 'reach' each person through the classical lecture approach. Tutoring by teaching assistants is not possible because of limited manpower and funds. Computer and television techniques allow students to learn in a stimulating way at their own pace.

METHODS

Two electronic techniques, VITAL and CoSy, were chosen and implemented primarily for introductory geology, and for review material for two senior courses, Glacial Geology (46-205) and Sedimentology (46-409)- Both techniques are being perfected at the University of Guelph. VITAL is a minicomputer-based, menu-driven, educational system which derives from the televisive TELIDON (VIDEOTEX, NAPALPS codes). CoSy is a teleconferencing and electronic mailing system. Neither one is closely tied to specific - hardware at the receiving end, although a color screen is recommended for best use of VITAL.

VITAL allows information to be presented in graphic and text form, in full colors (everything is color coded), and with simple animation which can synthesize the main processes of sciences and

arts (Fig. 1). Each "screen" (page) can be prepared by anyone with less than one hour training.

However, simplification of complex concepts is best achieved through close collaboration between the instructor and talented designers. The generation of good graphics is the most time consuming and difficult part of the process. Once the graphics are generated, they can be used in various ways, in one or more courses, and rearranged to fit isolated lectures and seminars.

TEACHING APPROACHES

VITAL (Versatile Interactive System for Teaching and Learning)

The subject matter of introductory geology has been subdivided into 12 topics, essentially one topic for each semester week (Table 1). For each topic about 60-80 graphics have been generated. Several graphics are modifications of classical ones, well proven in previous teachings of the subject, however, most others were newly created.

TABLE 1. VITAL modules for Introductory Geology

Topic	Reference	Self-Test	Quiz
ORIGIN OF EARTH	x	x	1. Earth str. & origin
EARTH'S STRUCTURE	x	x	
MINERALOGY	x	x	2. Miner. & Ign. geol.
IGNEOUS GEOLOGY	x	x	
WEATHERING	x	x	3. Weath.,Glac. & Sed.
GLACIAL GEOLOGY	x	x	
SEDIMENTOLOGY	x	x	
PALEONTOLOGY	x	x	4. Paleo. & Strat.
STRATIGRAPHY	x	x	
STRUCTURAL GEOLOGY	x	x	5. Struct., Metam. & N. America
METAMORPHISM	x	x	
HISTORY OF N. AMERICA	x	x	

The graphics were presented to students in four modes:

1. Reference modules, with extensive captions
2. Self-test modules, multiple choice questions and problem solving.
3. Quizzes (4 per semester), which are marked automatically by VITAL
4. Lecture slides (or videoscope and videotape projections) with simple captions

REFERENCE MODULES. The graphics are fully labelled and captioned. The important concepts, ideas, and processes are capsulized on a screen which develops in a few seconds, but slowly enough for students to conceptually follow what is going on (the speed can be regulated from 300 to 9400 baud: at the moment we use 1200 baud). The information can be presented on a full screen, or split screen methods can be used whereby the students can select, compare and contrast things of their own choice from within a module, for instance various types of unconformities, evolutionary stages of organisms.

The challenge for the instructor and designers has been to convey information and, more importantly, to trigger specific thoughts in the minds of the students with a combination of words, forms, color codes and stylized animation. When well done, students are very responsive and opt for long sessions at each sitting (1/2 to 1 hour for each complete module).

The reference and self-test modules are made available to students as the subject matter is first presented in class, and remain available throughout the semester.

SELF-TEST MODULES. In this mode, the graphics used in the reference module, plus other very simple ones, are presented stripped of their labels, together with 'multiple choice. or 'true and false' questions, or with simple problems for the students to solve. The VITAL technique allows any type of question to be formulated and any type of response to be register, including.phrase-responses. Concatenated questions can be prepared such that various students can be led to the correct answer if they make mistakes.

Mastery of a subject can be requested before the student can progress to other subjects. When the wrong response is given to a question the computer can provide help, suggestions or "leg-pulling". We have found that, occasional outrageous, albeit polite, statements and some humour, break any tension and make students interested enough to purposely choose the wrong answer to see the reaction of the computer (that is, of the instructor that put the material in).

The main difficulty for the instructor has been in preparing good questions, subject to the space limit of a 16x40 screen. The help of good published Instructors Guides is acknowledged. However the pool of questions must be adapted to specific courses and updated, a simple thing to do with VITAL.

LECTURE MODE. Few graphics, generally without legends and with simplified captions, are transformed into "moving slides" projected with a "videoscope". This technique makes lectures professionally perfect without the need of a professional designer. We have found through experience and reaction of students, that after the firs few weeks, VITAL acquires the role of basic information dissemination and lectures can be readily used to explore in some depth basic concepts of geology.

QUIZZES. Quizzes are designed to test the progress of the students and to entice them to acquire regular work habits. This is particularly important in a semester system where proper time scheduling is the key to success.

Each quiz consists of 10 questions randomly selected from a large (200-300) pool. Each pool consists of the questions of the self test modules the students are tested on, plus other (about 50) new questions on the subject matter, and a number of questions (about 10) derived randomly from the pool of each previous quiz.

Each quiz is available for one specified week during which the students can take it at any convenient time from any available terminal, on a honor system. The fact that students may wish to take and discuss quizzes with a friend is not discouraged. We have found that each student takes the driver seat when his/her ID number and marks are on the line !

Quizzes can be administered in any way one wishes. We have selected to make VITAL (and CoSy) optional: students may gain by these techniques, including marks, but they do not loose anything if they do not use them. That is, students can try twice to achieve at least 80% in each quiz. If 80 or 90 % is achieved, the student is awarded 4 marks, if 100 % is achieved 5 marks are given. If a student does not make the 80% level, or the quiz is not tried at all, he/she does not receive anything, but nothing is lost either: the value of marks not-gained in the quizzes are added to the value of the final examination. The midterm, laboratory and final examinations are administered in the conventional, hard copy way, under surveillance.

Students have responded favourably to the VITAL-quizzes. The tension of 'test' is greatly reduced: student can try as many time they want the self-tests modules until they feel comfortable and try the quiz, with two permissible trials and not-loosing anything, not even self-respect, if they fail to make an 'A' grade. The

teacher likes a few quizzes too because for a potential total cost of 20-25 marks the following is achieved:

(1) students review the VITAL modules several times (both reference and self-test).

(2) some students who do not make the 80% score in a quiz in the first two trials, keep trying, up to 4-5 times, although they know that such extra scores do not count. These people are those that need the system most, and in trying to "beat the machine " they get a good dose of it.

(3) marking is done by computer, with enormous saving of manpower and some beneficial psychological effects (some negative too..!). One positive effect is that most students regard the instructor not as the judge, but the teacher who can provide help to "beat the computer". This is a great advantage for teaching responsive students, particularly if they have selected to use CoSy, thus can be easily reached.

CoSy (Computer Conferencing System)
VITAL can be, and is in some other courses, used alone. However, we have chosen to use it in conjunction with CoSy to provide electronic communication between students and instructors and among students themselves. Usually students prefer to use the personal 'mail' system to instructors. Only later in the semester they do adventure into expressing their opinions in 'open conferences' where everybody can read and comment. A message, mail or conference type, receives an answer within 12 to 24 hours. Students or instructors send a message from a University computer terminal, or home computer equipped with modem, to personal electronic 'mailboxes' (central University computer) or to 'baskets' of conferences. Whenever one signs on the system, he/she is informed that new mail or conference messages are available. Answers can be quickly typed and sent back. The students contribute as much as they gain from this system. They keep the instructors informed on problems, and they suggest modifications to be made to parts of the course. CoSy allows 'communication' and concise discussion: it is "academia" at its best.

CoSy is more difficult to use than VITAL. It also requires to have "something" to communicate. Every person has turned a television set on, thus can use VITAL. CoSy needs some typing skills, adherence to certain very simple but yet unforgiving rules, and many students still have a "fear of computers" . Whereas 99% of the winters '86 and '87 geology class has used VITAL consistently with many repeats of the modules, and up to just few hours before the final examination, only 70 % of the class has signed on to CoSy, and only 25% of these were very active.

EVALUATION OF THE SYSTEM

The combined VITAL-CoSy teaching enhancement system in its present configuration is best suited for local or distant education of Natural Sciences or similar. In future it will allow linkage (windowing) with minicomputer simulation programs, a 'must' for its use in senior classes and mathematical sciences, but 'not advisable' in introductory courses like geology until more students entering University will be computer-literate.

VITAL is also an electronic means of obtaining ongoing information on students progress and difficulties, tests, evaluation of specific portions of the modules and of specific self-test and quiz questions.

Students have responded in various ways to GEO-VITAL, according to their ability and learning disposition. Everybody has used VITAL extensively; most 'A' and 'high-B' students have used extensively both VITAL and CoSy, together with high attendance rate to lectures and readings of textbooks. Some science students have used CoSy primarily to obtain information and answers for laboratory exercises. Some arts students have successfully used VITAL as the primary source of information, attending very few classes.

Few students have dropped the course after the first week of lectures. The average mark for the class was in the mid-high sixties, two out of 300 students failed.The response of the students pooled during the normal evaluation of the course, has been overwhelming favourable, and essentially all of them have recommended continuation of the VITAL-CoSy system in future years.

The system may be time consuming for the instructors because of the possibility of helping the slower students through VITAL, and for being in frequent communication with the more inquisitive students via CoSy. One advantage of the electronic system is that it drastically reduces the need of office appointments for discussing problems and giving clarifications to individual students. The system is not necessarily impersonal, indeed the opposite occurs and strong electronic and class-room ties develop. The students also feel that the instructors are never farther than the closest keyboard, sometimes the one at home, without the frustration of trying to find them in the office.

VITAL, alone or preferably tied with CoSy, has great potential for distant education courses as well. The central distributing system can be reached electronically via modems, or each module can be loaded in one or two diskettes, mailed, and run in any minicomputer equipped with a color (for best results) card and monitor.

COST AND USE OF THE SYSTEM

What about cost and time involved in setting up a course like GEO-VITAL ? Some colleagues have used VITAL and/or CoSy only for parts

(few modules) of their courses, thus starting in a non-expensive way and adding as required. Even for a complete course like GEO-VITAL, a relatively small initial financial and time investment is required if the Guelph material is used , and if some minicomputer equipment is available. To start computerization of a full course from scratch, a considerable amount of money and time is required for instructors, designers and computer technical people. Such time and costs may be comparable to preparing a textbook, or double the effort needed to set up a new course, considering that much material is not only newly created, but also designed in a professional manner. However, once the bulk of the material is in, the instructors themselves or the teaching assistants, without any particular computer expertise, can easily review, re-arrange and modify graphics and captions, generate new text and graphic pages, add or remove self-test questions, quizzes, and so on: everything is menu-driven, simply and quickly. The material can be readily adjusted to the particular needs of a course given at a University or through distance education and in High Schools, and can be shared electronically with colleagues throughout the world.

ACKNOWLEDGEMENTS

Departments and people of the University of Guelph directly involved in this project were:

Department of Land Resource Science:
Peter Martini : Professor of Geology
Steve Sadura : Geological technical assistant

UNIVERSITEL (VITAL):
Les Richards : Manager
Elisabeth Black : Database Supervisor
Doris Burnfield : Design Coordinator
Mary Nairn : Design Coordinator
Andrea Nixon : Operator
Judy Walpole : Design Coordinator

Communication Services (CoSy):
Carl Gorman : Director
Tim Colwill : Operator

Technical Operations:
George Taylor : Manager

Mark Evans and Alan Campbell of the Department of Land Resource Science, contributed in introducing parts of the system to the geology classes of winter 1986 and 1987.

The project was funded by a New Initiative Grant of the University of Guelph with matching funds from the Office of Educational

Practice of the University, and some contribution from the Department of Land Resource Science. The co-recipients of the New Initiative Grant were I.P. Martini, T. Gillespie, T. Hermmann and W. Sharkey.

Figure 1. Vital pages. A. Work station to prepare or view VITAL pages, showing a list of modules of the accessed database. B. Vital page of the Glacial Geology reference module illustrating the formation of roche moutonnee. In the real screen, the figure would be color coded and show simple explanatory movements of the glacier and rock particles. Instructions to access other frames are indicated at the bottom.

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INTENTIONAL SOCIALIZATION AND COMPUTER-MEDIATED COMMUNICATION

Dr. Elaine K. McCreary, University of Guelph
Mr. Jonn Ord, Client Services, T.V. Ontario

After decades of experience with technology transfer in the arena of agriculture the University of Guelph with its new emphasis on communication technology has discovered that many of the insights related to adoption-diffusion of a new technology through a population can be applied to computer-mediated communication (CMC) in large scale organizations. This paper describes the dissemination of CMC technology throughout one large scale organization, the Educational Data Network of Ontario (EDAN), and the special value-added aspect of socialization that enhanced simple technical competence with this new communication technology. The paper discusses reasons for the choice of distance mode for initiation of users. It presents the criteria by which sites were chosen for participation, guidelines used for design of the province-wide training program. It reports successful features of the on-line modules, and concludes with some final insights on orientation programs of this scale.

ADOPTION-DIFFUSION OF CMC THROUGH LARGE SCALE ORGANIZATIONS

Large scale organizations that have complex internal structures involving units of people who work in isolation from each other and especially when those units are geographically dispersed find that any new procedures pose special problems of introduction, orientation, initiation and instruction. When those new procedures are for communication among personnel rather than production of goods or other functions, that new mode of communication is not much less traumatic than moving the entire company into another climate and culture or even moving them into space. The impact will be significant. They will not only reproduce their former lines of communication using the new medium but they will find new functions and new lines of communication opening up.

One such experimental endeavour was undertaken by EDAN (Educational Data Network), a project jointly involving the Ontario Ministry of Education, TVOntario, and a private corporation, with consultants from the University of Guelph. The Ministry designated 75 sites for initial activity in the network, comprising participants drawn from educational businesses, universities, and primary and secondary schools throughout Ontario.

CHOICE OF DISTANCE MODE FOR INITIATION OF USERS

In its first four years of promoting CMC throughout a community of 770 faculty, 2500 fulltime support staff, and 12,700 degree program students, the University of Guelph came to conclude that the most effective means of initiating new users was through a person-to-person intensive training program of an hour or two, involving closely guided hands-on practice with the equipment and software, heavily supported with a user manual and most importantly followed up with some tutoring involving a "buddy". The buddy system of immediate friendly feedback, advice and user support seemed in our experience to be by far the most significant variable. However, for the Educational Data Access Network of Ontario, neither of the two most important features were going to be financial feasible. A face-to-face initial training that would require the transportation and housing of 75 participants to a central site or even several regional sites was out of the question and one of the key features of their activity in their home bases was that there were no colleagues equally, let alone better, prepared in technical matters involving computer-mediated communication.

Add to the restrictions of financial parameters time constraints where an experimental program is given three to five months to prove its usefulness, then a second set of problems emerges. Experience has shown that a novice user with untested equipment and a manual, in three months is barely literate enough to begin to make use of electronic mail and begin to see the possibilities of the system. Far more than this was required for a successful test period within the three-month time horizon.

However, despite financial constraints, the Ministry of Education and T.V. Ontario are both committed to equalizing opportunity for learning throughout all regions of Ontario, and therefore decided to make participation in EDAN available to any site that could conform to the following criteria. The host site had to be able to provide hardware in the form of a microcomputer and modem. It had to have phone line access. It had to provide one of its personnel as a demonstrably interested participant who would make a time commitment of a total of ten (10) hours distributed as 1/2 hour sessions per working day, five days a week for two weeks. Half an hour per day was a manageable time commitment for participants to make, and it influenced us as designers not only to opt for an initiation process that would be principally distance mode, but to emphasize on-line training rather than paper instructional modules. This, we felt, would maximize the trainees' hands-on engagement with the technology and minimize disruption to their regular work routines.

GUIDELINES FOR DESIGN OF THE PROVINCE-WIDE TRAINING PROGRAM

Goals

The training program was structured to give advance on-line instruction over ten half-hour periods lasting two weeks. Participants would then come together in regional workshops for special follow-up training with workshop specialists from TVOntario. The purpose of the on-line training in advance of face-to-face meetings was twofold. Firstly, it had to be written in such a way as to enable 75 isolated new users to develop skills in a self-conducted manner with the software of COSY--the conferencing system that they were learning.

Secondly, the on-line training was designed to give them guided interactive experiences with other users on the assumption that their ability to interact, discuss, negotiate, argue, reconcile, and reach decisions with colleagues was the real purpose of the training not simply keyboard competence to write electronic memos.

Style

With the two goals in mind, an intensive compact skill development and interactive socialization to this mode of communication, several points of style were decided upon. Firstly, that the writing instructional style, like most distance education, would be chatty and upbeat for the purpose of encouraging learners who were otherwise working in social isolation. Secondly, that there would be a carefully sequenced set of programmed tasks with short-term reinforcement to encourage the new user with a sense of progress, security, and increasing confidence.

User Supports

Like most distance education systems, special features of user support had to be added to this province-wide training program. Principally these were administrative and technical support. Correspondence was undertaken in advance with administrators at each of the 75 sites to solicit their participation and cooperation, and to indentify the local staff member who would be suitable as the first to learn this new system. Telephone contact had to augment other means of correspondence. Once people received the small-scale paper module that accompanied the on-line training, their first problem was to make that initial electronic contact with the host computer at TVOntario. Here again a telephone hotline was essential recourse for isolated users who had no technical advisors on site. Once on-line, there was a detailed "Help Hierarchy" of options to refer to including programmed help menus and access to experts in an on-line conference.

Workshops

In order to accommodate a constituency of 75 learners with only

three central staff, training packages were mailed out to two sub-sets or cohorts of learners per week. As their two week on-line training was completed, a regional workshop would be convened -- principally to consider what their professional applications of this now familiar medium might be and to help them move directly into setting up and moderating appropriate conferences. Timing was arranged so that as each set of workshops was completed, another cohort of on-line learners would be coming due for their follow-up workshops.

SUCESSFUL FEATURES OF THE ON-LINE MODULES

Standard Module Format

The first feature of the ten on-line modules that worked very well was its standard format. Each day had a "to begin" section that lead the user to the on-line location for that day. Each module had "today's commands", a list of the new commands that would be learned, and the full set that would be used on that day. Each day had "supplementary instructions" if any were necessary to carry out the day's task. Each day indicated" electronic work spaces" that would be in use helping the new user to think in terms of discrete areas of work within the system.

Sequence of Modules

Each additional unit of commands was sequenced in an order compatible with new user interest: writing options before editing skills, read options before writing, getting on and off the system successfully before any other task at all. Almost all frequently used commands were mastered in the first five modules. Module 6 required they work with others in triad in "conversation mode". Module 7 was a tour de force review of previous commands. Module 8 taught users to move from mode to mode acquiring a private database using the "file" command. In module 9, they learned to print paper copy of their private and team creations. Module 10 moved the whole consituency of new users to a discussion of applications in preparation for their upcoming workshop.

Screen:Paper Ratio

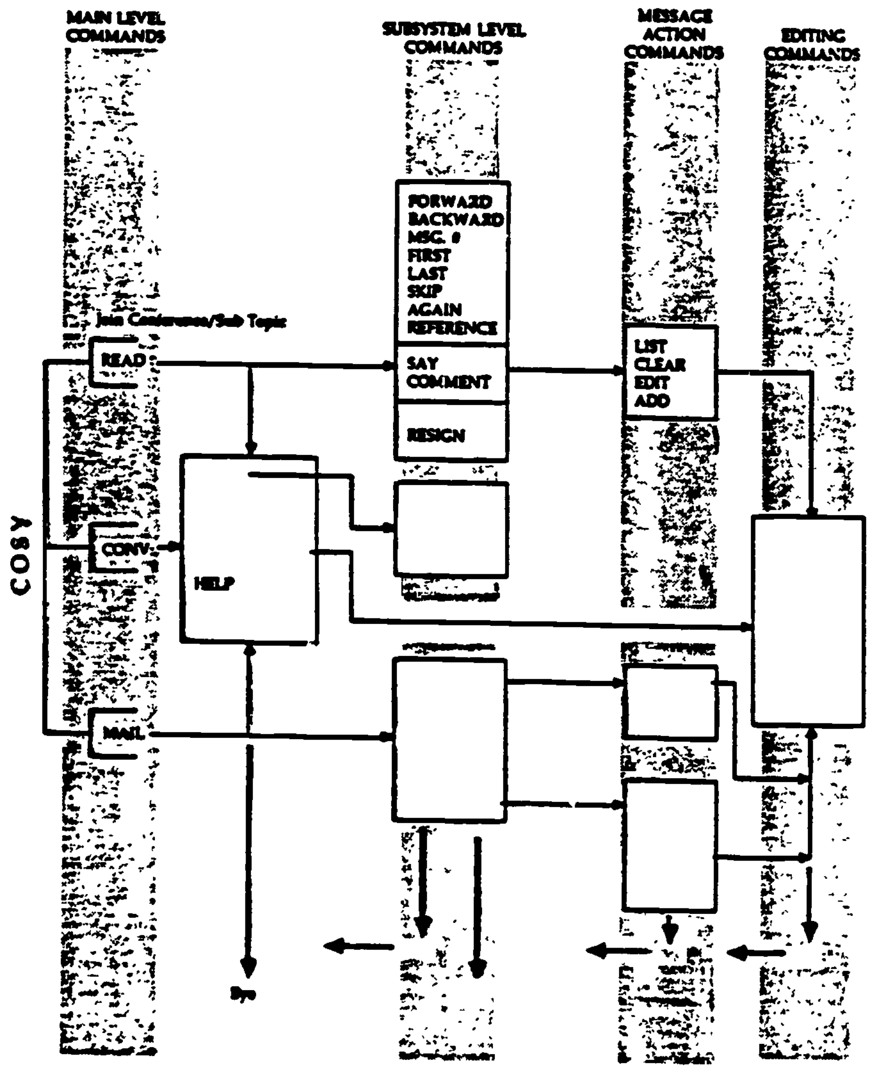
The whole intention of the on-line training was for the learner to experience continuous response and coaching from the training writers as driven by the learner's own actions and prompts. Given an instruction, the new user would try something and either be assured it worked, or be given a corrective procedure on-line, or through the safety feature of the paper back-up kit. Paper was essential at the first sign-on and that format for opening the day's work was kept just to increase the novice user's sense of security. Throughout, we tried to proportion on-screen activities to paper back-up at about 80:20.

Progress Maps of the Command Structure
A feature that worked particularly well for visual learners were the maps. These were graphic illustrations of the training sequence show as full command structure through its four levels, with the help section accessible from any of the other levels.

DAY 2

COSY COMMAND STRUCTURE

PROGRESS MAP OF DAY 2

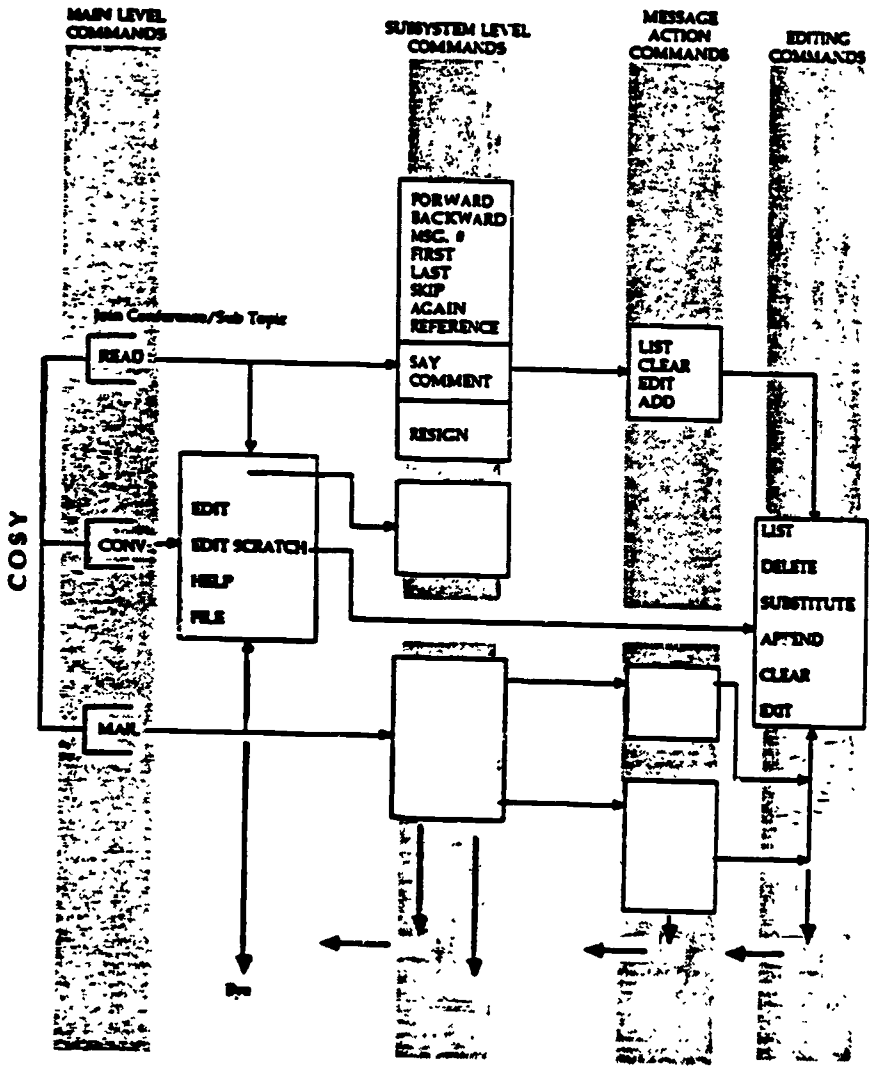


This overview of the COSY command structure was first shown as a set of interlocking blanks. As they proceeded into a new sub-set of commands each day, those would be shown in their appropriate place within the graphic of the COSY command structure. In this way, users were given an advance organizer that became a more explicitly articulated road map of the whole command structure as they personally added new sets of compctencies.

DAY 3

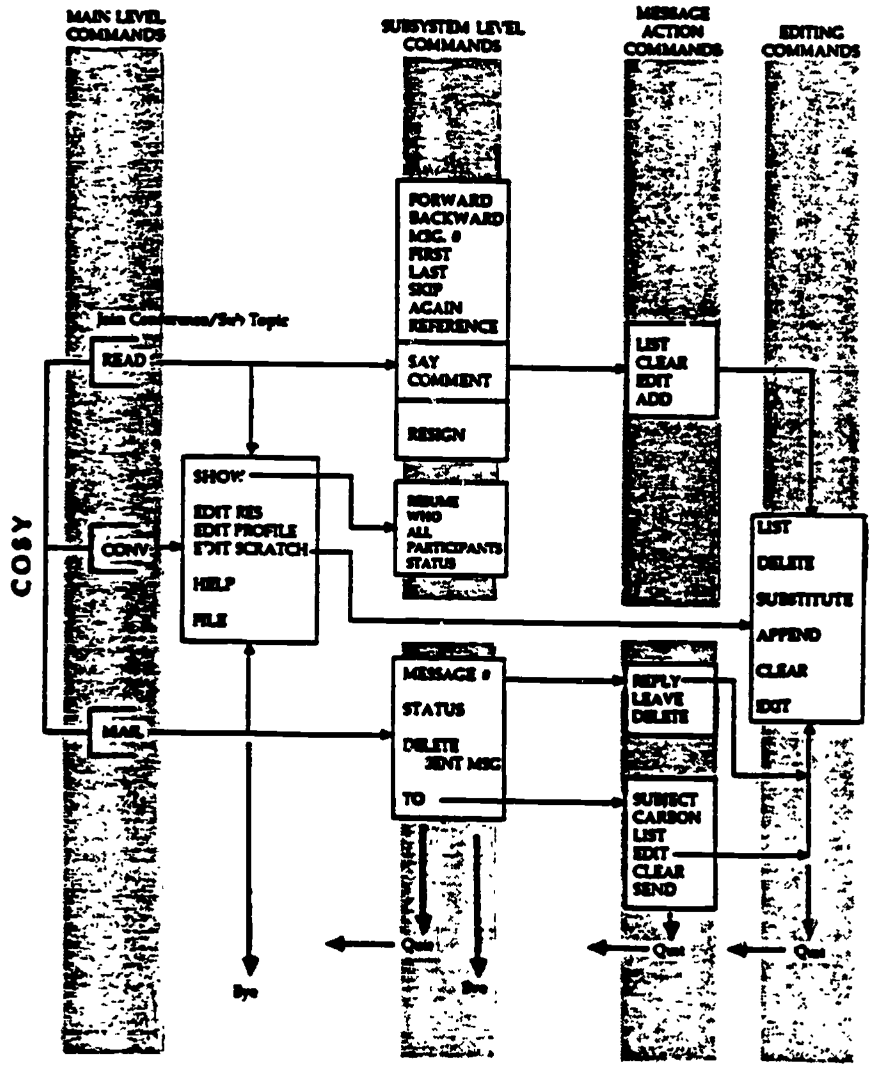
COSY COMMAND STRUCTURE

PROGRESS
MAP
OF DAY 3



COSY COMMAND STRUCTURE

DAY 5



PROGRESS
MAP
OF DAY 5

SOCIALIZATION SEQUENCE
From the beginning, new users were moved through a set of small and large group tasks requiring them to engage in some of the various social environments that CMC provides.

As soon as they could write, even before they could make editorial corrections in a message, they were required to send a message to their tutor or moderator, to indicate that they had made it that far through the modules. The purpose was to ensure that they would receive personalized mail very early on when the tutor responded to their check-in.

When they had learned editing skills, they were set a casual task of reading and making small talk in a social mixer called "Fireside", while elsewhere they worked on the more onerous task of editing a personal resume for posting where all the community of new users would be able to read it. "Fireside" proved a social vehicle for some people dispersed throughout the province who had in fact met face-to-face before at professional conferences.

Their chatting was visible to newcomers, providing some role modeling that newcomers could consider in their "required" conversational triad with two far-distance buddies whom they had not met before. The triad had a task to complete, in the form of a brainstorm on "sources of stress in the workplace". Dealing with serious enough issues, it was nevertheless intended to be an amusing exercise...out of which the triad would do some decision making and present to the whole community a short list of irritants and antidotes for sources of stress in the workplace. In the last module, people began to pool their suggestions for the workshop to follow that would address professional applications of CMC province-wide, principally for methods and curriculum working groups.

In the meantime, more than 20 special interest conversations had sprung up, completing the possible combinations of small group/large group and task-oriented/free flow discussions, as illustrated in the figure below.

Intentional Socialization Experiences

	Free-Flow Discussions	Task-Oriented Discussions
Large Group	"FIRESIDE" social mixer	Professional application to methods & curriculum
Small Group	20+ Special Interest Conversations	"Less.Stress" conference

USER SUPPORT DURING LARGE-SCALE ORIENTATION

Care was taken to foster the process of change required of the new users by establishing consistent contact, support and direction during implementation of the training sequence. This process began during the identification of sites by EDAN staff; it increased during on-line training with the introduction of 'on-line buddies' or working triads of learning partners that contributed to a sense of mutual support and team obligation. the sense of group was extended to the larger community through the face-to-face workshop with an immediate invitation by each special interest group to the rest of the community to participate in a new conference addressing their professional interests.

One former user of the system who had just participated in this training commented that "the whole system seemed much more user friendly". The user mistakenly assumed that the conferencing software had been greatly re-written to achieve this result.

Consistent and persistent pre- and post-training contact was essential to a successful experience for isolated new users. A certain amount of creative and supportive pressure was useful to ensure that the new user not only complied but initiated new behaviour, continued and was reinforced in that new behaviour by positive results. Throughout the experience it was vital for participants to feel sustained support from peer groups, administration and project personnel to ensure that the initial pressure and effort did not result in discouragement and alientation.

FINAL THOUGHTS

Socialization aspects of CMC communities in the workplace and elsewhere are going to be posing us interesting problems for years to come. It was our experience that the additional effort required to build in a range of social experiences, in order to enable new users of the medium to become accustomed to the idioms, the pacing, the courtesy, and the affective aspects of on-line communities was well worth the effort. Future efforts can only ensure that we become more refined in our identification and encouragement of behaviours that will make on-line communities civilized places to live, and productive places to work.

ISSUES IN THE DEVELOPMENT OF INTELLIGENT TUTORING SYSTEMS

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May 1987

Abstract

Intelligent tutoring systems (sometimes known as Intelligent Computer Aided Instruction, ICAI) have grown out of adaptive instructional systems. Such systems try to combine problem solving experience and 'discovery' learning with the effective guidance of tutorial interactions. It becomes important to develop tutorial strategies which know "when" to interrupt a student's activity, "what" to say and "how" best to say it.

The process of developing a system with such capabilities begins with the problem of forming an adequate model of student behavior. One project at Guelph involves designing and building an Intelligent Tutoring System for the Artificial Intelligence Language Prolog. In order to construct a student model for the system, experiments are being carried out to study student's programs and thought processes in a variety of ways. "Buggy" programs are captured and their study is contrasted with the results of questionnaires. The relevance of prior knowledge of other programming languages to the student's learning capabilities is also investigated.

This paper highlights features of the proposed system that go beyond CAI and discusses the work already done at Guelph on student (user) modeling issues in the context of learning Prolog.

Introduction

Studies of students learning cognitive skills have shown that private tutoring seems to be much more effective than conventional classroom instruction. In the classroom, students have to listen to lectures, read texts, and then later work alone on homework problems. Private tutoring on the other hand, provides the student with an experienced person to guide the reading and problem solving. This type of one-on-one activity paves the way for a more intimate interaction.

The notion of providing students with individual tutors has in the past been an unrealistic prospect for teaching institutions.

Staff time and cost considerations have been the obstacles. However, with recent developments in computer technology, individual tutoring is now both feasible and relatively inexpensive. In fact, computer assisted instruction (CAI) has been a part of many school curricula for the past decade.

With the recent advances in the area of computer science known as artificial intelligence (AI), methods have been developed which can be used to enhance CAI. The outcome of this has come to be known as intelligent tutoring (IT) or intelligent computer assisted instruction (ICAI).

Intelligent tutoring differs from other CAI approaches to education by trying to provide effective instruction to problem solving the same way that a human tutor does. A number of the more traditional CAI systems were "automatic page turning" or "fill in the blank" instruction programs. While these programs are indeed very useful, they often assume all students to be equal.

Another trend in computer assisted instruction programs has been the development of programs to simulate laboratory equipment. The wide range of simulation programs (see proceedings of this event) seems to be in a period of explosion. For example, there is even a program available (City Software, 1985) to simulate the use of a nuclear magnetic spectrometer. High resolution graphics and faster processors have made these programs a useful alternative to the rising cost of laboratory equipment.

The development of more "personal" interactive computer programs has resulted from the realization that students do not all have the same problems and needs. Intelligent tutoring systems try to address the individual student's strengths and weaknesses; by so doing, the tutor can avoid redundant sessions and provide extra instruction on the more troublesome ones. By utilizing these concepts, programs have been developed that can effectively create customized teaching strategies.

This paper presents some of the issues concerning the development of computer tutors. We begin with a description of the various components associated with a typical intelligent tutoring system and how they fit together. The focus of the following section is on acquiring knowledge about student problem areas. This can be useful in the design of a "bug catalog". This, in turn, is crucial to the design of a student modeling component, which is then described and examples of existing systems are given. The discussions are based on experience gained in our efforts to develop an intelligent tutoring system for teaching students how to program in the AI language, Prolog. The last section describes the need for a Prolog tutor. Finally, the paper is summarized and concluded.

Components of an Intelligent Tutoring System

Intelligent tutoring systems are made up of a number of modularized components (see figure 1). The "domain expert" has background information of the specific domain of study. The "tutoring expert" is the part of the system which contains an expert system for instruction. This component has problem solving, explanation, and diagnostic modeling strategies built into it. With this information the system can present material to the student and process the student's response. In order to build a tutoring expert, a "bug catalog" containing a list of possible problem areas should be developed. This provides the developer with essential information in deciding what types of problems assistance can be given on. The tutoring expert can determine what a student knows and what s/he is confused about (i.e., what "bugs" the student has), when the student should be interrupted and what should be said, and what further sessions the student should perform. In order to provide this kind of tailored assistance, a model of the student's knowledge and difficulties must be maintained, in what is called a "student model".

```
                  Problem Solving        Explanation        Diagnostic
Modeling
                    Strategies          Strategies      Strategies
                             \               |              /
                              \              |             /
                               \             |            /
                                \            |           /
                                 \           |          /
                 Domain Expert <-------> Tutoring Expert <-------> Student
Model

                                          student
```

FIGURE 1: A Typical Intelligent Tutoring System

The following section examines how we went about gathering information to develop the tutoring expert, with a focus on what kinds of problems typical students would encounter.

Knowledge Acquisition and the Development of a Bug Catalogue

In order to build a domain expert, information about the particular domain must be gathered and made explicit. This

process has come to be known as "knowledge acquisition" (Hart 1986). The domain expert should have a thorough knowledge of the various aspects of the area under investigation. There are several ways of acquiring knowledge, each of which are quite unstructured. The ones examined in this section include monitoring programming sessions and handing out questionnaires.

One method of acquiring information about how students learn programming is to monitor their programming sessions. This can be done either by actually watching the students as they work, or by "grabbing" their edit sessions.

First we developed a programming problem and gave it to a group of computer science students as an assignment. As the students were working on their programs, we would "grab" all their editing sessions. By looking at each students successive attempt at a solution we hoped to be able to gain insight on how they were thinking and what kinds of problems they encountered. Upon completion of the assignment we gathered together the edit sessions, made hardcopies of them, and began the painstaking process of analysis. We found that the successive edit sessions were characterized by zero, one, two, or more changes. To account for the program versions with zero changes we speculated that the students had ended their edit sessions due to time constraints and personal reasons (e.g., tiredness, hunger, other work to do, etc.). We also found many of the problems to be due to spelling mistakes. The more program related problems included: improper use of variable names, unexpected backtracking, and recursion related issues. It did provide us with a rudimentary bug catalogue, but also led us to look for alternate methods of data collection.

At the end of the experiment the following new questions arose: How could the method of analyzing program versions be automated? Was the programming problem a relevant one to base conclusions on? Would the insight gained be useful in the development of student models?

As mentioned previously, another way to learn about student difficulties is to actually watch them program. This is useful because when students need help, they will often ask. This method of videotaping groups of students has been more widely advocated recently (Curtis 1986). Also, if you are there watching someone making changes in their program, it's easy to ask them why they made the change. With both of these situations occurring, a great deal of insight can be gleaned. We have yet to test this method, but it is fair to say that however one goes about acquiring knowledge of student difficulties, it is an incremental and rather unexplored area; there are no formal methods or general rules which can be applied.

What is a Student Model?

We have assumed that since most students have different learning rates and that the problems they encounter are often different from student to student, there is a need for more student specific tutoring strategies (Kearsley 1987). This has led to the notion of developing a "student model" to store each student's current knowledge state. This section examines the need for student models and discusses how one is developed.

The term "user model" became popular in AI during the early 1980's. A user model usually means "some form of representation of the person using the computer system". Many aspects of AI regard user models as an important tool for use in human-computer interfaces. Besides intelligent tutoring systems, other areas where user models have been employed include expert systems (Clancey 1981, Cohen 1986) and natural language systems (Carbonell 1985).

As noted by Wahlster (Wahlster and Kobsa 1986):

> "A user modeling component is that part of a dialogue system whose function is to incrementally build up a user model; to store update, and delete entries in it; to maintain the consistency of the model; and to supply other components of the system with assumptions about the user."

The incremental building of a model of the user's cognitive abilities and preferences enables a system to respond in a most appropriate way for the person using the system.

When we refer to a system that is specifically to be used as a teaching or instruction system we modify the term "user model" to become "student model". Thus, a student model is a computer system's model of the student's current state of knowledge and beliefs about a particular domain.

As noted by Van Arragon (Van Arragon 1986) early CAI systems were quite simple in that they were often:

> "drill and practice programs that would quiz a student, and then keep track of the number of right and wrong answers so that the questions can get harder or easier based on the student's progress"

Today, modern teaching facilities have replaced the ancient boarding school methods of "drill and practice" routines, with the more cognitively intuitive methods of "learning by

discovery". Along with new teaching methods in the school systems, the development of CAI programs is going through similar changes with the incorporation of student models.

The introduction of student models has enabled programs to predict students' levels of understanding and to recognize their particular learning style. Some students learn best by analogy, while others through experience, and even others by being told. A good introduction to related AI research in learning can be found in the book, "Machine Learning" (Michalski et al, 1983).

Whatever the preferred learning style, the system should be able to make inferences from students' responses to questions and exercises, modifying its teaching strategies accordingly. A student modeling component should also be able to recognize and correct student misconceptions and deviations. Therefore, a model should be flexible enough to store and retrieve a wide range of student information.

Example Intelligent Tutoring Programs with User Models

Early CAI systems had no student models. However, as CAI programs became more "intelligent" with the help of AI techniques, systems began to evolve with "overlay" and "bug" modelers. An overlay modeler uses stereotypical information about the domain to store whether topics (or skills) are known or unknown. A bug modeler works by storing information about bugs or misconceptions. These modeling constructs have been built into the two ICAI systems, West (Burton and Brown, 1982) and Buggy (Brown and Burton, 1978).

West is an ICAI program which evaluates and suggests improvements to students' learning elementary arithmetic constructs. Learning is facilitated by having the interface set up as a board game. The object is to move a player across the board by writing and solving algebraic equations which determine the distance to be moved. Whenever the student's solution is different from how the "domain expert" would solve the problem, the student is provided with hints on how to make better moves.

The program Buggy models bugs made by students solving arithmetic problems. It was designed to give teachers experience in diagnosing students' incorrect procedures. Buggy gives teachers experience in discovering the underlying causes of student errors by presenting examples of bugs. Then the teacher has to try to deduce what the problem is with the particular buggy example.

The tutor we are developing is to teach the AI language, Prolog, to computer science students as a second programming language. Computer programs that have been developed to teach programming

include Proust (Johnson and Soloway 1985), the LISP Tutor (Anderson and Reiser 1985), and Scent (McCalla et al 1985).

PROUST is a system that takes programs written in Pascal by novice programmers and performs a "bug analysis". The program not only points out mistakes to students, it also determines how the bug can be corrected and suggests why the bug arose in first place.
The LISP Tutor is an ICAI program used to teach the AI language LISP to students. The program works by presenting a series of tutoring modules to students where they are given requests to work with and develop various aspects of LISP programming tasks. As the student is writing the solution, the tutor watches, trying to figure out what correct or buggy information could have led the current input. When the input is buggy, the tutor interrupts and gives advice. There are several modeling components in this program including an ideal student model, a buggy model, and a current student model.

SCENT is an ICAI program that also teaches students to program in LISP. Its current phase is to provide sophisticated debugging assistance to novice students through the use of extensive trace facilities. This project is still in its early phases, but its main intention has been to provide computer science students with programming environments that will induce learning. It will undoubtedly make use of expert models and student models.

Other features which can be added to ICAI programs to facilitate learning and to make them less intimidating to students are natural language understanding front-ends and the use of cooperative strategies. Natural language front-ends enable students to converse in English with the tutoring system. Cooperative strategies include such things as spelling correction and misconception correction modules. These features address the plans and goals of the student using the ICAI system.

Student Modelling in the Context of a Prolog Tutor

The project at hand attempts to advise students according to the premise that there are interference effects when learning Prolog, which come from a student's ingrained knowledge of procedural languages (like Pascal). The following example programs illustrate some of the differences between the two languages. This database program is to assist in building a genealogy to determine if various people are related to one another. While the programming would be simple in Prolog due to its built in searching technique of backtracking, the same program done in Pascal would be quite tedious. Figures 2 and 3 illustrate these programs.

```
        parent( Parent, Child )
    /* The above FACT states that the variable "Parent" */
    /* is the parent of the variable "Child")           */

        ancestor( RelativeX, RelativeY ) :-
                    parent( RelativeX, RelativeY).
        ancestor( RelativeX, RelativeY ) :-
                    parent( RelativeX, Child ),
                    ancestor( Child, RelativeY ).

/* The above RULE states that "RelativeX" is an ancestor of */
/* "RelativeY" if "RelativeX" is the parent of "RelativeY"  */
/* or if both "RelativeX" is the parent of "Child" and      */
/* "Child" is an ancestor of "RelativeY"                    */

...the database:

parent( Baden, Karl ).
parent( Geofrey, Baden ).
parent( Karl, Zoe ).
parent( Baden, Jennifer ).
parent( Jennifer, Braeda ).
parent( Norah, Karl ).
parent( Sarah, Norah ).
parent( Serina, Sarah ).
```

FIGURE 2: Prolog Database Program

In order to find out whether or not two people are related to one another, all the person using the system has to do is type in the following:

```
ancestor( RelativeX, RelativeY ).
```

(Where RelativeX and RelativeY are substituted with the names of the actual people in question.)

For example, typing in: ancestor(Baden, Zoe)
Would produce the response: yes.

```
program ancestor( input, output, relationfile );

type
     relation = record
     parent : string;
     child : string
     end;
var
     relationfile : file of relation;
     done : boolean;
     name1,
     name2 : string;
```

```
     response,
     result : char;
procedure search(      );
begin
1) check to see if there is a parent = name1
2) if there is, check to see if there is a child = name2
     if there is, then stop, the search was successful
     otherwise check to see if there is a child of a
         child (or child of a child's child, etc)
         that is = name2
3) continue until a successful search has been achieved
  or the range of possibilities has been exhausted
end;
procedure ancestortest( name1, name2 : string, result :
                                                   char );
begin
     reset( relationfile );
     while not eof( relationfile ) do begin
     search( relationfile );
          ...
     end;
{    if the search was successful then
       result = 't'
     else
     result = 'f';       }
end; { ancestortest }

begin { main }
     done = false;
     repeat
         writeln( 'enter two names: ' );
         read( name1 ); readln( name2 );
         ancestortest( name1, name2, result );
         if result = 'y' then
             writeln( 'yes, they are related' )
         else
             writeln( 'no, they are not related' );
         writeln( 'like to try another pair (y/n) ?');
         readln( response );
         if response <> 'y' then
             done = true;
     until
         done = true;
end. { main }
```

Relationfile:

Baden Karl
Geofrey Baden
Karl Zoe
Baden Jennifer
Jennifer Braeda
Norah Karl
Sarah Norah
Serina Sarah

FIGURE 3: Pascal Database Program

While the above program is not quite complete, already one can see there is a lot more programming involved to develop a database program similar to it's Prolog counterpart. While we do realize there is a lot of input/output and search coding for the Pascal program, this is exactly the point. Prolog has a built in search facility, and questions can be interactively posed to the database without a need to do any input/output programming. For similar database and knowledge base development applications, Prolog is by far superior than Pascal. This has been a reason why it has been chosen by many AI researchers to be the language of choice for the development of expert systems. We feel that since there has been such a thrust to learn to program in Prolcg, there is a need to have sophisticated intelligent tutoring programs to assist students learning the language. However, because the language is relatively new, most students are learning it after significant exposure to other 'Pascal like' languages. Some major language differences are listed below.

in Prolog:

1) There is no looping facility other than recursion.
2) There are no assignment statements.
3) There is a built in search facility (depth first).
4) The use of list structures is important (as in Lisp).
5) Answers are obtainable only by querying a database
6) Program efficiency can be obtained through the use of a special 'cut' operator, which is tricky to use and without a procedural parallel.

(The extent of these differences can depend on the particular Prolog implementation.)

In teaching Prolog to our undergraduate classes at Guelph, instructors and T.A.'s would repeatedly hear students complain and struggle with efforts to reconvert their thinking to the mind set of declarative languages. However, a study of the 'buggy'

programs alone did not unearth enough evidence to really support this theory.

As a result, other knowledge acquisition techniques were tried and are underway. Questionnaires were designed to ask the students directly how they felt about any interference problems from other programming languages. These initial questionnaires were circulated to a 4th year/graduate class (486/686) at the University of Waterloo, where the students were learning Prolog for the first time, after many years of procedural experience. The sample size was 85. Another class (200 students) was surveyed with the same questionnaire. This class was at a second year level and the students were being taught Prolog in the same course as Pascal, but following it. A sample of the questionnaire and an analysis of some results is shown in figures 4 and 5 (see appendix). It is interesting to note that there appears to be less of an interference problem with students introduced to Prolog at an earlier stage, even if it follows Pascal. (Actually these students already had some exposure to Fortran and Basic.) Control flow and the use of recursion were two areas which seemed to cause difficulties. Further questionnaires were circulated pinpointing particular problem areas concerning a recursive routine the students had been asked to program. The questionnaires proved to be valuable, but in a different sense from the study of 'buggy' programs. A system is now being automated which attempts to be a combination of the two techniques of data collection. Every time a student edits a new version of his program, he is prompted with a set of questions asking him what he thinks was wrong with the earlier version and how he has attempted to correct the mistakes. The 'buggy' programs and editorial comments can then be studied, comparing the student's perceptions with the actual problems.

Prototype System

Several systems have already been developed primarily to debug Prolog programs (and indeed most Prolog implementations now come equipped with fairly sophisticated debugging capabilities.) The work of Shapiro (Shapiro 1982) uses a formal grammar approach, whereas some work carried out at the University of Calgary employs a graphical debugger. A recent technique employed by Hartley (Hartley 1986) compares a student trace with the 'true' program trace in order to track for errors. We are developing a system which concentrates more on a true tutoring capability, as opposed to a debugging facility. When an error is detected at run time, the system will suggest a variety of possible causes based on the study of the bug catalogue, questionnaires, and the premise that certain types of errors arise from the interference phenomena discussed earlier. The system can then provide a list of possible causes. The student can choose to request further information on one of these, giving him further suggestions of

where errors could likely occur. The student will be pushed, as much as possible, to discover the exact cause of the error himself and to correct it. As previously mentioned, some existing systems already make use of a prescreening technique to decide what sort of background a student has and then tailors the tutorial help appropriately. Questions along the line of the first question on the questionnaire of figure 4 (see appendix) could be used, for example, to guide the system in deciding on the extent to which errors can be explained by background problems.

Further refinements include prompts asking the student what he intended the outcome (final result) to be and then comparing this with the actual outcome. (This is for situations where either complete or partial run time results were obtained, but they were incorrect.) The knowledge base of the system envisioned can a updated with the information collected on students using the system.

Summary and Conclusion

This paper has discussed some of the issues associated with the development of intelligent tutoring systems. The various components associated with a typical intelligent tutoring system have been discussed with a particular emphasis on how to acquire the knowledge necessary to understand what some of the specific problem areas for the students may be.

The present status of a recently conceived project at Guelph concerning the development of a Prolog tutor has been discussed in this context. Clearly much work remains to be done. However, it is felt that a much better system will be developed if more attention is paid to studying student errors ahead of time, instead of designing a system first and then going back to study problem areas.

Appendix

AI - Prolog

Feb. 1986

Phase One: Prolog Questionnaire

NOTE: The purpose of this questionnaire is to try to gain some insight into the problems associated with the learning of Prolog after one has gained some familiarity with other programming languages.

1) Please list the programming languages which you have had some experience programming with prior to learning prolog:

2) We are particularly concerned with difficulties in learning prolog arising from interference caused by previous programming experience in other languages. Please indicate the extent to which this has been a factor in your learning the prolog concepts listed below:

	Not a factor	Caused some difficulty	Caused most of the difficulty
a) Syntax			
b) Control Flow			
c) I/O			
d) List Processing			
e) Recursion			
f) Backtracking			
g) Cut			
h) Logic Operators			
i) Database Operations			
j) Complex Conditions			

FIGURE 4(1)

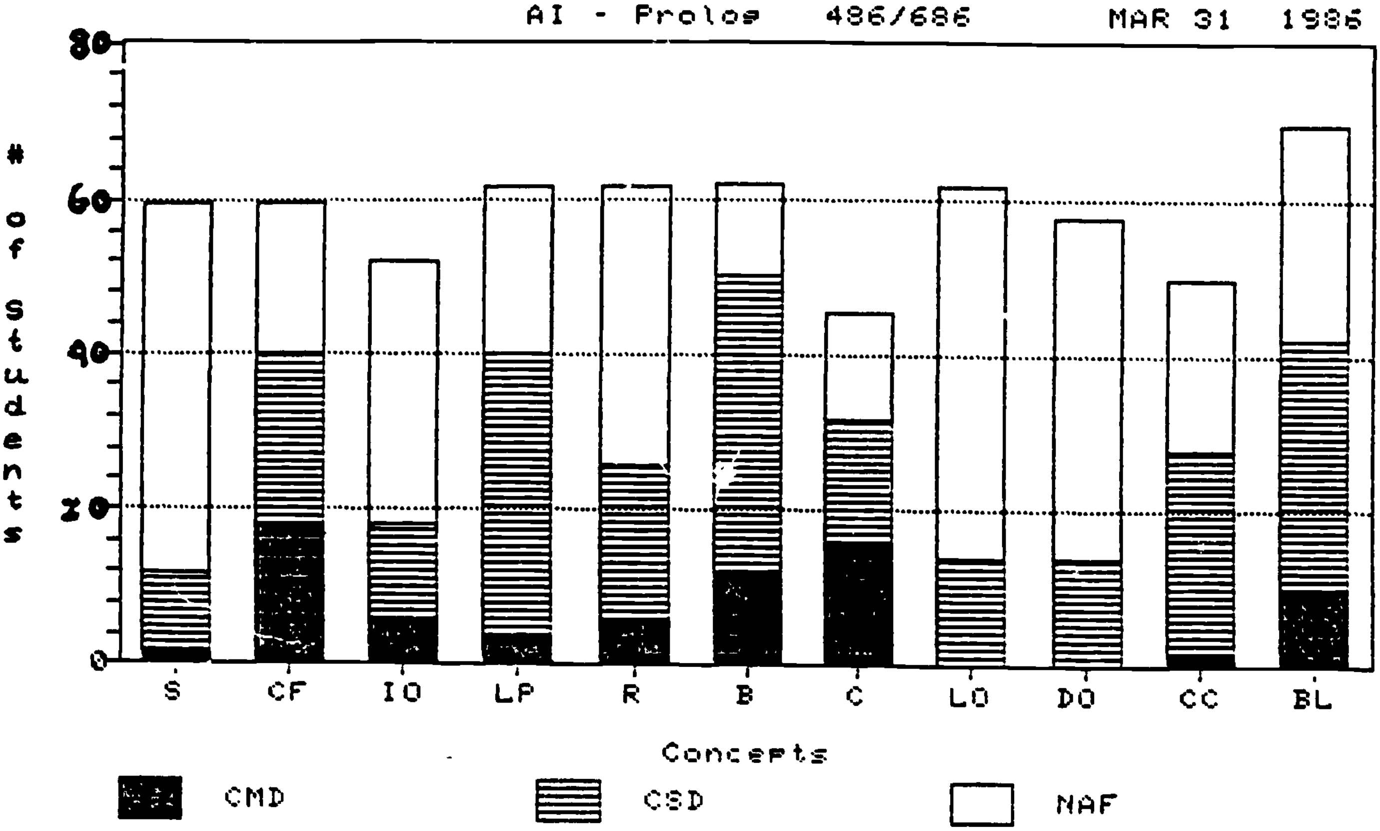
3) Finally, if you feel that there are indeed problems caused by your background in other languages when learning prolog:

do they i) subside after a few weeks into prolog ☐

ii) continue to influence your prolog programming abilities ☐

iii) only cause a problem with 'getting started' in Prolog on the first programming problem you attempt. ☐

FIGURE 4 (2)


AI - Prolog 486/686 MAR 31 1986
# of students
80
60
40
20
0
S
CF
IO
LP
R
B
C
LO
DO
CC
BL
Concepts
CMD
CSD
NAF

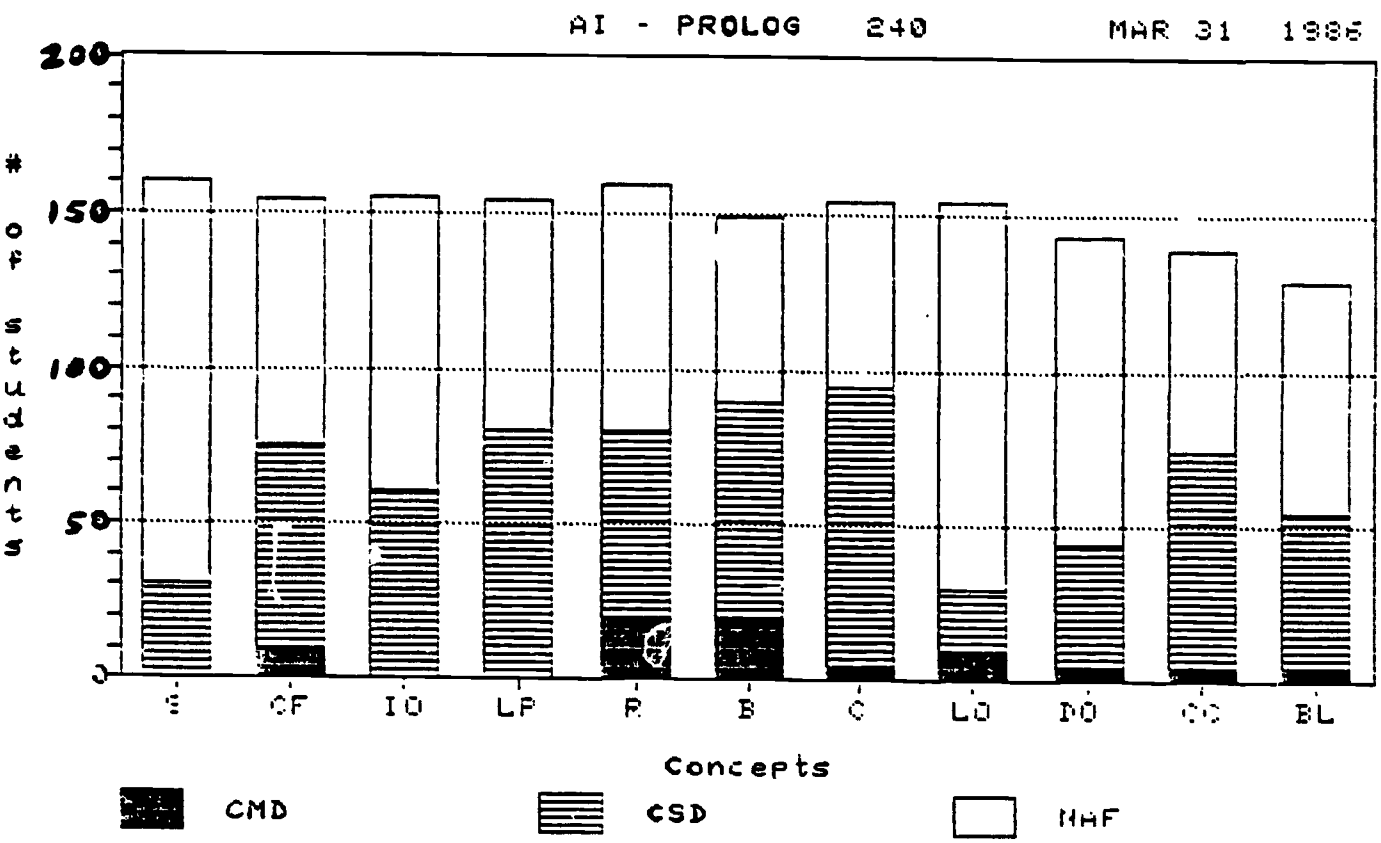

AI - PROLOG 240 MAR 31 1986
# of students
200
150
100
50
0
S
CF
IO
LP
R
B
C
LO
DO
CC
BL
Concepts
CMD
CSD
NAF

FIGURE 5(1)

CMD means caused the most difficulty
CSD means caused some difficulty
NAF means not a factor

S	=	syntax	B	=	backtracking
CF	=	control flow	C	=	cut
IO	=	input/output	LO	=	logic operators
LP	=	list processing	DO	=	database operations
R	=	recursion	CC	=	complex conditions

BL is an attempt to get the students to express their feelings about whether or not their background in other languages caused problems when learning prolog.

bottom space = continued influence from other languages.
middle space = problems subsided after a few weeks of using prolog.
top space = problems were noticed only with initial attempt to program with prolog.

es:

1) All students had experience in at least three procedural languages and none had experience in other declarative languages.
2) This was our first questionnaire.

FIGURE 5 (2)

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Which Objectives, Which Technologies? A Decision-Making Process

Two questions arise when any faculty member considers the use of an emergent technology for instruction. The first is a decision question, "How should I teach this so that my students will learn it?" or "What methods and emergent technologies should I use to promote student learning?" The second is an empirical question, "How is this best taught?" When the group supporting the use of an emergent technology is part of an office set-up to encourage scholarly approaches to teaching, it is important to make these implicit questions explicit as a first step in problem-solving. This explication is also the first step in a "curriculum analysis" process. The use of this process can lead a faculty member from trying an emergent technology in a single course to changing ways of thinking about the course and teaching in general. This paper describes the application of a decision-making framework to the question of "Which instructional technology should I use?"

The question of "How can I best teach this?" begins an evaluation of the relative effectiveness (in promoting learning) of two or more methods. This is the starting point in instructional design leading to a three-category typology of instructional objectives each with appropriate general teaching strategies (Robinson, Ross, white, 1985). This typology derives from literature on metacognitive strategies in teaching and learning, notably the work of Glaser (1978) and Brown et al. (1983).

The learning objectives for teaching are of two main types, cognitive and affective. Cognitive objectives have to do with developing student's knowledge of the subject. Affective objectives have to do with nurturing positive values, beliefs or attitudes about the subject matter or about the student as learner or practitioner of the subject. We generally espouse the goals of developing two kinds of knowledge learning, usually labelled "declarative" or "theoretical" knowledge (facts, concepts, theories) and "procedural" or "applied" knowledge (steps in intellectual or psychomotive procedures (Howard, 1987). Poorly designed courses which fail to take these distinct types of knowledge into account often fail to achieve their objectives, especially those of developing procedural knowledge. This is because procedures, whether of complex problem-solving such as experimental design, diagnosis, decision-making, or consultation or psychomotive clinical procedures are rarely learned by passive listening (Ross, 1980).

Effective procedural knowledge learning results from a series of instructional steps. The effective teacher of procedural knowledge begins with an explicit modelling of the procedure accompanied by a verbal description of the modelled procedures. This is followed by guided practice with constructive, timely and interactive feedback on

performance, followed by independent practice also with utilisable feedback on performance (Ross, 1980). A more elaborate model also includes the attention to the establishment of a theoretical knowledge base for the discussion including definitions of terms used to describe the procedure and its sub-routines such as "decision-making", "correlational stands" or "consultation", "hypothesis development" or "problem definition".

In contrast students' achievement of new concepts or the integration of concepts into more elegant theoretical explanations requires the use of instructional strategies of a different nature. Here we begin by promoting awareness of existing conceptions, and challenging those conceptions to produce an expanded knowledge, and finally integrating this conception into the student's larger theoretical knowledge (White, 1985).

The purpose of this paper is to use these basic ideas from curriculum analysis to describe a decision process about which emergent technologies to use. Then the "How best should I teach this?" question becomes the starting point for an evaluation of the effectiveness of the procedures chosen. Parenthetically, the paper illustrates in skeletal form the procedures for curriculum analysis described by Robinson et al. (1985).

The decision-making procedures are illustrated diagrammatically in matrix form. When an instructor is asking about an emergent, the first question for the design assistant is "What are the kinds of objectives to learning?" Is the instructor merely seeking to introduce variety into the method of presentation of factual material, or to make such material accessible to individual students out of class time? Or are there objectives for more complex learning such as concept development or growth in the ability to solve problems; design experiments or diagnose ailments. The latter abilities are examples of "complex intellectual skills" or "inquiry skills" (Robinson et al, 1985) and as such require skills learning. Concepts, on the other hand, develop best through interaction between students and instructor (White, 1985).

Figure 1, summarizes basic effective procedures for teaching students how to undertake complex (or simple) inquiries.

Figure 1: Inquiry Skills Teaching

• Modelling with description	Instructor
• Student practice with description	Student instructor
• Student practice with description	Student
• Student competence	Student

White encapsulates the results of his action research on those teaching procedures as "Instructor say, instructor do. Instructor say, student do. Student say, student do. Instructor get lost." (1983). Most instructors in higher education when they reflect on concept development where it is done well would elicit at least the basic steps outlined in Figure 2.

Figure 2: Interactive Concept Growth

```
Course Entry                                   Inadequacy
  Concept       ---------------------->        Challenge
 (Student)                                    (Instructor)

     |                                          |  |
     |                                          |  |
(next course)                                   Growth
     |                                          |  |
     |                                          |  |

 Adequate                                      Modified
(Expanded-      <----------------------         Concept
 Focussed)                                      Student
 Concept
```

White has elaborated this to the point where any professor working in philosophy of language would recognise his or her standard teaching procedures (1985), but the simpler diagram will serve our purposes.

Taking the inquiry skills, Figure 3 suggests a method the instructor might use to consider the characteristics of teaching required at each phase of teaching, from introduction of a procedure to its evaluation.

Figure 3: Identity Characteristics of Available Modes/Technologies for Instruction

	Professor/ Large Class	Small Class/ Lab	Film/Video	Other
Interactions/ Questions	MOD	HIGH	?	
Feedback				
Hand-on				
Practice				
Repetition				
Consistency				
Cost:Time Money				
Equipment Availability				
Instructor's Confidence or Ability to use				

These requirements are then matched to available modes of instruction such as classroom, small group or laboratory, programmed learning. Figure 4 illustrates this.

Figure 4: Identify Criteria for Phases of Instruction (e.g., Inquiry Skills)

Criteria-Needed for:	Modelling/ Describing Procedure	Guided Performance	Practice	Evaluation
	----------Phase----------			
Interaction/ Questions	MOD	MOD	LOW	NONE
Feedback to Student	NONE	HIGH	MOD	MOD
Hands-on Practice Accessibility?	?			
Simulation Practice				
Repetition				
Consistency of Instruction	HIGH	HIGH	MOD	?
Etc.				

When the faculty member has considered these requirements and available modes of instruction, the decision to use a specific technology is easy. Furthermore, attention has been given to basic notions of effective instruction, thus avoiding the pitfall of using alternative technologies to replicate ineffective instruction. As well, the creative use of individual technologies and conjoint use of various methods are stimulated. Similar steps can be taken for instruction aimed at developing or integrating students' concepts. Such approaches are possible when technological support staff are knowledgeable about empirical research about effective instruction in various contexts.

As to the affective objectives, the use of the most appropriate methods serves to motivate students in two ways. The more obvious motivation of novelty may be the less important. As educators we are becoming more and more aware that our students are partly motivated to learn or at least not put off learning, when they see that they are becoming more skilled or knowledgeable in the subject of study. So attention to providing better instruction in cognitive learning, paradoxically can produce gains in the affective domain (e.g., Nash, 1976;

Augustine, 1978). Students gain confidence in themselves as learners and a liking (or at least reduction of disliking) for the discipline as they become aware of their own competence at learning.

In conclusion, this outline is not intended to be prescriptive but merely illustrative of one potentially useful procedure for answering the question "which objectives, which technologies?". Its purpose was simply to suggest that faculty and technology support staff use a dual perspective when considering the use of emergent technologies. One perspective derives from knowledge about the capability of the technology. The second comes from a consideration of educational research into effective instruction anchored in metacognitive theory. Potentially the integration of the two perspectives can enhance the quality of instruction in both the specific course and subsequent course development by the faculty member. So our initial question expands the term "technology" to add the technologies or procedures of educational design. Empirical data about how best to teach for different objectives are used as the bases for the decision "What methods and emergent technologies should I use to promote student learning?"

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LIBRARY INSTRUCTIONAL MODULE

ABSTRACT:

The University of Guelph Library's computer-assisted instructional package employs the VITAL (Versatile Interactive Teaching and Learning) software package. The Library modules form a generic, inter-disciplinary package designed to meet the needs of a wide variety of academic library users. The six basic modules offered range from the novice level ("Library Hours", "Library News", "Guide to the Building", "Borrowers and Borrowing") to the level of more sophisticated library users (interactional modules on the "Online Catalogue" and "Library Research").

Keywords: LIBRARY INSTRUCTION - CAI,
LIBRARY ORIENTATION - CAI,
VITAL

PLANNING:

In January, 1986, under the direction of the library's "Orientation and Bibliographic Instruction Committee", a task force was formed within the University of Guelph Library, to create an instructional/orientation package using the VITAL (Versatile Interactive Teaching and Learning) system. VITAL software was developed by Tayson Information Technology in conjunction with the "Instructional Technology Support Group" under the Office for Educational Practice at the University of Guelph. A detailed description of VITAL is included in these Proceedings.

The VITAL task force was made up of four reader service librarians. Although some knowledge of microcomputers was desirable, task force members were chosen primarily because of their experience in providing reference service in an academic setting, and because of their ongoing participation in the development and provision of a variety of library instructional services. It was hoped that direct involvement of the "purchasers" of the system in its development would both reduce costs and result in a better final product. Unlike earlier classroom teaching modules developed at Guelph (where graphic artists created screens designed on paper by course instructors), the library project was intended to be carried out by the end-users themselves - planning, design, creation, and revision of the module was performed by library staff, in consultation with the Instructional Technology Support Group. Since they were closely involved both with the development of the system and with the eventual users of the system, library staff were in a unique

position for monitoring and "fine-tuning" the instructional package in a responsive and efficient manner. The success of the library VITAL "test" project has in fact set somewhat of a precedent at Guelph -the Instructional Technology Support Group now routinely trains faculty and teaching assistants in methods of frame creation. The Instructional Technology Support Group itself produces only complex graphics, and concentrates instead on training of and consultation with VITAL user groups in the instructional and visual design of their modules.

The decision to develop a VITAL module for the University of Guelph library was motivated by several concerns. It was intended that a computer-assisted instructional system would enhance and supplement the library's regularly-offered building tours and class instructional sessions. The system could be used to reinforce what students learned in library instruction sessions. Usage of the module could be monitored, and would in turn help the library to develop and refine other orientation programmes. As well, it was hoped that a self-instructional system would offer a minimal level of instruction to library users during "off" hours, when reader service staff are not available to provide personalized instruction. It was thought that such a service would be of especial use to off-campus and continuing education students, and to non-university visitors, who generally cannot come in to the library during regular reader-service hours.

TRAINING:

At two introductory sessions, members of the task force were given basic instruction by Instructional Technology Support Group staff in VITAL sign-on procedures, basic commands, methods of frame creation, and general design principles. After this introduction, the librarians began creating frames. Each librarian devoted approximately fifty to sixty hours to preparing the first phase of the library module.

Initially, the learning process was difficult and slow, as none of the librarians had significant experience in either graphics design or systems technology. During this period, learning centred on the mechanical aspects of the VITAL software. A basic mastery of colour graphics technique was acquired - the effective use of colours, overlays, and text presentation all had to be learned.

Approximately twenty to twenty-five of the total 120 frames which made up the final library modules were created by Instructional Technology Support Group staff. These were incorporated in the library package by the library staff, with minor modifications and some additional text. Some of these frames were simple re-workings of frames created several years

earlier as part of the library's participation in a Telidon test-project during INET field trials. Others of these "created" frames were felt to be essential to the module, but of too complex a design for library staff to attempt creating. Initial costs to the library, then, consisted of a fee for the training sessions, charges for frames created by Universitel staff, and the "hidden" costs of library staff time. Since most of the frame creation was carried out by library staff, however, direct costs were reduced greatly. The major investment on the part of the library was that of purchasing the equipment needed to run the VITAL system. The module runs on a stand-alone system comprised of a PC (with a twenty megabyte hard disk), a colour monitor (with a NORPAK PCD6 colour card), and a TOAD (Teaching on a Disk) disk.

Once trained, the librarians were able to continue frame creation independently, while maintaining informal contact with Instructional Technology Support Group staff, who now acted as resource persons: giving advice about the aesthetic and pedagogical qualities of the module, as well as on hardware and software matters.

IMPLEMENTATION:

In operation, VITAL has proved to be a flexible system, adaptable to a wide range of instructional applications. One of its most useful features is the self-test instructional module, in which the instructor creates graphics frames and assigns questions related to the illustrations or to the subject matter.

Students answer these questions on the computer, and are instantly told whether their answer is correct or not. At the end of the session, they receive a score. In a library setting, the "score" is not reported to the user - this feature is obviously of more utility (and more acceptable) in a classroom setting than in a public service context. Library users are encouraged, but not required, to apply newly-learned informational skills. Unlike the typical classroom module, the library version of VITAL makes less use of self-test frames, and more use of "reference"frames which display fixed, assigned information. These frames are assembled in a logical, tree-structured sequence; the user selects from the main index and follows on-screen instructions to view information, which is usually a combination of text and graphics.

The library modules form a generic, inter-disciplinary package designed to serve all types of library users. There are four information modules and two interactive modules, one of which includes a question/answer segment. The four informational or reference modules provide such basic facts as library hours, floor maps, subject browsing, and borrowing regulations. This

information complements other types of information sources in the library; for example, subject information sheets, wall maps, guided tours, and an audio-cassette tour of the library. There are cross-references in VITAL to these other sources; VITAL is in turn "advertised" during library tours.

On individual module frames, information is presented in poster format, with essential elements highlighted, and textual details reduced to a minimum. In the planning stages, the text and illustrations were worked out on standardized "Entry Record" sheets, which provided a grid for designing graphics, and spaces for recording routing and keyword specifications. A flow chart was then drawn to determine routing and sequencing of frames. Experience proved the importance of well-planned routing, since it allows users to browse through the information package with ease, and to find quickly and directly the information they are seeking. When possible, users are always given the option of returning to a previous page, to the next page, to the main menu, or of exiting from the system completely. As it stands now, the system is self-explanatory and runs without personalized assistance. Minimal operating instructions are posted beside the terminal.

After being designed on paper,frames were created using VITAL software, stored temporarily as DOS files, then uploaded into the public library module. Frames can be easily updated, changed, or deleted using VITAL software.

CONTENTS:

In May, 1986, the VITAL equipment was set up for public use on the main floor of the library, next to the main Information Desk. During the first phase, 1986-87, the following menu choices were available:

1 LIBRARY HOURS

2 LIBRARY NEWS

3 GUIDE TO THE BUILDING

4 ONLINE CATALOGUE

5 BORROWERS/BORROWING

6 LIBRARY RESEARCH

LIBRARY HOURS and LIBRARY NEWS are simple informational modules which are frequently changed and updated as library hours,

orientation tours, and special events alter. GUIDE TO THE BUILDING is the largest module. Using floor maps, this package outlines the physical layout of the library buildings, and describes a variety of library services. The ONLINE CATALOGUE segment summarizes the main features and capabilities of the library's online catalogue and circulation system, and includes a short quiz tailored to the use of these resources. BORROWERS/BORROWING offers a brief description of the library's borrowing and inter-library services. LIBRARY RESEARCH explains how to use abstracts, indexes, and the library's catalogues to find information in books and journals.

PUBLIC USE:

The opening screen of the library version of VITAL is a picture of the Library building, with an on-screen invitation to "Press Return" to begin. Whenever there is no interaction on the system for three minutes, VITAL automatically returns to this opening page. This "billboarding" attracts the attention of passersby, so that the system is self-advertising. The library Vital system is available to <u>any</u> library user, and runs during all hours the library is open. No password is required to enter the system. However, the Library Instructional Module has also been made available at several locations throughout the campus via the University of Guelph's communications link to the VITAL courseware database. Access to the module at the remote terminals requires an individual I.D. number and password, and thus is largely limited to students who use VITAL as part of their coursework, or to demonstrations of VITAL by the Instructional Technology Support Group.

In order to obtain feedback from users, a form labelled "Comments" was placed next to the VITAL library terminal as soon as it was made public. These forms have been collected regularly, and responses from library staff have been posted when appropriate. Comments to date indicate that while some users have found the electronic presentation of information rather elementary and unsophisticated, the general impression has been favourable. Users' opinions seem to be generally based on first impressions, and, for most of them, upon their first encounter with an interactive information system. Initial feedback showed that users were having difficulty logging onto the system, and some difficulty with browsing through the various menu levels. Since the logon procedure has been streamlined, and the routing of menu choices (hidden and public) expanded and simplified, the number of complaints of this type has dropped to a minimum.

FUTURE PLANS:

Introducing a special application of the relatively new videotext technology to an academic library setting has proved to be a challenging task. Some of the initial challenges have been met - library staff are now relatively confident in their abilities to design, create, route, and modify the VITAL screens; improved signage and routing have reduced user frustrations; and modifications to the VITAL software have made creation and manipulation of graphics and text much easier than it was at the beginning of the library project. More importantly, the potential applications for VITAL in a library setting are promising, and largely untapped. The system will continue to be adapted to changes in library policy, procedures, and philosophy of bibliographic instruction. A self-test module is already being planned to aid instruction in the use of the library's new CD-ROM catalogue. Additional modules are also being developed for bibliographic instruction in specific academic subject areas, and for graduate research. Short, subject-relevant library segments may be added as part of VITAL modules being used in specific courses at Guelph. All of these additions to the library's VITAL package will be interactive in nature, so that user interest (and therefore learning) is maximized.

The biggest challenge in developing the Library Instructional Module in its next phase will be to exploit what VITAL does best - sophisticated graphics effects, and a potential for <u>interactive</u> learning. Both of these elements are highly desirable in library instruction, but very difficult to attain through the traditional library instructional modes of signage, paper hand-outs, and large-group tours or lectures. In summary, then, the University of Guelph Library's VITAL project has had a satisfying start, but has also left much room for adaptation and growth. Fortunately, library staff have learned much from their initial involvement in the development of the module, and the VITAL system itself is flexible enough to allow for the necessary growth and change.

June, 1987

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Computer-Assisted Language Learning (CALL) at the University of Guelph

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INTRODUCTION

Language learning has had a long, and not always happy, association with educational technology, including television, language laboratories, film and other media. The source of the problems can be summarized as an imbalance between hardware and software, equipment being acquired before its implications for language learning were thoroughly explored, and before an adequate number of quality programs were available.

Most problems were eventually resolved: while live television did not work, videotape became an indispensable learning tool; language labs centering on automatic progression disappeared in favour of Media Centers for individualized learning.

CALL also went through a very discouraging phase when the only machines available were main frame or minicomputers. Programs written for these machines tended to emphasize rote learning and were soon discredited. The arrival of the micro computer, with its capacities for individual, easy access, colour/graphics capabilities and foreign character founts, changed the situation dramatically. The micro became one more efficient tool to support the language learning process and to provide a range of activities suited to different learning situations and differing learning problems.

Currently, CALL programs are of six main types: individual drill/tutorial practice and/or remedial practice for grammar and vocabulary; games which include text reconstruction and simulations; writing assistance programs; grammar learning programs; and a wide range of template programs (mini-authoring systems)which allow non-specialists to custom design discrete lessons in areas such as reading comprehension, dictation and vocabulary building reflecting very specific local needs (Paramskas 1986a).

In the research stages are natural language interactive programs using parsers and voice-recognition, interfaced with video discs which will in effect simulate real-life communicative activity in the second language.

The University of Guelph has been a participant in the development of several current programs for French as well as English, Spanish, German, Italian and Latin: CLEF, a complete drill/tutorial courseware package for basic French grammar; the templates PROMPT (for reading comprehension), DICTATE (for dictation) and LISTEN (for aural comprehension), each of which functions for several European languages. An original Guelph project, GRAMMA, a parser for natural language input for French, is in the research stage.

These projects and programs, all written for IBM and compatibles, are described in detail in the following sections.
CLEF (Computer-assisted Learning Exercises for French)

CLEF is a courseware package for remedial/tutorial practice at the beginning-intermediate level of French as a second language. It is designed to function as an interactive electronic workbook, replacing the traditional print media workbook, and consists of 62 lessons covering basic French grammar (see Appendix A). Each lesson is made up of 1) a grammar explanation; 2) vocabulary drill for words used in the exercises which might not be transparent to a typical Canadian anglophone; and 3) a set of 3-5 exercises. Colour and graphics are used for pedagogical purposes; exercise types range from fill-in-the-blanks, through simulations and text reconstruction.

One of the principal design objectives of CLEF was the production of a sophisticated, universal language learning program, since learning populations and their instructors in Canada often differ widely in their skills, approaches and training. A collaborative approach to design was the solution(Holmes, Mydlarski and Paramskas 1982): CLEF was written by a team of instructors and programmers at three universities and one school board: the universities of Guelph, Calgary and Western Ontario and the London (Ontario) Board of Education. Reviewers have commented on the result (Russell 1985): software which is as portable as possible in pedagogical terms, i.e., independent of specific course organisation and specific textbooks.

CLEF Grammar explanations are stated in "classical" or neutral terms; no particular teaching approach is favoured. Since each lesson drills one discrete grammar point, instructors are able to shuffle the order of the lessons to suit whatever text or method they are using. CLEF is textbook independent: the vocabulary relies on cognates and a selection of the most frequently used words. When other kinds of words occur, they are first presented in the introductory vocabulary drill. As a fail-safe, and to

deal with a user population other than the target one, there is a dictionary function within each exercise. Users may at any point type "?", plus the word they do not understand. The translation appears at the bottom of the screen. All comments to students are given in French, although instructions are in English for the first 20 lessons and in French thereafter, and the optional grammar explanations remain in English throughout.

The program is menu-driven and designed to be completely user-friendly especially for those who are completely unfamiliar with computers. Two-finger typing skill is adequate for use; one may move from any one section of the lesson to any other by using the "quit" function (one keystroke).

Computer responses to user errors are a key factor in any pedagogical software. The program must be able to anticipate common errors and give clues specifically designed to help users overcome that particular error. CLEF avoids as much as possible catchall responses ("Wrong try again") where the input is significative.

Errors have been classified into three categories: flubs, non-significant errors and significant errors (Paramskas 1983). Flubs are the result of spastic fingers - extra spaces, trailing spaces, lack of spaces, and odd capitals. These are disregarded if the answer is correct, and are automatically rewritten. Non-significant errors include single missing letters, doubled letters and single extra letters. The response to these is "There is(are) extra letter(s)", "There is(are) letter(s) missing" or, simply, "A typing error?" Users are allowed two tries for each question, but non-significant errors are not counted.

Significant errors are those which touch upon the grammar point being drilled (i.e., verb endings, adjective agreements, etc.) In this case, a long list of anticipated common errors has been foreseen, and when such an error occurs, it triggers an appropriate message, i.e., "Attention, the subject is plural, not singular"; "The ending is right but the stem is wrong" etc. Non-significative input (zero or garbage input) receives the only catchall comment in the program: "Sorry, not correct, try again". If the correct answer is not produced on the second try, it is given to the user, and the next question presented. Any non-answered questions reoccur in a "revision" at the end of the exercise.

Messages for correct answers are varied, random and two-tiered, ranging from Gallic excess for a correct answer at first try ("Fantastique!" "Chapeau!") to a subdued "OK" or "C'est ça" on the second try.

Whenever possible, alternate answers are accepted as correct.

For example, in a lesson on time, 6:15 may be acceptably given as "six heures et quart; six heures quinze; dix-huit heures et quart; dix-huit heures quinze".

Learner motivation is an extremely important factor in successful language acquisition. Motivation generally decreases where the learner perceives him/herself as caught up in an inflexible system whose pace and feedback are determined by a "machine"(Gagné 1977). The pattern drills derived from the global-structuralist learning theories are good examples of demotivating, mechanical formulas. Motivation generally increases where the students see themselves in control of learning and have choices in pacing and access (Paramskas, Error correction Alberta). CLEF is designed to reinforce high motivation both by giving control of pace to the learner and through a series of options.

Student control of pacing takes two forms: access control and progression control. Access control simply means that exercises may be chosen from the menu listing in any order, may be repeated or skipped, and the user may exit exercises at any point and be returned to the main menu.

Progression control is a more complex issue. Early CAI materials often relied on an internal timer to guide learners: so many seconds for viewing this screen, so many seconds to arrive at the right answers, automatic branching if time was not respected. It was felt that speed of acquisition was a factor in learning language and deviation from a standard rate, regardless of the ability to produce right answers, indicated some sort of failure. Under the influence of newer theories called "communicative", practice materials became more learner centered (Paramskas and Thomas 1986). The CLEF system rarely uses a timer, but rather depends on a carriage return for progression. In effect, this means that the fast learner and the slow learner may each go at his/her own speed, without feeling penalized, rushed or bored.

In addition, a series of options were developed to reinforce user ability to organize pacing and access to materials individually. These include the translation and quit options mentioned above. Within each exercise, users may also recall a summary of the

grammar in point form without having to leave the exercise and access the more complete introductory grammar explanation.

CLEF has met all of its proposed learning objectives. However, there is one drawback: the system is rigid, as any printed textbook can also be called rigid. Unless instructors are programmers or have access to experts, they cannot change any item or insert materials of their own; and even if programmers were available, the amount of time needed to program and debug would be prohibitive. In addition, all instructors know that no system ever completely meets their needs unless they themselves have designed it. As a result, the universities of Guelph and Calgary went on to write software which allows instructors with no computing knowledge to develop their own materials: PROMPT DICTATE and LISTEN.

PROMPT (Program for Reading cOMPrehension - Teacher controlled)

In this Guelph/Calgary project, it was decided to focus on a basic skill which has been widely neglected in second language study: reading comprehension. Students have traditionally acquired this skill on their own, plodding through texts with the help of a dictionary. If their comprehension level was checked at all, it was done through post-tests, by which time it was too late to correct misinterpretations resulting from comprehension difficulties or misuse of dictionaries. In addition, current trends in second language teaching emphasize oral communication and pour most resources into this area, to the detriment of reading skills. Yet without solid reading skills, no student outside an immersion situation can hope to acquire vocabulary and structures beyond a survival level. Educational theorists and teachers see the need for individual, supervised practice so as to build up reading skills (Mydlarski 1987).

While communicative methodologies perceive comprehension as the very foundation of second language learning, time is simply not available for such a tutorial approach. One of the pedagogical "ideals" is to have access to individualized materials reflecting differing learner capabilities and interests, and/or particular approaches favoured by each instructor. In cruel reality, the time necessary to create suitable materials is such that most instructors are forced to rely on standardized, commercial materials aimed at a hypothetical "average" learner, and to set exercises in which feedback is also relatively limited, sometimes to just "right" or "wrong". With a template system, however, a teacher could select any written materials at a variety of registers, quickly type in his/her questions and comments, and stockpile them in the computer. The exercises would be easy to edit, thereby ensuring a longer life (Paramskas and Mydlarski 1984).

PROMPT consists of two dimensions: (1) a program of prompts directed to teachers who merely need to type in their material in natural language, and (2) an interpreter program which uses the material entered and displays it for student use.

PROMPT includes a number of generally accepted features to guide CALL authors: control of speed of progression, choice of target language (French, Italian, Spanish, English, German and Latin), choice of instructional strategy, capability to try out a lesson just created, additional instructions for naive authors, control of some of the options available to the student, capability to edit any part of the program, and the capability to skip ahead or to exit from the program.

The student side of the system includes student control options (such as control of speed of progression, ability to move forward or back or to exit, help features which access the dictionary or additional instructions) and a high degree of interaction with the help of graded hints in the form of a dialogue which directs learners towards the answer. This dialogue becomes an integral part of the learning process as students discover and practice the structure and lexicon of the target language through reading.

Two kinds of exercises are included in the PROMPT format. The first is a passage of text followed by comprehension questions of the multiple-choice type. A series of menu-driven programs enables the teacher/author to enter the passage of text along with questions, multiple-choice answers, and comments on each choice. The author may also enter definitions and/or translations of words into the program's dictionary. All routines for display, options and error mark-up are embedded in the new exercise automatically while it is being created. It is intended that the multiple-choice answers contain a "best" rather than simply a "right" answer in order to encourage the use of precise language. All of the choices may be more or less acceptable but if a student chooses an imprecise answer, the program initiates a dialogue to lead the learner to a more nuanced response.

The second format is a variation of the cloze exercise. The student must reconstitute a passage in which certain key words have been omitted. The teacher/author enters the passage using markers to flag the words that are to be omitted, and may also provide clues, alternate answers, roots (where appropriate) and special prompts for anticipated wrong answers. As students respond to the exercise, the program automatically checks for spelling errors as well as morphological errors such as wrong verb endings, and displays a suitable comment. As in the multiple-choice format, the author may also include entries in

the program's dictionary (up to 50 entries for each exercise, which has a maximum length of 4 screen pages).

An editing feature in PROMPT enables teachers to change any part of the exercise in seconds and to test the new lesson. In some cases, PROMPT displays menus which guide the author quickly to the exact place to be changed or updated. When the exercises are ready for student use, a lesson assembler program transfers selected exercises to a student diskette. Since the content is supplied by the teacher, PROMPT lessons are suitable for a wide range of students, from junior to post-secondary.

DICTATE

While current language learning approaches emphasize the oral aspects of the second language, software to support oral/aural learning is almost non-existent. Voice recognition and production software does exist, but its quality is such that no second language teacher would accept the models produced. Technology will eventually solve this problem also. In the meantime, and using relatively unsophisticated materials, some support exercises for aural skills can be designed.

Dictation is a venerable, if not positively ancient, technique for sharpening the ear to the sound patterns of the target language, and learning the coding necessary to express those sound patterns in writing. It is, however, an extremely labour consuming exercise on the part of the teacher who wishes to exploit all of the pedagogical possibilities of dictation: each student production must be checked carefully; ideally, specific comments should be attached to each error; and the results handed back to the learner while his/her memory of the exercise is fresh. It can be easily understood that most instructors either avoid the entire situation or resort to such less-than-ideal feedback procedures as student auto-correction or mutual correction. Even when the feedback is done by the instructor, comments on specific errors are rarely given.

In the template called DICTATE, another Guelph/Calgary project, simple technology is used to facilitate and perhaps even improve the traditional dictation exercise. The text is supplied by an audio device, such as an unattached cassette recorder, controlled manually by the student who, these days, has no difficulty in manipulating this type of machine. The student is told to listen to the first sentence on the tape and to type it in a box on the screen, called the work area. The student can edit the sentence and, when satisfied, press the enter key to have the sentence checked. The program highlights all errors which the student may then correct. Otherwise, help in the form of a clue (the next letter in the word being processed, for example) or the on-line glossary may be requested. Once the sentence is correct, it is

moved to the top of the screen and the work area is cleared to enable the student to continue the exercise with the next sentence (Mydlarski and Paramskas 1985).

In contrast to the procedure commonly used in pencil and paper dictation where correction comes after the dictation, error mark-up in DICTATE proceeds one sentence at a time. This offers several advantages. A lengthy dictation would require considerable typing and could become boring or discouraging for the student, particularly if the whole screen is lit up with errors (the electronic equivalent of the "bleeding" page). Moreover, sentence by sentence correction offers the possibility that a student might learn from a mistake in one sentence and avoid making the same error later on, if the word were to recur. It was also felt that, because a student cannot advance in the exercise until the current sentence is rendered correctly, a series of small successes, unlike the red ink effect, would maintain self-image and provide motivation to continue (Mydlarski 1987).

The authoring system for DICTATE operates much like PROMPT with regard to text and dictionary entry. Authors may choose an existing passage or create their own. As source material, teachers may select any audio tape or any written text to record on tape. Once the material is ready, it is entered into the template as on a typewriter; teachers/authors have only to provide a glossary and the predictable errors, with a comment attached to each error. If teachers/authors choose not to supply any anticipated errors with appropriate comments, the program will automatically proceed to check the spelling. DICTATE uses a combination of pattern mark-up and error anticipation. The mark-up pinpoints the location of the problem by highlighting incorrect characters. Dashes are inserted for each missing letter. The system adjusts for non-significant punctuation and capitalization. Unwanted spaces are ignored. If further analysis is desired, students request a clue. Clues are verbal explanations provided by either the system or the author. Other features of the authoring system are similar of those of PROMPT, described above.

LISTEN is a third Guelph/Calgary project whose aim is to foster content-based aural comprehension, by using a combination of the techniques of PROMPT and DICTATE. The text to be understood resides on an audio cassette tape or a video tape, with the monitor sitting next to the computer. Either oral or written questions are given to the student, who answers in writing using either a multiple choice format, or a fill-in-the-blanks format. As in the previous two templates, exercise design is very simple for the teacher, and feedback to the student is immediate and specific. The above mentioned options are also available: a dictionary, a glossary, clues. One of the clues would allow students to identify an unknown word by citing the nearest

previous one that he/she understands, and setting parameters to print the following words until the unknown one is reached, at which point the dictionary may be consulted if necessary.
GRAMMA (Grammanalyseur/Grammanalyser)

Most CALL software consists of a set environment which the student must manipulate; there is relatively little place for free input. Any natural language (free composition) production can presently be evaluated only by an instructor, who must provide feedback on several quite different levels: orthography, morphemic and syntactic errors, style, coherence, originality. In second language learning, this procedure usually results in a paper covered with ominous notations in dangerous looking red ink, in a student who may become paralyzed by the dimensions of the disaster, and in an instructor who feels very frustrated at having to correct basic errors, and to spend a great deal of valuable time doing it. If a program could be designed to use a computer as an expert system, a pre-filter, a sort of grammatical tutor which the student would consult before handing in the composition, the instructor could spend quality time on evaluating those elements of written production which deal with substance and ideas: style, coherence, originality.

For a computer to become a grammatical tutor, however, it must be taught to "understand" at least some parts of a natural language. A computer can do this by means of a programming technique called parsing, which states syntactical rules for analyzing input, along with variegated semantic networks which permit some sorting out of ambiguities.

A "parser" can thus be defined in its simplest terms as a computer program which can decipher natural language input to a greater or lesser degree. The different types of parsers are usually grouped according to function: artificial intelligence research (Feigenbaum and Barr 1982); machine translation (Melby 1984); automatic textual analysis for literary concordances (Lancashire 1986); games such as ZORK or ELIZA (Kossuth 1985, Underwood 1984); first or second language learning (Paramskas 1986b). The latter group is generally referred to as "pedagogical parsers" and is further subdivided into two types: programs which assist student writing (organisation of ideas, sentence length, subordinate clause excess, repetition of flagged words such as "thing"), and programs which judge student writing (feedback on misuse of morphology, grammar; some semantic judging).

The design, as well as the capabilities, of parsers vary widely. There is no parser program yet available that "understands" natural language both syntactically and semantically. No one, to this author's knowledge, has as yet managed to write a parser that can handle 100% of free input. Machine translation programs such as the one used for translation of weather data from French

to English and vice versa by the Canadian Federal government manage up to 80% accuracy in a very restricted semantic field; the other 20% must be taken care of by humans. An analytical parser such as DEREDEC (Plante 1986) can generate deep structures very accurately, provided that the user first does an initial superficial level tag of each word, and provided the sentence is a standard one. Generative parsers such as ILIAD (Bates 1981) which have a resident semantic network, can produce fairly complex sentences that are semantically correct, but the student can only manipulate the sentences generated, not initiate them. The prototype of pedagogical parsers, Writer's Workbench (Raye 1983) is in fact limited to applying readability indexes, flagging discrete words such as "thing", counting syntactical and semantic reoccurrences and judging according to a pre-set formula what constitutes "good" style. The only syntactical deviance it can spot is the split infinitive. For years, IBM has been working on a pedagogical parser whose initial objective was complete analysis of complex natural language input with critical comments on both style and content. It began as EPISTLE, then transformed itself into CRITIQUE (Jensen et al 1986). It has yet to appear on the market.

The main source of the difficulties specific to the design of pedagogical parsers is the attempt to deal with syntax and semantics simultaneously. One may hope that in the future a complete parser will be developed, but for the present a more modest approach might produce practical results.

Guelph's GRAMMA project seeks to develop a pedagogical parser limited to the analysis of the syntax produced by students of French as a second language. Its aim is to signal to the user basic syntactical deviances, allowing the writer to eliminate most of the typical errors produced during a second-language composition. Correction is not automatic: errors are flagged and it is up to the writer to correct. No semantic judgement is made: the writer could produce a Joycean, surrealist or nonsense text and GRAMMA would accept it as long as the structures are acceptable.

In dealing with a language such as French, which has great morphological redundancy in its written form, it was most practical to divide graphemes into two groups: closed and open. Closed categories are those made up of a relatively small number of discrete items. Determiners, for example, consist of a short list of items which can be stored in memory; the same can be said of prepositions and pronouns. Other categories are to a greater or lesser degree "open" - that is, capable of containing an excessively large number of discrete items - the noun, the descriptive adjective, much of the category of "verb". There is, for example, no feasible way of listing all the possibilities of "noun", so that the program looks for a "default" system which sets up probabilities (Paramskas 1987).

Having received a partial definition of graphemes in the form of lists, the parser program first scans a sentence and tags each item (defined as any series of letters preceded and followed by a space or punctuation) according to the closed categories known.

For non-identified items, a set of probability rules are applied: sequences in which the open categories co-occur with closed categories. For example, an adverb (the most common of which can be listed) can be defined as anything ending in -ment that is not preceded by a determiner. In a given sentence under analysis, there are a number of unknowns labeled X left over from a first scan. Probability rules in the form of if/then statements are applied: if previously tagged item Y occurs in front of unknown item X, X is presumed to be a noun, unless tagged item Z co-occurs. Approximately 20 pages of such statements can cover basic French grammar as a second language learner would tend to use it. One case of unresolved ambiguity for French occurs if a previously identified noun is followed by a descriptive adjective (open category) followed by a positive verb (open category) in the present indicative which is not an auxiliary or semi-auxiliary. The only solution, while not elegant, is to ask the user if the item after the noun is an adjective or a verb (definitions and examples are provided) and proceed with the analysis.

Once items are identified, relationship definition occurs. Relationships are of two types: "links": gender, number, person agreements, for example; and "scenarios": identification of "illegal" sequences and "illegal" links, which constitute the bulk of a learner's errors when writing in this second language.

In the first two passes of analysis, the parser tags each item in the sentence, without reference to links or scenarios. It will therefore accept "je voulait" or "de le garçon" or "Il faut que je va"; once all items are identified, the categories of relationships will be applied, and any resulting discrepancies reported to the user.

The initial version of GRAMMA has been designed and is currently being programmed. It is expected that the final version would develop as a result of a series of field tests, in which original student compositions would be parsed, and where the parsing failed, GRAMMA's rules would be amended.

CONCLUSION

The CALL projects which the University of Guelph has initiated or in which it has collaborated are characterized by a focus on learning needs, as opposed to research in programming techniques. There has been a progression from fairly rigid programs imitating to a certain extent print media models, through the development of tools which allow teachers to control CALL materials, to the concept of a completely interactive student/computer situation in which the learner defines and controls his/her own learning needs and in which the computer becomes an original language learning tool.

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APPENDIX A

CLEF - LESSON CONTENTS

1. The definite article
2. Subject pronouns
3. -er verbs
4. The imperative of -er verbs
5. The interrogative with est-ce que
6. The indefinite article
7. The negative (ne...pas)
8. être
9. -re verbs
10. The agreement of adjectives
11. The position of adjectives
12. -ir verbs
13. avoir
14. Expressions with avoir and être
15. Contractions with à and de
16. The possessive construction
17. Possessive adjectives
18. Numbers 1-100 and dates
19. aller and the futur proche
20. venir
21. Prepositions
22. Stress pronouns
23. faire and expressions with faire
24. The partitive
25. prendre, comprendre, apprendre
26. pouvoir, vouloir
27. The interrogative & demonstrative adjectives
28. Time
29. dire, écrire, lire
30. Interrogative inversion, interrog. adverbs
31. The past indefinite with avoir, and agreement
32. partir, sortir, dormir, sentir, servir
33. The past indefinite with être, and agreement
34. The direct object pronouns
35. savoir, connaître
36. The indirect object pronouns
37. mettre, remettre, permettre, promettre
38. Verbs with prepositions
39. y, en
40. devoir, recevoir
41. Qui est-ce qui/que, qu'est-ce qui/que
42. voir, boire, croire
43. Relative pronouns: qui, que, dont
44. Adverbs
45. Reflexive verbs, and agreement
46. Negatives: jamais, rien personne, etc.
47. conduire, rire, courir
48. The future
49. Verbs with irregular stems (envoyer, etc.)
50. The comparison of adjectives and adverbs
51. The imperfect tense
52. venir de; depuis + present/imperfect
53. souffrir, ouvrir, offrir, couvrir
54. The conditional
55. naître, mourir
56. The demonstrative pronouns
57. The present subjunctive: form
58. The present subjunctive: uses
59. Impersonal expressions (falloir, valoir etc.)
60. The pluperfect and the past conditional
61. faire causatif
62. The passive voice

COMPUTER LITERACY: A PRACTICAL APPROACH

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In the fall of 1986, sixty-three students enrolled in English 251, a mandatory course in literary criticism, at the University of Waterloo. These students were enrolled in the Co-op program, a successful program which integrates practical work experience with academic studies. As usual, the students were informed of the requirements for the course - a minimum of three essays of 1500 to 2000 words on various literary works. However, these essays were to be written and submitted electronically, using the University's IBM mainframe computer, and would be marked and returned to students in the same way.

The decision to use a computer system in the course was based on a number of factors. The University certainly had facilities to accommodate the approach, as it provides extensive computer resources on a twenty-four hour basis to all students, as well as training and support for arts students in particular. Many resources, such as writing tools and on-line mail and messaging, were available only through the computer. Also, most of these students would soon discover that their work experience required the intelligent use of computers, and the requirement of having to use a computer for essential academic work was a valuable learning experience.

The students in the course came from a variety of computer backgrounds. Those who had taken a first year introductory course, ARTS 198, had exposure to all the tools they would be required to use. Many, however, had taken a first year Computer Science course which taught them how to use the Macintosh microcomputer, and others had personal or high school experience with microcomputers as well. This experience was not directly related to the world of the IBM mainframe.

To do their course assignments, students had to be able to log on to the IBM system and use the CMS

operating system, read, send, and respond to electronic mail, use a text editor, print files, and send and receive files. They were also encouraged to learn to use the electronic writing tools provided for their use.

The procedure students followed was to first log on to the system. Any mail which was sent to them, either by other students or by the instructor, marker, or teaching assistant, was immediately listed. They could choose to read the mail or postpone reading it to another time. The mail system offered a "reply" function which made it simple for students to respond immediately to mail messages. Students could keep their mail in a file, which was useful for mail concerning essay topics and class news which they needed to refer to later. They then ran the CMS editor (a number of versions were available) and either began entering an essay or editing an existing one. Once the essay was complete, they used a simple command to send a copy of it to the course account. The command responded with a message when the file had been successfully sent. Terminals and printers were available on-campus twenty-four hours a day, seven days a week.

Regular training sessions provided by the Arts Computing Office were promoted in class, and additional sessions were scheduled to meet the demand. A written document giving some instructions on CMS was distributed to supplement existing documents available to students from the Math and Computer department. Despite these preparations and ample warning of the course's computer requirement, the deadline of the first essay found many students unprepared.

The variety of problems students had with their first essay and, often, in subsequent essays, made some training issues become quite clear. One training concern is whether to concentrate on purely

practical matters or general computer concepts. Much of what beginning users are taught is of the "magic button" variety, where students are simply told what keys to press to get the desired reaction. Concentration is on how to do things, which is a common-sense approach, but often general information about the computer, the operating system, the programs, and the way these components communicate is neglected. As a result, students and are ill-prepared to understand what to do when things go wrong. Students who did not realize that they were running a program called the editor within an operating system called CMS on a terminal which communicated with a central computer in a specific way had no basis for explaining or understanding problems they encountered. Students became physically dependent on one particular type of terminal, or even one particular terminal, because they weren't able to recognize the relationship between the terminals and the computer system. Time was wasted and effort lost because students weren't aware that when they used the editor they were working on a copy of their file, not the original file, so inadvertent changes could be ignored and files recovered. It was clear that a combination of conceptual and practical information was essential.

Another problem was that the Arts Computing Office courses provided general information for a wide range of users. These particular students needed instruction only in what they needed to know how to do to meet the requirements of the course. As a general rule, there is always more than one way to do anything, but for the urgent and immediate need of these students, they required quick instruction in one reliable way to do their work. Sophisticated usage could come later, as the need for it arose.

Confusion arose from the "ask your neighbour" syndrome, where students would turn for aid to

someone else, who was working on a different system or editor or application, and whose instructions would only confuse them more. The potential for disaster was increased by the fact that many students wrote their essays in the early hours of the morning, when no support staff was available to rescue them. A more complete instruction and reference manual was prepared mid-term to try to solve these problems.

An aspect of training which would be valuable to include in future courses of this type is training in the use of the computer as a writing tool. There are many drawbacks and advantages to writing with a computer, and students would have been helped in both their proficiency with using the computer and with essay writing itself by some instruction in this area.

For example, students should have been actively encouraged to print their essays, even though they were not required to hand in a paper copy. Quite simply, it is impossible to proofread accurately on a terminal screen. Individual characters can be difficult to distinguish and the stylistic flow of a paper cannot be determined from viewing a few paragraphs at a time. They should have been warned of the dangers of freely using the fast and easy move, copy, and delete functions of the editor, which often lead to choppy writing. They should have been taught of the many uses of the "search and replace" function. This can be used not only to find errors, but to save on typing time. A student can simply specify a string (such as "WS" for "William Shakespeare") for a long or difficult repeated term, and then replace it throughout the document with one command.

The writing tools provided for student's use were designed to find spelling errors, the use of "to be" verbs, cliches, colloquial expressions, commonly mis-used words, and transition verbs. Few, if any,

students actually used these, and it was clear that simply documenting their existence was not enough to ensure their use.

For the marking of essays, the use of the computer solved a great many problems and made organization of work simple. The procedure the marker followed was to log on to the system, respond to any mail from students, and check the "reader" (a sort of electronic in-basket) for essays submitted. Essays were consistent in appearance, so all could be considered equally, without advantage to those students with access to devices to present their essays more attractively. No time had to be wasted puzzling over handwriting, by either party - essays and marking comments were both completely legible.

Essays were marked using the same editing program the students used to write them. Comments were inserted, in solid capital letters, beneath the line they referred to. Standard abbreviations (such as "SP" for spelling mistakes) were used, and a list of these was given to all students. Since the file was being edited, comments could be as long as necessary. The text below the comment them simply moved down to make room for the new material, so comments did not have to be squeezed into margins. Also, comments could be easily edited if the marker re-considered a criticism or question. Overall comments, the mark, and the initials of the marker were always placed on the bottom of the file. When most or all of the essays had been submitted, marked essays were returned to students. This involved re-naming essays so that the name reflected that they were marked and sending them back to the students. Students could then either print or display them to review the comments.

Administratively the use of the computer was very helpful. A utility called "CLASS MAIL" sent

information on deadlines, assignments, and general news to every student in the class. Students had only to log on to keep up to date with their course requirements, placing the responsibility clearly on the student. News and information was announced in class, but students who missed class were assured of keeping up to date on assignments and general news if they simply signed on to the computer. Students were each given an alias as well as their difficult computer user i.d. so that mail could be sent to, for example, "Kevin" rather than "KLKROEKER". It was easy to see how many essays had been submitted, since they were all kept in the course account, and the computer recorded who had submitted them and the time and date of submission. Notes about missing essays were send electronically to students, so that the marker had a record of who had been informed of a late paper. Marked essays were accompanied by a mail message to inform students that essays had been returned and to ask for confirmation that students received them. This was not strictly necessary, but a number of students managed to "lose" their essays in either sending or receiving them, so it was adopted as a safeguard.

The mail system also made it easy for students to communicate with the instructor or marker without a face-to-face confrontation or the difficulty of physically finding the individual.

There are many possibilities for future uses of the computer as a writing and marking tool. For example, instead of using abbreviations such as "SP" in marking comments, a macro could expand the abbreviations into complete comments once the marking is complete. An on-line tutorial about writing problems could be designed, and comments on essays could direct students to the section of the tutorial which deals with the particular problems they have demonstrated in their writing. A

spelling and grammar checker for the marker's use could be designed, which would highlight errors and count them so that the marker would get an idea of how careful the student had been, without having to mark each error. The Computer Aided Learning module on The Rape of the Lock, which provides an on-line version of the text and several layers of detailed information about word definitions could be expanded to include other texts. Students would be able to use the module to help prepare their essay, and copy portions of the text directly in to their essays.

This use of the computer for the writing and marking of students essays and the administration of a course was a successful experiment. It is being repeated with a new group of students in the same course, as it clearly provided many benefits for students and instructors alike.

Laurie Pearce

May 1, 1987

The EOP: Graphics & Teleconferencing

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Abstract

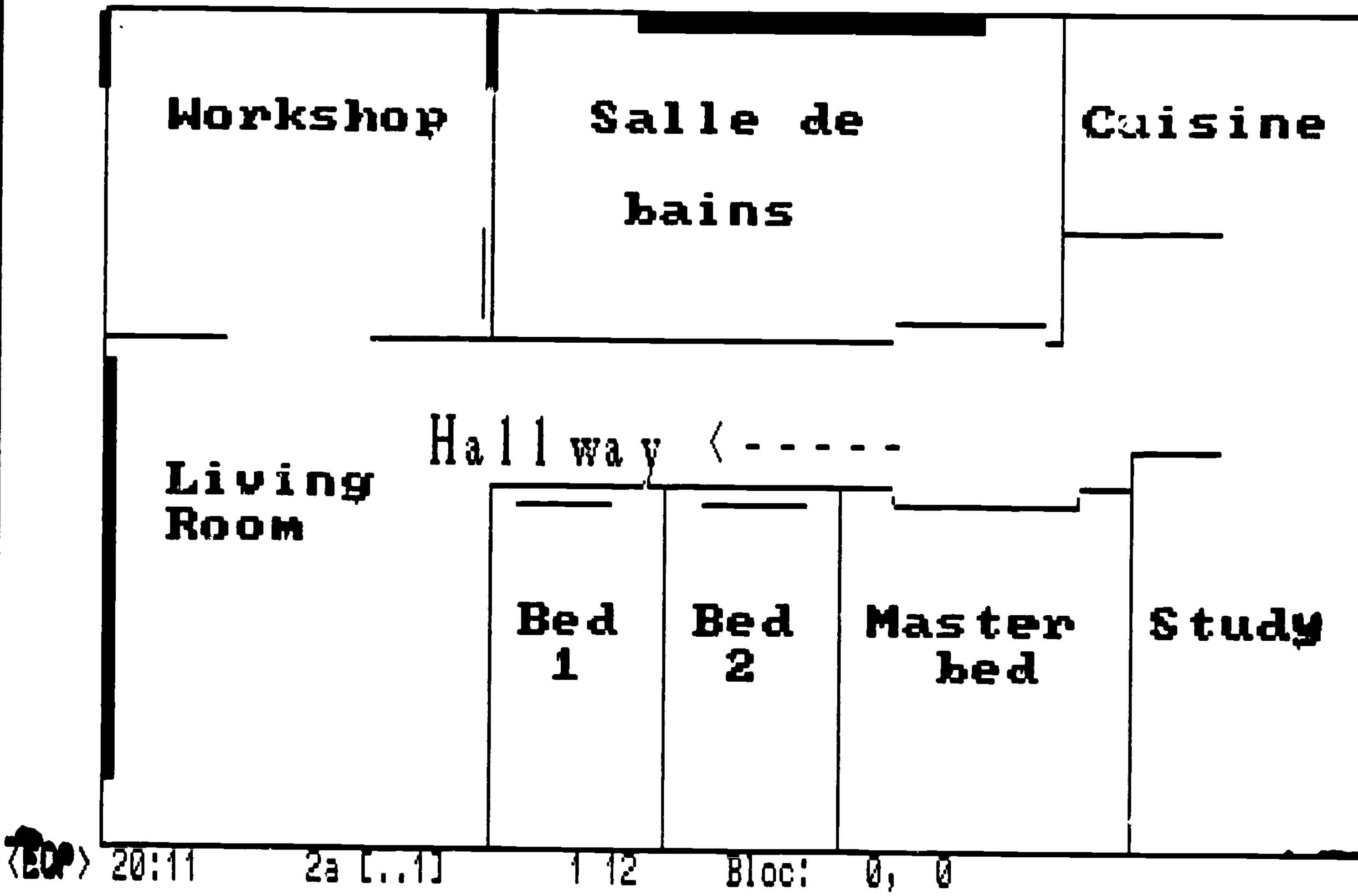
This presentation reports on the availability of the Electronic Overhead Project (EOP) and its application in teleconferencing or tele education. This system allows a professor to create/edit (an electronic equivalent of) slides and present them to an audience. Since the whole system is microcomputer based, it is easy to provide remote modem control of the system thereby providing teleconferencing capabilities, including 2 way pointing and graphics.

0. Introduction

The slide editor can be used to create and edit "computerized slides" which are an ASCII coded representation of the content of a transparency. This content can be text, graphics, or a combination of both and a scenario. Graphics may include bit mapped captured files, video scanners output, video digitizers or standard graphic drawings. The system presented here is a software program providing these functions.

Once a set of "slides" has been created, the program can be switched to the "presentation mode" for presenting the slide show to an audience. A video projector is normally used to replace the computer monitor in order to accommodate large classes or audiences. If a 2 way communication system via modem is installed, teleconferencing becomes available. Furthermore additional sites can be serviced via the use of a phone bridge. The systems provides low cost communication system for teaching to remote sites. Since the whole system is PC based, it uses only off the shelf hardware and software components. Cost savings can be made by using voice/data modems which allow to halve the requirements for long distance phone links. The system has been used successfully in several courses and many conference presentations. Testing is underway for using it with VSAT satellite technology for teaching in remote north Ontario universities. Another project under development will use this technology to link several universities in Europe and Africa to Ottawa University.

The editor status line at the bottom of the screen illustrates the 3 modes of editor operations (fig. 1). The user can switch between these modes at any time for easy text/graphic entry. Another function key suspends editing and allows the user to "show" the presentation, the same key switches back to edit mode for easy modifications or new additions to the slide show.



Workshop
Salle de bains
Cuisine
Living Room
Hallway <-----
Bed 1
Bed 2
Master bed
Study
<ECP> 20:11 2a [..1] 1 12 Bloc: 0, 0

Figure 1

The 3 editor modes are now described. The editor provides the following editing possibilities.

a. Text editor

In this mode, the user has at his/her disposal a traditional text editor, its operations are very similar to Wordstar (TM) or similar editors. Although most standard text editor functions are supported there are some particularities to be found in this text editor since it was designed to edit transparencies as opposed to documents. These particular are now listed.

. Font specification: It is possible to specify (with a function key) one part of many character fonts, and see the text as it will be shown in the presentations. An unlimited number of font is available since the fonts can be created and imported from many commercial font editors.

. Up to 12 line each slide has a maximum of 12 lines (or 6 of only large fonts are used). The line size is also fixed (40 or 20 according to the font used). Since the output is a set of slides, there is no need for document type specifications.

. Insert slide/delete slide commands functionnaly replace the traditional Page oriented commands. Carry over from one page to the next is not available, as it does not make sense while editing slides.

. Bloc commands (copy block, more block etc.) apply to a set of slides defined by its first and last slide, instead as of to a set of characters.

. A duplicate slide command is available for helping the creation of animated slides and animated sequences.

. Timing functions It is possible to associate an estimated time (in minutes) that one wishes to spend on a particular slide. These times can be modified, incremented, decremented at edit time. They allow the presenter software to (gently) guide the presentation as to speed limits and time constraints.

. Merging slide shows is possible in a manner very similar to the concatenation of documents with regular text editors.

. Compatibility with other editors. The same set of keystrokes as in Wordstar^tm, Turbo Pascal^tm or Turbo Prolog^tm editors is available, the user has therefore no need to learn new commands, in fact a complete slide show can be written on a regular text editor such as Wordstar^tm and the resulting document be imported into the EOP editor for presentation. Conversely a "slide show" document can be printed/edited using a text editor such as Wordstar. This presents no problem with text slide but can be cryptic with certain types of graphics.

b. The graphic editor

In this mode, and with the help of a mouse, a graphic table t, or a

keyboard, the user can design and enter simple graphics (rectangular frames or boxes, lines, free hand movements, circles etc.). The operation of the editor in this mode is similar to the one offered in software products such as MacPaint[tm], PC brush[tm], Dr. Halo[tm] etc. Pictures can be superimposed to text. Any available frame grabber can be used to capture graphic output from most commercial packages and incorporate these captured graphics into the show. The capturing process condenses the file in the standard GWrite format providing substantial memory and floppy disk space savings. The sequence of image components can also be saved in order to recreate the image element by element during a presentation. If desired, other paint programs can be used to create images and their output can be imported into a slide show where the picture can be overlayed by text, comments, other pictures etc.

Another method for creating graphic is to define "graphic fonts" (for example icons) with a font editor, and then simply use the text mode to enter the desired drawing. This method requires a sizeable time investment for the design and the creation of the font, but proves to be much more helpful, practical and cheap in memory requirement especially if the whole content of a course will use the new font. For example a course in chemistry will benefit from using specific chemistry oriented icon fonts for its illustrations.

A third method for creating graphics can be found in the presenter software (not the editor) however we will describe it now. At edit time, a user can specify the name of a MS DOS program to be executed from within the slide show at a particular point in the presentation. This program can do anything the user needs at that time and in particular draw graphics, animations, simulations etc. etc. (fig. 2).

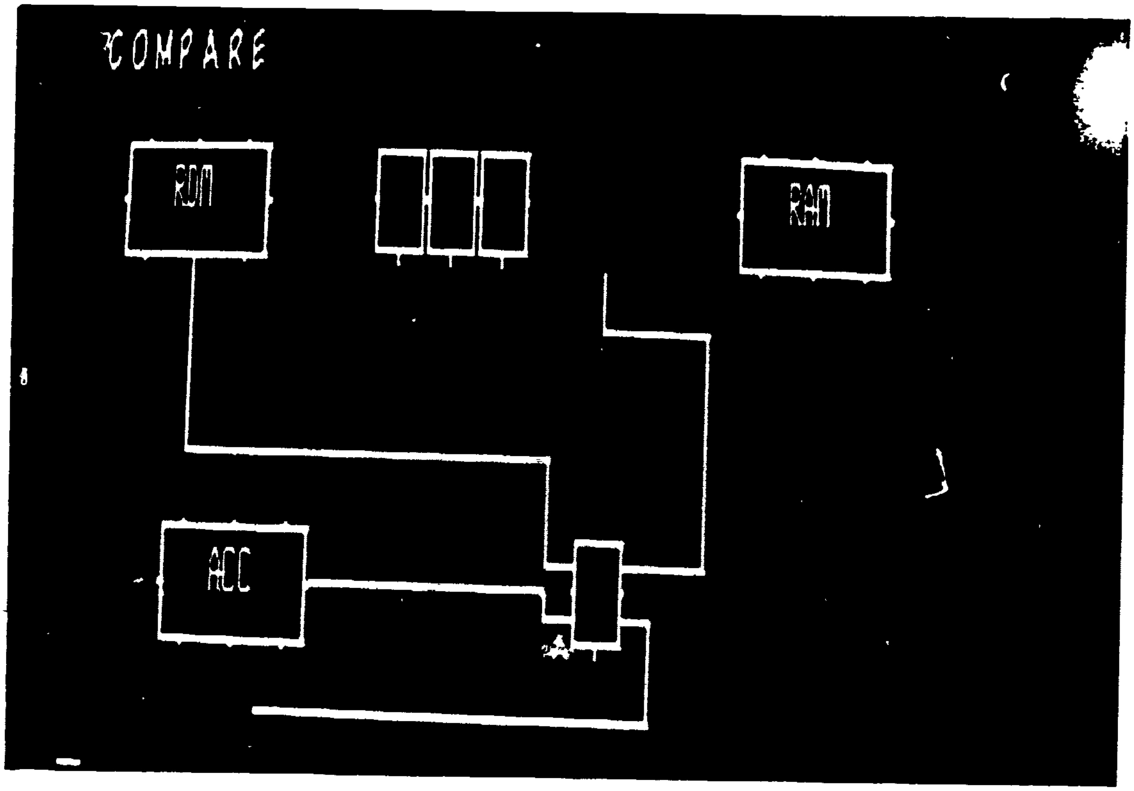


Figure 2

c. The scenario editor

Once the slides content has been decided and entered, the user usually would enter the edit scenario mode. In this mode he/she can specify the various animations and presentation functions available to each part of the slide or slides.

For example a slide (or part of it) can be shown, or hidden, or partially covered, or partially overlayed by another slide, or a line may be animated or blinking. Highlighting functions (frame, underline, blink, italics) can be invoked and its sequence in the show decided. Automatic time control can be specified (or manual control). Some of these functions will be described in following section on the presenter software since they are presentation functions, several dozens of these exist, and the user has probably more functions available than will be required.

Editing a scenario consists in editing 6 parameters for each part of a slide that is to be singled out as a "point".

1. Presentation function: What happens to the "covered point" when the "slide is put on the projector" (i.e. hidden, shown, blinking). A noop function means the point is ignored, while a view function means it is simply shown as is.

2. Explanation function: When the content of a slide has been shown (as per presentation functions) the slide scenario is scanned again point by point and a second command is processed. For example what was hidden can be uncovered, what was shown can be removed, overlaid, highlighted, etc.

3. Font. Which font is used to display this point.

4. Textcolor and background color for color cards and monitors if available.

6. function subparameter. This is used differently by the various functions, for example it may specify a font change, a duration in mn, the number of times an item is to blink etc.

d. Other functions

Once text, graphic and scenario are specified, standard file oriented functions permits the user to save on disk, concatenate shows, save and retrieve blocs of slides, look at directory etc. etc.

2. The presenter

The EOP was designed mainly as a tool to "present" a slide show. In this mode, a slide show is selected from the menu of presentations available and then either automatically or under the teacher's prompting the EOP will present each slide following the associated scenario.

If a presentation is reasonably formal (i.e. conference) the presenter simply presses the "Gotonext point" key on the keyboard or the remote control, and the EOP will follow the scenario as to what to present and how to present it. However at any time the user can choose any presentation

command he/she chooses to adapt to audience reaction, questions, or change of mood. Furthermore the slide sequence can be modified at anytime by using ESC and choosing the new (next) slide. This in effect overides the scenario. A "Oops" command permits to return to a previous slide if more explanation are required as requested by audience feedback.

At anytime during the presentation, the user can use an electronic pointer (a set of cursor controlled icons) with many different shapes, available in order to direct people's attention to particular portions of the slide. This pointer is controlled manually, can be removed, and can be copied onto the slide, in a manner analog to leaving pens, arrows etc. on a regular transparency.

Another manual function available during presentation is the scratch pad. When it is invoked, the screen is erased and a scratch pad is available for typing and displaying any text. If a mouse is used, free hand drawing is also available for sketching. The user returns to the interrupted slide with another keystroke.

During presentation, the built-in timing functions can alert the user of several problems: going too fast relatively to the planned schedule (or too slow), amount of time remaining and spent. Other functions include time-of-day and a stop watch for timing exercises or students.

Some of the most common presentation functions available are:

highlighting: frame, underlying, bold, move (animate) blink, italics

Transition: next slide, goto slide, oops, open window, strike out

animation: draw and hide, switch boards, do an animation, animate a line, switch line, hide line.

primitives: draw, hide, overlay, from top, from bottom, from left, from right.

system: change directory, load graphic, overlay graphic, point, change cursor shape, enter scratch pad mode, clean up overwritten comments, erase board, erase screens change board, stop watch.

Teleconferencing is no different than presenting to a local audience. Since the scenario (or changes to the scenario) processing is echoed to the serial port (with standard error correcting communication protocol), the slide show is exported to a remote PC running the same software.

Conclusion

The EOP was designed for classroom use and has been used often in this mode of operation. However with the single addition of modems the presenter can control more than one PC and thereby can show the course in many different locations. A very small bandwidth is required (300 bauds) since only scenario control has to be transmitted. This turns the system into a very cheap teleconferencing mechanism.

HORTICULTURAL PRODUCTION SYSTEMS PLANNING AND ANALYSIS

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In 1970, two new courses in horticulture were offered. These were named Production Systems (53-036) and Production Analysis (53-404). Any aspect of horticulture was subjected to basic exercises in planning and scheduling the work and materials required to grow horticultural crops or to render services of a horticultural nature. A financial analysis of each assignment was required also.

The original idea for these courses came from a horticulture course taken by the author in which each student planned an expensive and an inexpensive spray program for apple scab. This required the integration of knowledge of spray chemicals, disease characteristics, and growth characteristics of apple trees. Later in teaching a vegetable production course, this idea was expanded upon in a project in which the students prepared a weekly schedule of all the work, listed all the materials and equipment, and calculated the cost of growing a specific vegetable for one year.

Critical Path network methods of planning and scheduling activities and resources form the basis for the present courses. Arrow networks (Latterner, 1967) are convenient for establishing relationships between jobs, but line or bar (Mulvaney, 1969) networks represent the duration of each job to scale within a specific time frame (day or week). The resulting visual presentation (chart) is much easier for managers and workers to comprehend.

Network concepts were taught using slide transparencies. To avoid errors and waiting while students copy diagrams in class, a textbook (Riekels, 1971) containing prints of the diagrams was prepared. Later, in the first revision (Riekels, 1973), a general discussion of networks was added. The third revision (Riekels, 1983) was expanded to include detailed explanations of all diagrams and definitions. In the fourth edition (Riekels, 1984), some original ideas, specific to horticultural crops and services, were added to the basic network concepts.

In the early years of the courses, student assignments consisted of three separate production plans on three different topics plus a fourth assignment which integrated two or more topics to give maximum utilization and balance in scheduling workers and other resources. Three individual topics were reduced to two topics as similiarities were noted. Even later, only one commodity was required, but a second assignment was the incorporation of

alternative methods of producing the same commodity. The object of these single commodity assignments was to isolate the inputs, work, and costs pertaining to only one topic or commodity.

As the years passed, student inputs became more comprehensive gradually raising the standards and the content of the projects. Now, only one major assignment for two or more commodities is done, but the costs are subdivided for each commodity so the student can still learn how to assess individual crops within a more complex situation. The primary objective of the project is to create a plan that has a high probability of success if the work was attempted under real conditions.

Schedules of work, labor, resources, and crop growth for two or more horticultural commodities are shown in a bar chart representing one year of production. Job times (start, finish, and duration) are drawn to scale on the chart, and workers and other resources are listed with each job in a style that allows management personnel to see work alternatives easily and to balance jobs, workers, or other resources accurately and quickly. Employees can determine their work assignments easily also.

In the financial analysis, the total costs for each job are calculated and this forms the basis for cost control in the system. Individual job costs are simply added to determine the operating expenses per commodity or service. Very expensive jobs and job components can be identified easily for later adjustments to reduce the costs of an unprofitable crop or service.

Several years ago, an APL program (43 CPM) on critical path was used to teach network concepts. Unfortunately, this program could not be expanded to include all the work for one year in the production of horticultural commodities.

Recently, a computer spreadsheet (PC-CALC) has been incorporated to do the cost analysis of each production plan. A properly prepared spreadsheet with all formulas completely integrated will allow a manager to analyze any and all expenses at any time. Any anticipated change can be entered and the entire spreadsheet can be completely recalculated to determine the impact of one or more changes on the total cost of the system. Tables 1, 2, and 3 show portions of a spreadsheet for a project on golf course management.

The formulas for calculating the hourly cost of the of all fixed assets are stored in the appropriate cells in column F. The formulas are adjusted to calculate across each row pertaining to a specific piece of equipment, but the spreadsheet displays the results of the calculations in column F, not the formulas. A special spreadsheet command will display the formulas, if desired.

For example, the hourly cost of the tractor (Table 1, Row 22) is calculated by: ((B22-(0.05*B22))/C22/D22+E22+(.15*E22). This formula includes the purchase price (B22), the salvage value calculated at 5% (0.05*B22), the expected life in years (C22), the total number of hours of use per year (D22), the hourly fuel cost (E22), and an hourly maintainence estimate (15% of the fuel cost) (.15*E22). The annual depreciation is computed first, then, divided by the hours of use to get the basic hourly cost of the machine. After this is determined, the cost of fuel and an estimate for maintainence are added to get the complete hourly cost.

The hours of use (D22) are calculated by the formula (P17+P27+P37), which is entered into spreadsheet cell D22. This formula transfers the durations of these jobs which use the tractor, such as "SPRAYING FAIRWAYS" in Figure 2, from the specific job (P37); adds these durations together and puts the sum in cell D22.

To complete the cycle of calculations, the hourly cost to run the tractor is transferred to cells N17, N27, and N37 by entering the formula (F22) into those cells. In this manner, any change to the duration of any job using the tractor will result in the automatic recalculation of a new hourly cost of using the tractor (F22). This new hourly cost is automatically transferred to the appropriate cells in column N and new costs for the jobs are displayed in columns Q and R.

Costs of labor (cells T41 to T45, Table 3) and expendables (cells T6 to T13, Table 3) can be incorporated automatically into various activities in a similar fashion. Three activities in Table 2 utilize greenkeeper 2 at a wage of $9.00 per hour (T44, Table 3). If the formula (T44) is entered into cells N3, N8, and N36, then any change in the wages of greenkeeper 2 will be automatically transferred to these cells after the initial change is made in cell T44 of the spreadsheet.

In Table 2, the formulas in column Q multiply the quantities (column M) of each resource by the rate or price per unit (column N) and by the hours of use (column P). For expendable items, such as fertilizer (lines 24 and 29) and spray chemicals (lines 34 and 39), time is not a factor, so a value of "1" is entered in column P to complete the multiplication correctly. The cost of the tractor to "MOW ROUGHS" in row 17 is calculated by the formula: M17*N17*P17. Column R contains the costs of the jobs. Specifically, the formula in cell R18 is: SUM(Q16:Q18) which simply adds the costs of the resources for mowing roughs.

A manager can scan column R quickly and identify the most expensive jobs which should be analyzed first in order to reduce costs in the system. Then individual components (column Q) of an

activity can be examined and adjusted easily to create a less expensive production plan.

For example, a manager would likely reduce costs of "FERTILIZING" (Table 2, Rows 21 to 29) more by applying less fertilizer (cells M24 and M29) or by negotiating a lower price (cells N24 and N29) than by attempting to speed up the work to reduce the duration of the jobs. However, the labor to "MOW GREENS" (Table 2, cell Q3) is the most expensive component of that job. A manager could attempt to speed up that task by purchasing larger mowers to do the work in less time. As the duration of the job becomes less, the cost per hour of the mowers will increase. The manager can enter new mower prices into the spreadsheet (cells B5 and B6, Table 1), and repeatedly recalculate the spreadsheet until the least expensive balance of these resources is attained.

Once a spreadsheet has been completed to show all resources and activities, copies can be saved to show the work and resource utilization for each week, month, or quarter. Cost summaries, as shown in cells R41 to R44, can be calculated for any time interval in the system. Using this information, cash flow patterns can be determined easily and these patterns can form the basis for borrowing operating capital intelligently.

A spreadsheet which is completely cross-referenced permits a manager to enter a minimal amount of new information at any one time and then see the effect of the new information on production costs and profits almost immediately. Conceivably, a manager with a product to sell, can be negotiating the selling price with a purchaser over the phone while simultaneously entering the proposed prices into the spreadsheet. By the time spreadsheet finishes its calculations, the manager will know whether to accept or reject the proposed prices.

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Table 1. Partial spreadsheet listing of equipment for a golf course including hourly costs.

	A	B	C	D	E	F
1	EQUIPMENT	PRICE	YEARS	HOURS	FUEL/HR	COST/HR
2				USE		
3		MOWING				
4	GREENS					
5	Toro GM 3 A	$18,000.00	10	504	$.40	$3.85
6	Toro GM 3 B	$16,000.00	10	504	$.40	$3.48
7						
8	TEES & APRONS					
9	Jac.G.K.IV	$16,500.00	10	504	$.40	$3.57
10						
11	FAIRWAYS					
12	Ran.350D	$50,000.00	10	480	$.30	$10.24
13						
14	ROUGH					
15	Jac.(5G)	$12,000.00	10	720	$.00	$1.58
16	Rot.7'(PTO)	$2,000.00	10	96	$.00	$1.98
17						
18		TRUCKS & TRACTORS				
19						
20	Ford (55hp)	$15,000.00	10	176	$.40	$8.56
21	Massey Ferguson					
22	tractor	$12,000.00	10	832	$.45	$1.89
23	Chev 1/2 Ton	$11,000.00	10	4	$4.00	$265.85
24	Cushman B	$16,000.00	10	580	$.50	$3.20
25						
26		SPRAYERS & SPREADERS				
27						
28	Pro-Turf Sprayer					
29	(300gal)	$3,500.00	7	48	$.00	$9.90
30						
31	Hahn Fertilizer	$1,500.00	10	64	$.00	$2.23
32	Spreader					
33						
34		ACCESSORIES				
35						
36	Hole Cutters(1)	$75.00	2	100	$.00	$.36
37	Cup Setter(1)	$15.00	2	100	$.00	$.07
38	Hole Cups (20)	$5.00	2	1	$.00	$2.38
39						
40		HAND TOOLS				
41						
42	Shovels(3)	$15.00	5	115	$.00	$.02
43	Spades(6)	$20.00	5	104	$.00	$.04
44	Turf Edgers(2)	$15.00	5	42	$.00	$.07

Table 2. A partial spreadsheet listing of jobs and job components for a golf course.

	K	L	M	N	O	P	Q	R
1	JOB	RESOURSE	QTY	RATE	UNITS	HRS		JOB COST
2								
3	MOW	Grnkpr1	2	$9.00	/HR	504	$9,072.00	
4	GREENS	ToroGM3A	1	$3.85	/HR	504	$1,940.40	
5		ToroGM3B	1	$3.48	/HR	504	$1,753.92	$12,766.32
6	7days/wk x 3hrs/day x 24 wks							
7								
8	MOW TEES	Grnkpr1	1	$9.00	/HR	504	$4,536.00	
9	7days/wk	G.K IV	1	$3.57	/HR	504	$1,799.28	$6,335.28
10	4hrs/day x 24 wks							
11								
12	MOW	Grnkpr2	1	$7.00	/HR	480	$3,360.00	
13	FAIRWAYS	Ran350D	1	$10.24	/HR	480	$4,915.20	$8,275.20
14	5days/wk x 4hrs/day x 24 wks							
15								
16	MOW ROUGH	Grnkpr2	1	$7.00	/HR	720	$5,040.00	
17	5days/wk	MFerg	1	$1.89	/HR	720	$1,360.80	
18	6hrs/day	Jac 5Gng	1	$1.58	/HR	720	$1,137.60	$ 7,538.40
19	24 wks							
20								
21	FERT	Asst Sup	1	$14.00	/HR	32	$448.00	
22	GREENS &	CushmnB	1	$3.20	/HR	32	$102.40	
23	TEES	CSprdr	1	$2.23	/HR	32	$ 67.84	
24		20-5-8	100	$35.00	/25kg	1	$3,500.00	$4,118.24
25								
26	FERT	Asst Sup	1	$14.00	/HR	64	$896.00	
27	FAIRWAYS	MFerg	1	$1.89	/HR	64	$120.96	
28		HSprdr	10	$2.97	/HR	64	$142.72	
29		31-0-0	200	$25.00	/25kg	1	$5,000.00	$6,159.68
30								
31	SPRAY	Asst Sup	1	$14.00	/HR	24	$336.00	
32	GREENS	CushmnB	1	$3.20	/HR	24	$76.80	
33		CSprayr	1	$6.79	/HR	24	$162.96	
34		PCNB	20	$50.00	/25kg	1	$1,000.00	$1,575.76
35								
36	SPRAY	Grnkpr1	1	$9.00	/HR	48	$432.00	
37	FAIRWAYS	MFerg.	1	$1.89	/HR	48	$90.72	
38		TSprayr	1	$9.90	/HR	48	$475.20	
39		Killex	20	$15.00	/litre	1	$300.00	$1,297.92
40								
41					ACCESSORIES			$179.26
42					TOTAL OVERHEAD			$35,500.00
43					TOTAL OPERATING			$106,283.11
44					ANNUAL COSTS			$141,962.37

Table 3. A partial spreadsheet listing for expendable materials, labor, and general overhead including building costs for a golf course.

	S	T	U	V
1				
2		EXPENDABLE MATERIALS		
3				
4		PRICE	UNITS	
5	FERTILIZERS AND CHEMICALS			
6	22-0-16	$22.00	25kg	
7	31-0-0	$25.00	25kg	
8	20-5-8	$35.00	25kg	
9	Killex	$15.00	litre	
10	Terrachlor(PCNB)	$50.00	25kg	
11	Topdressing Sand	$40.00	cu. ft.	
12	Bunker Sand	$60.00	tonne	
13	Fuel	$ .45	litre	
14				
15		OVERHEAD ITEMS		
16				
17	TAXES			$8,000.00
18	INSURANCE			$3,000.00
19	ELECTRICITY			$4,000.00
20	WATER			$1,000.00
21	HEAT			$5,000.00
22	PHONE			$1,500.00
23	ADVERTISING			$3,000.00
24	FEES			$2,000.00
25				
26		PRICE	YEARS	
27	MAINTENANCE BUILDING	$180,000.00	20	$8,000.00
28	Woodframe, Metal Siding, Concrete floor, 4,200 sq ft.			
29	Includes:			
30	Office Space 10x20' (desk, filing cab.,chairs).			
31	Employee Area 20x30' (lunchroom, wshrm & showers).			
32	Service Area 20x30' (mech. tools, work benches, shelving).			
33	Equipment Storage 60x40' (Warehouse space).			
34	Fertilizer-Chemical-Seed Storage 20x20' (shelving, raised			
35	floor, ventilation).			
36				
37	TOTAL OVERHEAD			$35,500.00
38				
39		LABOR		
40				
41	TYPE	$/HOUR		
42	GREENS SUPERINTENDANT	$20.00		
43	ASSISTANT SUPERINTENDANT	$14.00		
44	GREENKEEPER 1	$9.00		
45	GREENKEEPER 2	$7.00		

THE IMPACT OF INTERACTIVE VIDEO TEACHING

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The British Audio-Visual Association claims that we remember 10 % of what we read, 50 % of what we see and hear, but 90 % of what we say and do at the same time.(1) This revelation is of great importance to any educator. However, it has special significance to interactive video because interactive video covers all of the above learning combinations.

Interactive video is not an expensive toy conceived by business-oriented technocrats. It is a serious attempt by educators to deal with a new generation of students who have been raised and conditioned on a steady diet of color television. The average North American child sees about one thousand television commercials a week---roughly one million of them before s/he enters college or university(2). It stands to reason that today's generation of students has a much greater affinity to the TV medium than their parents ever had. For these reasons, more educators should take advantage of this powerful learning tool.

Business companies invest 20 billion dollars annually in advertising (3) because they have detailed proof that their message is effectively absorbed by the TV viewer (4). Language teachers have long realized the value of films and selected TV programmes as enrichment material. However, little research has been done in the field of interactive video learning as it pertains to language acquisition. Up to now we have neglected a very powerful learning tool.

Students who are entering our universities today have grown up along with technology. They have had their own TV sets; they have their own radio; some of them have their own computer. These students grew up with an interactive approach to their environment. If the program on TV is boring, or if they have heard enough music, they simply turn off the machine. Their interactions are based on an on-and-off response to a technological device. In a conventional classroom situation, today's students are tempted to say, "Can you fast-forward this lecture?". But this is exactly what the conventional instructor is not trained to do.

Sooner or later we have to adjust to this new participatory ethic. It is the educational manager who has to provide the means for this interactivity in the modern classroom. Today's technology has provided the means for us to adjust to these demands. A great opportunity for language instruction presents itself through interactive video because interactive video

responds best to the needs of this new generation of students. If we, as language teachers, do not utilize this medium more appropriately then students could turn us off too, like a boring TV show. Judging from the enthusiastic student response to the interactive VIDEO GERMANY program developed by Wilfrid Laurier University (5), we can say that they genuinely appreciate our effort.

The field-tested VIDEO GERMANY

The field-tested interactive video---we call it VIDEO GERMANY---was specifically developed for the language learner. It incorporates the highest level on the retention scale. Video Germany places a strong emphasis on the "say and do at the same time" (90 % retention) technique. It has clearly proven superior to other conventional it infotech-supported techniques, and has greatly increased student motivation.

In contrast to conventional video-supported learning, interactive Video Germany uses a different filming technique. The eye of the learner is the camera. It creates an illusion of an almost real situation. Instead of receptively watching the action on the screen, the learner in interactive video is the main character in the plot. He/she causes reactions and at the same time is constantly challenged to react by the persons on the monitor. This recording technique allows better utilization of the powerful TV medium for language instruction.

Interactive Video for the language learner should not be confused with talking to a machine like "Kit", the fully-computerized talking-car which long has been the favorite of North American children on TV's Knight Riders. Knight Rider will remain in the world of fiction for at least one more decade. However, as Paul Mermelstein, manager of Speech Recognition Systems for Bell Northern Research in Montreal recently said, "in terms of being able to give a set of restricted commands to some machines, we can do that today"(6).

This has been demonstrated by Mercedes Benz, the German car manufacturer, whose model 190E was shown at Expo 86 in Vancouver. The car will lock doors, open windows and adjust the angle of the rearview mirror. Separate verbal commands switch on the ignition, release or activate the handbrake. Even the radio responds to the driver's voice(7). Experts at the Symposium on Speech Recognition believe that within ten years we will be able to carry on limited simple conversations with a machine.

There is no need to wait ten years to incorporate interactive video into teaching. Interactive video has already proven itself in many fields through the videodisc systems. However, conspicuous by its absence among the already existing

interactive videodisc programs are interactive videos for the beginning language learner. This is understandable if we realize that even a totally integrated interactive (audio, video, computer) laserdisc system has its limits.

In order to get an interactive response from such a laserdisc system, the learner has to use a mechanical or electronic tool to generate a desired response on the TV monitor. This can either be a keyboard, a light pen, a mouse or a touchscreen. In any case the learner is required to make the decision by technical means in order to activate the program to its desired response.

This however, could be counter-productive for the learning of another language. Since speaking and writing are different learning skills, it is best to keep them apart in an interactive video approach. This separation of skills becomes significant especially when the aim is the creation of a realistic face-to-face environment.

We have therefore defined interactive video for the learner interested in a language approach that stresses the communication aspect. ''Interactive Video'', as it is referred to in this article means:

> a near-life communication between two or more persons via a TV screen whereby the learner is in front of the monitor. The verbal interaction should come as close as possible to a real person-to-person and face-to-face communication. No participant should be diverted by pressing keys or other gadgets which would reduce the illusion of reality.

The needs of a language learner are quite different from students learning any other subject, especially when the aim is to enhance the oral communicative skills. Pressing keys destroys the illusion of a real-life conversation. Therefore, in Video Germany we do not mix the skills nor the media. A switch from speaking to writing would amount to an emotional cold shower. Instead, the written exercises are kept entirely separate from the video episodes. With this technique the real-life illusion is kept intact. Furthermore, for Video Germany there is no need to press any buttons because the interactive stimuli have been incorporated directly into the software, the program.

In addition to the benefits to the students, there is another spin-off of equal importance. Because Video Germany can be played effectively in linear form as a video tape, it does not require all the extra electronic equipment necessary for a videodisc system. In other words, Video Germany is very economical. The main thrust of this interactive Video Germany approach however, remains the emotional and creative involvement of the learner. Sufficient evidence has been collected over the past two years which indicates that interactive Video Germany is a powerful

boost to student motivation and learning.

There is a distinct difference between a conventional video film and an interactive video. In a conventional video film the world is perceived and experienced through the eyes of the actors on the screen. The learner in front of the TV monitor remains a passive observer of a world which is presented by the actors on the screen.

In contrast, in interactive Video Germany the learner is the main character and therefore helps determine the action in the electronic world. The learner as the main character can therefore never be seen on the screen, because the eye of the learner is the camera which records the world. This recording technique allows better utilization of the TV medium for language instruction. It creates an illusion of an almost real situation. The main thrust of this interactive approach is the emotional and creative involvement of the learner.

In planning the Video Germany program we incorporated some basic principles from behavioral and cognitive psychology as well as the personality theory. Right from the beginning, we built in elements that challenge the student's natural need for survival. The student has to use his limited vocabulary to preserve his personal dignity. We consider this, in itself, to be a very important and meaningful exercise. It is called effort-stress. It not only promotes learning but also shapes the student's attitude towards coping in any difficult situation. Great importance is attached to the fact that with maximum fidelity the learning experience simulates the conditions under which the skill will be practiced in real life.

We all have the need to control our environment. Students become very anxious if they cannot control the language environment. In Video Germany we give students the opportunity to free themselves from anxiety by encouraging them to interrupt the speaker on the screen. In Video Germany students are urged to stop the speaker. They are encouraged to interrupt; they will ask the speaker to repeat or to speak slowly. Again, all this is incorporated into the program in order to give students a sense of control over their environment. This type of interactive technique creates self-confidence and leads to self-esteem which is a very powerful aspect for the successful language learner(8).

The interruption technique is especially important in a new language environment. The student has to be able to control the speaker(9). By being able to control the speaker the student will form a positive and healthy attitude toward the second language.

Video Germany consists of several parts. In the very first video lab the student is welcomed by a narrator while the title flashes

on the screen. Then the screen is automatically turned off while the narrator introduces the learner to the new approach. The audio-only introduction helps to ease away any emotional barrier the student might have. Since the Video Germany episodes are presented as the learner's trip to Germany, the student's willingness to believe in this illusion is prepared in this introduction. In a very calming and relaxing voice to the tune of especially selected baroque music the learner is first relaxed, s/he is then asked to close his/her eyes and is then eased into an imaginary trip in his/her own mind. This very enjoyable experience helps to break the ground for the acceptance of an exciting journey to Germany. After this introduction the video drills are presented.

The video drills are purposely arranged in a relatively sterile and conventional fashion. Here the student is being treated in the conventional manner, as a student who must endure some not-so-exciting learning tasks. Even though this video drill portion is intended to be a relatively sterile learning situation, students report pleasure in doing the drills. Most of the students consider the video drills beneficial. They feel it is helping them memorize and improve their pronunciation because they can clearly see the lip-movements of the speaker. Watching the movement of the lips is a natural and very effective technique for most language learner.

What does VIDEO GERMANY Contain?

In keeping with the underlying thought that the drill phases are to be considered as "work", we have distinctly separated them from the "reward": the Video Germany Episode. For the "real" trip to Germany, the learner is exposed to "real German" people and "real German" scenery. It is quite a realistic trip because everything is experienced from the perspective of the learner.

In order to maintain the "realistic" illusion, the episodes are never interrupted. It is felt that any interruption, at this stage, for comprehension check-up etc. is counter-productive because it destroys the illusion of reality. Students will adversely react to having their illusion destroyed. It would create an emotional barrier which affects the learning process.

During the real-life episode no correction is given other than what would be considered as part of a normal and natural reaction of a conversation partner. By strictly separating the "teaching" (drill, work) and the "real conversation" (reward) we have "matched" different approaches with the students' learning styles. The attention paid by Video Germany to the instructional situation exploits a variety of learning strategies which are most effective for most students. Individuals are able to learn "with their best abilities", as Diller has pointed out quite appropriately (10).

This underlying instructional approach has determined the different filming technique in Video Germany. It has determined the audio introduction as an ''easing-in'' of the student into a world of willing acceptance of the illusion, and every effort has been made to follow this illusion to its logical conclusion.

The episode begins, therefore, at the airport where the learner is greeted by a flight attendant and presented with a complimentary ticket to Germany. Then, in the waiting area the learner is approached by a helpless elderly lady who is returning to Germany from a visit to her son. Of course she does not speak English and therefore engages our video learner in a dialogue. The student is left to respond to all the questions. The narrator, who is never seen on the screen, acts as the learner's subconscious voice: he encourages him/her to respond and gives positive reinforcements. With the departure of the plane the first episode of Video Germany comes to an end.

The following episodes, ten in total, are basically the same in structure: first the different phases of the drills and then the Video Germany episode. In the process of the ten episodes the learner arrives in Frankfurt, asks for directions, takes a train to Marburg, finds a hotel, meets people and visits Marburg's modern university hospital. During the discussions with German friends a variety of subjects are dealt with, culminating in a Kaffee-and-Kuchen invitation by one of the friend's parents.

Quite often the learner is showered with information he cannot cope with. We provoke the learner to stop the speaker, to have the speaker repeat. With this technique we give the power to our student. We build self-confidence. Our student can do it! The feedback from the students is exclusively positive and enthusiastic. They feel that the real-life situations are challenging, interesting and most of all relevant. In the process, they experience and learn to cope with a variety of situations in Germany. They learn a great deal about Germany and they have to talk about their own country. All this is enhanced by the interactive approach which deeply involves the learner in the process.

Video Germany is independent of any textbook. However, it follows the basic development of the conventional college text. It starts with very basic elements and progresses step-by-step without making it obviously grammatical. It can, therefore, be easily integrated into a conventional beginners' course without dominating the existing curriculum. Each of the ten units of Video Germany lasts thirty minutes and includes the drill phases. In the language laboratory, the voices from the video and the learner are recorded on an audio tape. The tape can be replayed and corrected, if desired.

The comment expressed most often by students relates to the joy of learning with Video Germany. The enthusiasm of the students is based on the near-life situations, the personal and practical experience they gain through the interactive video approach. Students' motivation is considerably higher than those students who are only exposed to an audio language laboratory. In answer to the question, "What is your reaction to the Video Germany episode?" most students felt it was "excellent", and one student expressed the sentiment of many by saying,

"I really enjoyed it and I can't wait to arrive in Germany."

Sufficient evidence has been collected over the past two years that Video Germany is a powerful boost to student motivation. Moreover, Wilfrid Laurier University is thoroughly impressed by the results of the VIDEO GERMANY program. It is presently developing a second project, an interactive VIDEO FRANCE(11) program modeled after the Video Germany concept.

In conclusion, it can be said: the technology as well as the viability of the interactive video approach for the language learner is within our reach. We feel that we have made a significant step into a new era of effectively utilizing a very powerful tool for the benefit of a new generation of language learners. The interactive video-approach in fact has already demonstrated renewed interest in learning languages.

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2) Gerhard Marletzke, ''Jugend '85, Full Bock auf Medien?'', ARD MAGAZIN, Nr.1, 1986.

3) US Bureau of Census. Statistical Abstract of the United States 1986, p. 552.

4) Sandra J. Ball-Rokeach, M.Rokeach, J.W. Grube, The Great American Value Test. Influencing Behavior and Belief Through Television, London 1984, p. 92.

5) Video Germany, an Interactive Language Course for the Video Language Laboratory. By Dr. Herminio Schmidt and William E. Nassau LRPS; Copyright by Wilfrid Laurier University, Waterloo, Ontario; Canada, N2L 3C5.

6) Computing Canada, Vol.12, No.16, p.9, August 7, 1986.

7) SCALA, 7-8/1986, p.6.

8) H.H. Stern, "What can we learn from the good language learner", Canadian Modern Language Review, Vol. 31, No.4, pp. 304-318.

9) Jerry Richardson, The Magic of Rapport, 1984, p.151.

10) Karl C. Diller. ''Criteria for adapting language teaching methods to the learning styles and abilities of students. Proceedings of the Fourth International Congress of Applied Linguistics, ed. Nickel, G. Stuttgart: Hochschulverlag, (1976), 3, pp.341-351.

11) Video France (S\'ejour en France) is based on the same concept as Video Germany. Video France is scheduled to be available in the fall of 1988. (For more information write to: Wilfrid Laurier University, Waterloo, Ontario; Canada, N2L 3C5).

THE USE OF THE VETERINARY MEDICAL INFORMATION MANAGEMENT SYSTEM (VMIMS) DATABASE IN TEACHING

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In recent years the rate of growth of medical knowledge has been greater than that at any other time in history and veterinary medicine has both contributed to and been affected by this phenomenon. At the level of undergraduate teaching the proliferation of knowledge has resulted in the need to include increasingly more factual information in the curriculum, consequently reducing the time which students have to integrate and synthesize that information and thus develop and practice those problem-solving skills essential to the provision of optimal patient care. There is a need in medical education and veterinary medical education to explore teaching strategies which foster both the acquisition of knowledge and its use in the clinical setting. Those techniques which encourage active participation by the student in the learning process are the most likely to be both effective and well received.

Recent advances in computer science and technology have paved the way for the introduction of computer assisted instruction (CAI) in medical and veterinary medical education. The increasing availability of large computerized data bases of medical literature has allowed for the frequent updating of factual information. Computer-based "drill and practice" programs can assist with the memorization of unambiguous factual material. Medical information systems allow data collected in the process of actual patient care to be used in the construction of case simulations which help students to develop problem solving skills. When coupled with techniques for self-assessment students can master the skills necessary for clinical competence in the manner and time-frame best suited to their individual abilities and preferences.

Classically, involvement in patient care has been the mechanism by which students have learned how to apply their factual knowledge to the solution of real-life problems. This approach, although it is the most direct, does have several limitations. Specialization is a fact of life at any large teaching institution; therefore the amount of time which a student spends in any one area is by necessity limited. Unless the case load for that area is unusually large or the student is exceptionally persistent, the chances are that any one student will not see the range of problems that he or she will be required to recognize and manage in practice. In today's society the veterinarian is

still looked upon as a generalist, able to deal with problems involving any body system in a wide range of species, and to keep in mind economic realities while doing it. Patient data stored in medical information systems (MIS) can be used to supplement, in a case-oriented manner, the experience which the student acquires during the process of patient care.

VMIMS, The Veterinary Medical Information Management System:

The Veterinary Medical Information Management System, VMIMS for short, was developed at the Ontario Veterinary College and was implemented in 1983 for the purposes of storing information concerning patients seen at the Veterinary Teaching Hospital. VMIMS operates under the DOS and MVS operating systems using the Sharp APL programming language and is able to run on an IBM (or compatible) computer of the 4300 model series or larger. Built into VMIMS is a security system which prevents illegal access or data entry by unauthorized individuals. In addition, safe-guards ensuring client confidentiality are an integral part of the system. In designing VMIMS its potential uses for hospital administration, research and teaching were all kept in mind. The system continues to evolve through the input of all those who currently work with it.

At present over 28,000 individual patient files are stored on the system. These patient files contain data derived from several areas. Clinical information such as patient characteristics, diagnosis, operations or treatment codes and outcome, as well as other information required for administrative purposes is entered for every patient. Further information is added as it is generated during the process of patient care from the areas of bacteriology, clinical pathology, radiology, and parasite.

On admission each patient receives a unique hospital number through which that patient's record can be accessed. The same hospital number is used for any subsequent visits. Information within each record is arranged according to visits, with the most recent visit available first. Information for the various areas can then be selectively examined through the use of a menu system and it is possible within any one area to "page" backward and forward through the patient record in order to follow changes which have taken place in a parameter of interest over time. In addition to the "show record " function used to examine individual patient records when the individual's hospital number is known, a "search and gather" function allows groups of cases to be selected according to user defined criteria. For example, it is possible to select for examination the complete records or any part thereof of all German Shepherd dogs aged 10 years or older, treated at the veterinary teaching hospital in 1986. If a specific disease syndrome is of interest all cases of that syndrome can be retrieved by specifying the appropriate diagnosis

code. Again, once cases of interest are selected any of the information available in the records can be printed in a chart form or the individual case records examined by using the hospital number and "show record" function. It is possible to perform a limited amount of statistical analysis within the system itself or alternatively to transfer the data to a microcomputer for more sophisticated analysis. A limitation of the system at this time is the lack of information from areas such as anatomic pathology and cytology, both of which contribute information which is often of major diagnostic importance. Neither is there any information recorded for patients seen on-farm, nor is herd health data stored under the VMIMS system. It is planned to bring all of these areas on-line in the near future.

The Use of VMIMS in Undergraduate and Graduate Teaching:

In addition to its potential use as a source of information for the creation of case simulations, the VMIMS database can be used directly in a variety of ways in the teaching of both undergraduate and graduate students. At the simplest level use of the VMIMS patient file can enhance the experience of the student who is working in the clinical area and is directly involved in patient care. A patient's record can be quickly and efficiently reviewed allowing the student to become familiar with the case, including any previous problems which may have a bearing on the situation with which the student is currently confronted. Student learning as well as quality of patient care are both enhanced in the process. Under the guidance of an instructor students can "work through" a case, either that of a patient currently presented or a case previously selected by the instructor for review. By beginning with basic admissions data and then revealing more data from other areas as students request it the instructor can create the situation whereby the students actually "solve" the case. Reasons for the selection of a particular procedure, contribution of the result to diagnosis and patient management and possible alternative approaches can all be discussed at this time. This approach seems best suited for use with small groups of students in order that maximum interaction and involvement can be encouraged. Alternatively, cases previously selected by the instructor can be used to illustrate points made in more formal lecture, laboratory or seminar settings. The advantage of using the database directly is that a patient's entire file is available at any time and can be used immediately to answer questions which may not have been anticipated when the material was initially selected for presentation. Even in a formal classroom setting this approach allows for a greater degree of interaction between the instructor and the student. The feeling that cases and situations are relevant is enhanced through use of "real-life" rather than simulated cases or text-book examples.

Under the "search and gather" function the data base may be used in an informal setting to illustrate the range of changes which may occur associated with a particular disease syndrome by selecting and examining data from several cases of the disease of interest or alternatively, to investigate the problems associated with various groups of individuals having certain characteristics in common. This information can be used to increase the teaching value of cases seen by the student during clinical duty rotations or as a supplement to and reinforcement of information available in a textbook. Using the database in this way encourages students to view learning as an active process of discovery rather than a passive process of memorization. Once again, the fact that "real" cases are being used as examples seems to appeal to the students and increases their interest in the topic under discussion.

At both graduate and undergraduate levels access to the database can provide material for seminar presentations and papers allowing students the chance to actually seek out and manipulate data rather than relying solely on previously published textbook and journal information. This approach tends to lend interest to the topic and adds emphasis to the hypothesis that learning is an ongoing process requiring action and critical thought on the part of the student.

From our limited experience with use of the VMIMS database for teaching purposes it appears that students accept the concept readily and continue to use the database on their own to investigate and review clinical cases. Learning to use either "show record" or "search and gather" functions requires only a minimal amount of instruction as both functions provide comprehensive menus and on-line help.

There are some drawbacks to using the database directly in teaching not least of which is cost. Purchase of a computer dedicated to the VMIMS database should help to partially alleviate this problem. The speed with which data can be accessed can also be a problem particularly in formal classroom settings or at periods of peak use since the system currently shares time on the university mainframe computer. Again the purchase of a separate computer system, dedicated to the support of VMIMS, would help to solve this problem. Finally, as previously mentioned there are gaps in the record related to certain specialty areas which are not currently on-line. In spite of these disadvantages however, VMIMS can be used in a manner which is both effective and interesting to increase the exposure of students to case material, foster a problem-solving approach to patient management and develop an active involvement on the part of the student in the learning process.

Our initial attempts at using the VMIMS database for teaching have been quite limited in scope although both student and

instructor enthusiasm provide encouragement for further experimentation and development. It remains to be proven however, whether this form of computer-assisted instruction shows any advantages over more traditional forms. Performance and success of students as practitioners must be the ultimate standard.

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A COMPUTER SCIENCE SUMMER CAMP

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ABSTRACT

An overview is presented of the University of Guelph's Summer Computer Camp for the years 1983-1986 inclusive.

We describe main activity areas, breadth and depth of curriculum, and camper and parent responses. The low level of participation of females in each of the four years is discussed. The reactions of veteran (3 or more years) campers to the curriculum and to the camp concept are documented and evaluated.

June 30, 1987

A COMPUTER SCIENCE SUMMER CAMP

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1. INTRODUCTION

From 1983 until 1986, the University of Guelph Departments of Continuing Education and Part-time Studies and Computing and Information Science jointly operated a very successful Summer Computer Camp. The success of the camp indicates to us that this type of endeavor can act as alternative educational vehicle for the dissemination of computer science instruction.

The decision to hold the camp had been made in 1982. It was noted that a number of camps were being advertised which emphasized group instruction on a single brand of machine in a single language (usually BASIC), and it was obvious that the Guelph camp needed to offer a unique experience in order to succeed. We decided to promote a computer camp that was primarily residential, with virtually unlimited computer access, instruction by university faculty and senior students, and exposure to a wide range of equipment and a variety of languages. Because of these decisions it was possible to attract a camper population which was, for the most part, homogeneous and highly motivated, with both the desire and the ability to take advantage of the situation.

2. MARKETING

The major advertising was accomplished by a mailing to every school board in Ontario for distribution throughout their schools in January of each year.

This mailing made it clear to both the potential campers and their parents that this was a serious undertaking. With the application there was required a letter of recommendation from one of a math, science or data processing teacher indicating that the student had the potential to succeed in this computer-intensive environment. It was also requested that each applicant send a letter describing his or her interests in computers and what specifically he or she expected to gain from the camp. The application asked for the age, sex and experience level of the camper. The returned material presented the planners with a useful profile of the camper population which assisted in the curriculum development process.

The contribution of Continuing Education and Part-time Studies was pivotal in the success of the camp. They designed and commissioned all of the excellent graphics which presented an attractive interface with the outside world: advertising, certificates of accomplishment, camp pictures, certificates of appreciation to donors and guest speakers, and the interface with the University departments providing physical resources.

3. CAMP PROGRAM DEVELOPMENT

The camp program proceeded along two tracks: academic, and recreational and social programs.

3.1. CURRICULUM

Activities were developed for three streams: **rookies, hackers,** and **gurus.** Our experience the first year indicated that, in fact, the hackers (those who fancied themselves as "advanced") should be considered for the most part as campers with a higher level of exposure to computers as opposed to youngsters with a high degree of expertise. The few genuine hackers, with the gurus, were accommodated by special projects, and advanced tutorials. Ability level was the primary discriminant - not age.

A non-systematic search was made to find courseware or software which would have both an intrinsic value from a computer science point of view and appeal for the 12 - 16 year old campers. The computer curriculum for the week was designed to have a balance between classroom and hands-on time. All

campers had a formal introduction period in the first day to all of the tutorials, and were expected to attend at least three formal tutorials each day. Six slots per day were available for formal tutorials, free computing or individual instruction. Other blocks of free computing time were also scheduled.

The following main areas were featured, with rookies and hackers getting different depth of exploration in parallel or offset schedules: an introduction to computing including some history and basic concepts; instruction in BASIC; computer arithmetic and computer architecture; a lecture and hands-on demonstration on artificial intelligence and machine learning; Videotext, including a demonstration of Telidon page creation facilities; compilers, interpreters, stacks, FORTH, and similar language concepts and examples; robotics and the future of the workplace; simple graphics.

The curriculum support included Telidon exposure, LOGO, a programming exerciser called JOSEF, several FORTH machines, a TEACHMOVER robot arm, a hardware lab which included a computer-controlled model car, the resources of the local microcomputer club and the Department's complement of teaching equipment. In the second year, we added a laboratory containing two Apple IIc's, two PCjr's, two Macintoshes, and an Apple Corporation Lisa. Also for the 1984 and 1985 camps, we established a laboratory using BBC Acorn microcomputers. A large number of IBM PCs were used in special-purpose labs (eg. LOGO and Wordstar).

For the third and fourth years, we ran parallel sessions of 6 3/4-hour tutorials each day, and the streams were commingled to allow for differing skill levels. For example, Pascal and BASIC were offered in parallel, as were graphics and LOGO.

In the curriculum of the 1986 camp, the students were given an intensive Prolog tutorial, in order to compare their reactions to it and more traditional language forms.

Prolog is a declarative language in which facts and rules are represented in a database. The data base can be interrogated to give yes or no answers, or in ways in which it will return facts that satisfy given conditions. It requires a very different way of thinking about problems from the procedural approach of most

other common computer languages.

The students were shown some facts about family membership and they became very active at entering facts (or fiction) about their own families and characteristics of some of the members. Their familiarity with the electronic mail system led to them entering facts in one another's directory - not all of this activity was appreciated by the other students!

The concept of rules was introduced and the general schema for recursive rules was given with some suggestions for applications. The intention had been to allow them to build a series of toy expert systems of increasing complexity. We supplied them with a number of basic tools (rules) to enable them for interest, to print out all the elements on a list without them needing to know how lists are represented in Prolog.

As the camp progressed, more of the students abandoned Prolog and switched either to games or to electronic mail. However, a few students became engaged with Prolog and one student undertook not only to help others but to successfully debug some non-working Prolog versions of the mini expert systems.

The Prolog sessions showed that most of the campers enjoy data entry if the directions governing it could be quickly absorbed. They were quite prepared to become very involved in the basically dull story line about family membership. However, the majority of them were much less interested in thinking about a situation in the different framework required by logic programming. The younger campers had considerable trouble with the spelling required to interrogate the data base and that was a source of real frustration for them. It should be pointed out that the one or two students that became totally absorbed in the process made incredible progress and advanced further than we could have anticipated.

Every camper received at registration a binder containing prepared notes and background information on most areas of the curriculum. The classroom instruction topics were presented in such a way that campers were required to make a few notes in appropriate windows on the sheets. The remaining material contained examples, basic vocabulary and syntax for the different systems and historical and theoretical material for those who developed a particular interest in an area.

The staff was responsible for carefully monitoring the use of scarce resources such as the robot arm and encouraging interest on the part of those few campers who weren't self-motivated. After the introductory instruction in each area the tutors became primarily resource people and thus had the opportunity to observe the reactions, abilities and problem-solving approaches of the campers as well as to judge the relative value of the various activities.

3.2. RECREATIONAL AND SOCIAL PROGRAM

The Continuing Education and academic staff cooperated in the development of recreational and social activities, but the Division was responsible for all of the non-academic issues. The success of the camp is in large part a reflection of the careful planning and execution of the "after-hours" activities.

The day was organized from 7:00 am rise-and-shine to 9:30 late snack and bedtime. There were approximately five hours per day of scheduled computer activity (30 hours total during the week). Sports and outdoor games were interspersed throughout the camp day to release frustrations and ensure physical well-being. Evening programs involved such events as Japanese language and writing, amateur astronomy, a video games night, a lecture on George Orwell and 1984 (in 1984), theatersports (an interactive and competitive form of skit-theater). and current movies with a high content of computer graphics. Two outings were planned each week: a get-acquainted barbeque and a combined wrap-up party and awards night.

4. THE CAMPER POPULATION

The camp was held in three one-week sessions in the first two years and four such sessions in the latter two years. Limits were set on the number of campers accepted. In this way we could ensure the high degree of individual attention as well as maintain the one-to-one ratio of camper to machine. Both of these were factors which we felt were necessary for a quality experience.

In all years we drew campers from a broad geographical base. We had a considerable number from Northern Ontario and from rural and small town environments, as well as from major metropolitan areas. Since many of our campers are

in elementary schools and from non-urban areas, it would seem that we attracted youngsters whose desire for computing knowledge is not being met in their schools or communities. We attracted children with physical limitations as well, and they felt comfortable enough with our environment that they returned for subsequent camp years.

Our percentage of female campers stayed constant over four years at less than 20%. Their skills and interest varied widely, with only one or two who showed interest or aptitude. It would seem that the selection process has been at work on females in our school system (at least among those likely to apply to our camp).

The age percentages are as follows. (Again, they have remained relatively constant for four years.)

age	12	13	14	15	16
percentage	<30	30	20	10	10

The registration varied from 104 camper weeks in 1983 to 160 camper weeks in 1985.

5. AWARDS PROGRAM

Our camp was expensive and did not make a profit. The result to prospective campers was a steep fee which we hoped to defer through a fellowship or scholarship program. The money was to be obtained from corporate donors.

In the first year of operation, the number of scholarships was fairly large - 54 - but most came from the College of Physical Sciences at Guelph.

In the second year, the number of scholarships decreased, to 39, but they represented bona fide donations from corporate sponsors Canada-wide.

In our final year, we were able to offer some bursaries and full scholarships. In a presentation ceremony the campers got to meet representatives of the company donating their scholarship. The Department faculty and University personnel were able to meet with company executives.

One company executive, was an eighteen year-old president of a software firm, who donated two scholarships. Her letter to us indicated wistfully that she

would have liked such a camp when she was young.

6. POST-CAMP ANALYSIS

We received feedback on the camp from three sources: the campers, their parents and the staff. Longstanding campers were also queried in order to find what made them return each year for several years.

6.1. EVALUATION AND FOLLOW-UP

A short questionnaire was given to the campers at the end of the week to help us judge their reaction to the curriculum. We were interested in their perception of the total time they had spent at the computer, the time spent at each activity, and how much they felt they had learned about the various subjects.

The average total time per week spent on computing activities was claimed to be in excess of 34 hours, although the total time actually scheduled for these activities was usually 30 hours. These additional hours could be actual as opposed to perceived since a number of the campers were persistent in their desire for extra computing time - missing snacks, taking short meal breaks etc.

Each student was asked to estimate the time spent on one area which was his or her primary or most intensive activity. The average response was 12.0 hours. The second or next area of involvement averaged 8.0 hours of camper's time. As indicated by these figures the average camper was introduced to a wide variety of topics and from these chose one or two to explore in some depth.

The **parents** of the campers were sent a questionnaire several weeks after the end of the camp session. The major part of the information trapped in this process regarded the camp in general as opposed to the computer curriculum specifically. There was a 45% return rate on this evaluation summary. There was a unanimous expression of satisfaction with the camp from these respondents and 84% would encourage their children to return another year. All of the parents felt that their campers had increased their computer knowledge at the camp and there were many additional positive remarks indicating satisfaction with the curriculum, the staff and the general level of organization.

6.2. LONGITUDINAL PERSPECTIVE

A veteran of three camp years (1984-1986), LaMaia C. agreed to an interview in order to allow us to present the camp from a consumer perspective. The length of her involvement with the camp means that she saw it in various stages of evolution, and from the point of view of most of our target chronological ages.

The following are the questions asked, with her answers.

1. Would you attend the camp again? Could you explain why or why not? *Certainly, I enjoyed the camp a great deal and it seemed a worthwhile thing to do.*

2. How did you feel about the overall camp program? *It's a good way to run a program. Having a choice of classes is better than having them compulsory.*

3. If you were running the camp which of the existing parts of the program would you leave out? *I'd stop making the sports mandatory.*

4. If you were running the camp what additional programs would you add to the existing program? *I'd have more hardware and building - like Howie (the hardware tutor) was doing.*

5. How did you feel about the Prolog tutorial? *It was fun to learn something that I hadn't considered playing with before.*

6. What do you remember as the differences between a declarative language and the imperative programming languages you had used before? *Don't know. (the question was explained) Prolog seems to be perpetually recursive.*

7. What did you learn at the Prolog tutorial? *I learned basic Prolog and have retained most of it. I'll be using Prolog during the last few weeks of school in the computer science class as the last topic in the course.*

8. What did you learn at the C tutorials? *We learned the basic rules about C. I knew structured programming techniques before otherwise I would have learned about structured programming too.*

9. What did you learn at the graphics tutorials? *I didn't do this tutorial. Most of the people didn't know enough C to to interesting graphics so they taught C. The queues for the IRIS were too long so I didn't use them either.*

10. What can you recall about facts and rules in Prolog? *I remember that data structures could be easily accessed*
11. What can you recall about the Unix operating system? *I've been using VMS and UNIX was annoying since there were no help files and you felt that the designers had made it as difficult as possible to use the system.*
12. What can you recall about text editors? *Text editors are fun but they are not good on UNIX the Turbo text editor is superior to anything I've used on a mainframe.*
13. What can you recall about looping and transfer of control in C? *I'm not really fluent in C. Structurally C is about the same as Pascal. Serious errors in the control structures are more possible than with Pascal.*
14. What can you recall about file pointers in C? *Very little.*
15. What can you recall about recursion in Prolog? *Recursion is almost permanent in Prolog. Prolog likes backtracking and behaves as it everything is on a stack. Prolog is happy to pop stuff off the stack.*
16. Have you used anything of the things you learned at camp since going home? If so, how much? *Prolog will be used during the last few weeks of school. I used C for about a month in the fall and then went back to Pascal. I've used lots of things that I learned on my own - like sets in Pascal - during the free time. I've been playing with the robot here so I used what I learned using the robot arm.*

7. CONCLUSIONS

We are obviously proud of the camp. It has been largely self-supporting, has shown our University and Department in a positive light, and has not caused an unusual burden on the resources of the Department. Manpower requirements from the academic side are roughly equivalent to one single semester course for the academic coordinator, several teaching assistants, and a few hours of volunteer instruction from other faculty. The key ingredient in the success of this venture has been the quality of the marketing effort and the overall organization by Continuing Education.

The camp has given us the opportunity to interact directly with bright students in the middle years of secondary school. A mainstream view of computing. tailored to their skill and age levels, has been presented. A small Department with a limited liaison budget has been able to indulge in a low-key recruiting effort, and to advance the state of knowledge (significantly) of the individuals who came to the camp.

A Prototype Expert System For Teaching Brain/Behaviour Relationships

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Introduction

A number of major neuroanatomical systems can be identified in the brain that mediate different but overlapping functions. This software is a prototype of a rule-based (expert) system, written in prolog, that can be used to help students learn brain/behaviour relationships (see, for example, Fig. 1). A student using this program may describe behavioural functions and, in reply, the program suggests possible causes for this behaviour in terms of neuroanatomical activation or inhibition. Similarly, the student may describe neuroanatomical activation or inhibition and the program indicates what behaviour may result. The rule-based nature of the system allows the user to ask how particular results are generated and how other results may be inferred.

Some Sample Rules

The rules that make up the core of this software have progressed through a series of modifications. Some examples of the final rules are:

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* Questions regarding the microProlog programming may be addressed to the first author, Department of Computer Science, University of Western Ontario.

** Questions related to brain/behaviour relationships may be addressed to last author, Department of Psychology, University of Windsor.

cerebral-cortex

precise-motor-functions

precise-sensory-functions

complex-cognition

memory-trace-storage

limbic

reward

processing-into-permanent-memory

attack

hypothalamus

reflex-emotion

homeostasis

gender-specific-behaviour

gender-differentiation-growth

reticular-formation

consciousness

muscle-relaxation

Figure 1. Major brain/behaviour relationships.

R5 Activation of a system implies that the components of that system are activated to the same degree.

R1 Activation of a structure which is part of a system generaly implies that the system is also activated but to a lesser degree than the specific structure.

R3 Activation of a structure generally increases the function associated with that structure.

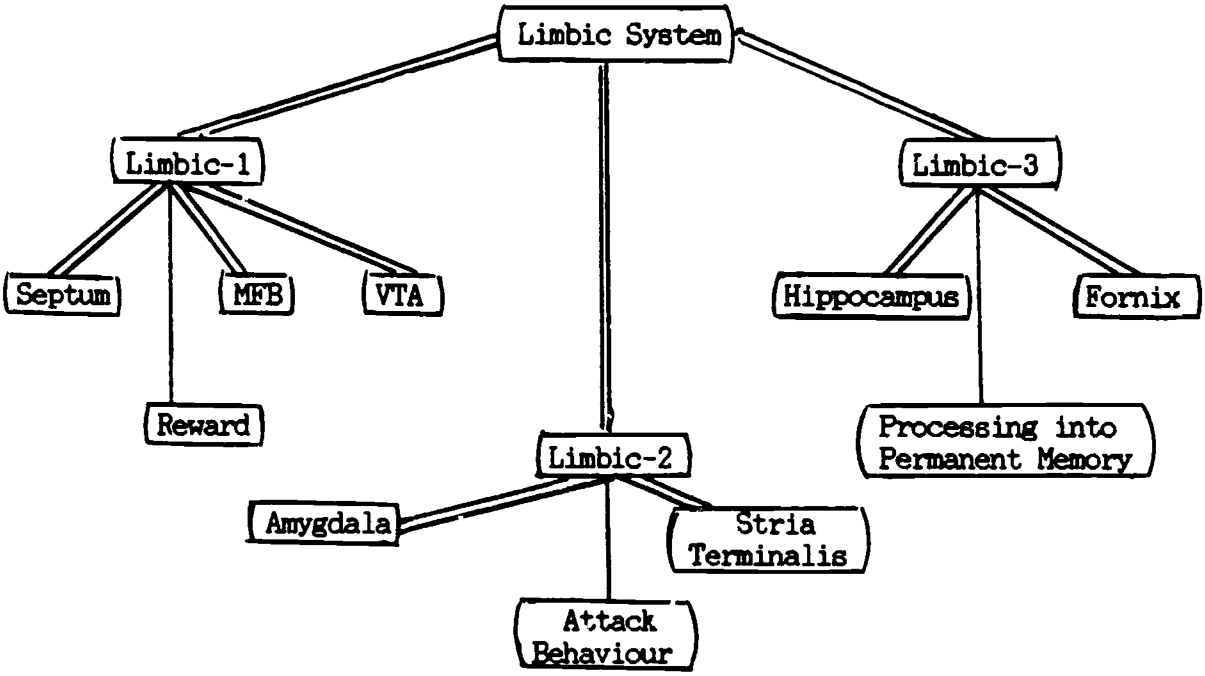
A model exists which defines the manner in which the rules are stored and manipu' ted. This means that there is a standard format for the rules and an algorithm (inference engine) for applying the rules to draw conclusions.

Representation of Knowledge

In this system, the domain knowledge is one of three distinct types. First, there is a set of facts that define the neuroanatomical systems, structures, functions, and the relationships among these entities. This level is represented in the form of a semantic network (see Fig. 2). The semantic net defines the systems and structures of the brain in the form of a hierarchy. In prolog, this network is made up of predicates. The predicate called **part-of** relates a structure to the system in which it belongs. For instance, **part-of (septum, Limbic-1)** indicates that the septum is one component of a sub-system labeled Limbic-1.

Another very important relation is named **associated-with**. This relation stores the assoc ation between brain systems and functions. For example, one subsystem within the limbic system has been shown to mediate positive reinforcement (reward). A fact is stored representing this information and

this fact is associated-with (Limbic-1, reward). Arbitrary labels, such as



Key: P = Part-of ═══
A = Associated-with ____

Figure 2. Partial Semantic Network.

Limbic 1, have been assigned to some brain subsystems that mediate functions because no formal name exists for these neuroanatomic subsystems.

The next level of knowledge is a set of transient or temporary facts. This set is made up of facts supplied by the user and facts that are inferred by the system. These facts define a particular state of the system or structure being modeled. For instance, if the user enters the fact that there is activation in the septum, this would be stored as a temporary fact. Also, if the system were to evaluate a particular situation, the conclusions drawn would also be stored as temporary facts. These can be contrasted with the facts that make up the semantic network (described above) that defines the structures and relationships within the brain that are never changed. Once the user decides that he/she wishes to explore a different situation, temporary facts must be deleted before new facts are entered.

The expert's rules constitute the third level of domain knowledge. They define how temporary facts and permanent facts may be used to draw conclusions. The rules are encoded using the following model:

<primary conditions> and <secondary conditions> imply <conclusion>

If the primary conditions and secondary conditions are proven to be true, then the conclusion is asserted to be true and will be stored as a temporary fact. The motivation behind the separation of conditions into primary and secondary

sets becomes apparent when the algorithm of inference is examined.

The Inference Engine

The inference engine is the part of a rule-based system which directs what rules will be used and how they will be applied. In this program rules are stored in the order in which they are to be applied. This method of scheduling the rules is sufficient because the scope of the system is limited. When processing is initiated, the inference engine will select the first rule, evaluate it, then select the second rule, and so on. When a rule is processed, the primary conditions are tested first. If there is a primary condition that is proven false, then the rule is abandoned. If all of the primary conditions are true then the rule succeeds and the conclusion is stored as a fact.

The intricacy of the model is revealed when there is a case where the conditions of a rule cannot be shown to be either true or false: this is termed an "unknown condition." First, consider the situation where all primary conditions are true and the secondary conditions are either true or unknown. In this case the user would be asked to assign a truth value to the unknown conditions. If a situation exists where one may expect the user to be able to resolve an unknown truth value, then this condition is included in the secondary list.

When the primary list contains only true and unresolvable conditions, then the secondary list is checked. If any secondary condition is false the rule is abandoned. Otherwise, it is desirable to try this rule again after more facts have been inferred. It would be a waste to evaluate the true conditions again so a new temporary rule is created that consists of all those conditions from the original rules that were unresolved. Of course, the

conclusion stays the same in the new rule.

As indicated above, each rule is checked in sequence. After all original rules have been evaluated, the set of temporary rules is processed in an identical manner. When there is no new fact added to the fact-base as a result of a successful rule, the process terminates.

The inference engine also has the ability to use defined rules in a backward manner, working from the conclusion to the conditions. That is, given a fact, the conditions required for a rule to assert this fact are discovered. This process is obviously not the same as that described above. In this case of reverse reasoning, a rule is found that has a conclusion that matches the given fact. Then an attempt is made to prove each condition of that rule. Some conditions correspond to permanent facts and may easily be proven to be true or false. The conditions that correspond to temporary facts are displayed and identified as required to satisfy the rule. Example number 3, below, outlines the approach.

<u>Examples</u>

The examples in this section do not demonstrate the difference between primary and secondary rules, but simply show how facts and rules are used to assert conclusions.

Example 1: The user wishes to know the result of activation of the septum (the facts and rules referred to in this example are stated above).

- the temporary fact that activation of the septum exists is stored
- rule R1 is applied:

R1 Activation of a structure which is part of a system generally implies that the system is also activated but to a lesser degree than the specific structure.

septum is activated and

septum is part of Limbic-1

THUS store temporary fact that activation exists in Limbic-1

- rule R3 is applied:

R3 Activation of a structure generally increases the function associated with that structure.

Limbic-1 is activated and

Limbic-1 is associated with reward

THUS store the temporary fact that increase in reward exists

Example 2: The user wishes to know what the possible outcomes of activation of the limbic system will be (note that rule 5 occurs before the others).

- the temporary fact that activation exists in limbic system is stored

- rule R5 is applied:

R5 Activation of a system implies that the components of that system are activated to the same degree.

limbic system is activated and

Limbic-1 is part of limbic system

THUS there is activation in Limbic-1

Limbic-2 is part of limbic system

THUS there is activation in Limbic-2

Limbic-3 is part of limbic system

THUS there is activation in Limbic-3

- rule R3 is applied:

R3 Activation of a structure generally increases the function associated with that structure.

Limbic-1 is activated and

Limbic-1 is associated with reward

THUS there is an increase in reward

Limbic-2 is activated and

Limbic-2 is associated with attack

THUS there is an increase in attack

Limbic-3 is activated and

Limbic-3 is associated with processing into memory

THUS there is an increase in processing into permanent memory

Example 3: The user wishes to know what might cause an increase in consciousness.

- R3 is selected as a possible rule because the conclusion of the rule fits the fact that is being investigated:
- R3 Activation of a structure generally increases the function associated with that structure.
- This rule indicates that if an increase in some function is observed then the structure that is related to that function is probably activated.
- The permanent fact Reticular-Formation-1 is associated with consciousness is located.
- Conclude that activation of Reticular-Formation-1 would cause an increased level of consciousness.

(Note. Reticular-Formation-1 is a label assigned to a subsystem of the reticlar formation.)

Future Modifications

The first major modification that should be attempted is the streamlining of the inference engine. This, coupled with a faster computer and a hard disk drive, would increase the speed of execution of the system to an acceptable

level.

Another major addition would be a natural language interface. As it stands, the user is presented with labels and short forms for many terms, and the user is forced to interact with the system using keywords. A natural language interface would make the system easier to learn, easier to use, and easier to understand.

General Bibliography

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DOCUMENT RESUME

ED 320 551 IR 014 467

AUTHOR	Herrmann, Thom, Ed.
TITLE	Show & Tell '88. Proceedings from the Annual Ontario Universities' Conference (Guelph, Canada, April 20-22, 1988).
INSTITUTION	Guelph Univ. (Ontario).
REPORT NO	ISBN-0-88955-151-0
PUB DATE	88
NOTE	202p.; For the proceedings of the 1987 conference, see IR 014 466.
AVAILABLE FROM	Media Distribution, University of Guelph, Guelph, Ontario, Canada N1G 2W1.
PUB TYPE	Collected Works - Conference Proceedings (021) -- Reports - Descriptive (141)
EDRS PRICE	MF01/PC09 Plus Postage.
DESCRIPTORS	*Computer Assisted Instruction; Databases; Drama; *Expert Systems; Foreign Countries; Higher Education; *Instructional Development; Intellectual Property; *Interaction; Interactive Video; Teacher Student Ratio; Videotape Recordings
IDENTIFIERS	Canada; Cognitive Apprenticeships; Computer Mediated Communication; Ontario

ABSTRACT

The 35 papers included in these proceedings report on innovative approaches to teaching used by faculty members at Ontario's technical colleges and universities. Included in this collection are papers on optimum instructional methods using microcomputers, teaching French conversational classes through drama, competencies for the educational developer, software development guidelines, educational delivery models using computer databases, interactive audio, journals across the curriculum, electronic technology and the intellectual property enclosure movement, teaching information design, a practical solution for high student-teacher ratios, student journals as a method for achieving cognitive apprenticeship in writing in the social sciences, computer mediated communication, expert system shells for student-developed social science instructional software and for tutoring in cognitive neuroscience, interactive videodisc instruction, a method for interactive seminars, and computer-assisted instruction modules in soil science. References are provided in each of the papers. (GL)

ED320551

Show & Tell '88

Proceedings from the Conference
April 20-22, 1988

UNIVERSITY of GUELPH

IR014467

Show & Tell '88

Proceedings from the Conference

April 20-22, 1988

UNIVERSITY of GUELPH

Copies may be ordered from:

Media Distribution
University of Guelph
Guelph, Ontario, Canada, N1G 2W1

Printed in Canada

ISBN 0-88955-151-0

Canadian Cataloguing in Publication Data

Show & Tell '88 (1988 : University of Guelph)
Show & Tell '88

Edited by Thom Herrmann.
ISBN 0-88955-151-0

1. College teaching - Congresses. I. Herrmann, Thom, 1943- . II. Title.

LB2331.S48 1988 378'.125 C89-093132-1

Preface

The Annual Ontario **Show & Tell** is an opportunity for faculty members at Ontario's various technical colleges and universities to share ideas, experiences and fellowship based on teaching.

This year the presentations included technological and pedagogical based experiences which were presented in what we believe is a unique yet effective format. Each participant gave a 15 minute general presentation (the TELL), and participated in a half hour demonstration/ discussion period (the SHOW) at which time interested individuals discussed specifics. In addition, each participant was given an opportunity to publish a report of their work in this review.

As you page through this volume, we, the organizers of the **Show & Tell**, believe that you will be impressed by the thoughtfulness, originality and concern about teaching expressed by the authors. Scholarship, as evidenced by these individuals, is demonstrated to be more than research within the confines of a discipline. It includes the questioning of what is done to and for students in higher education. The answers are interesting and important.

The organizers of the **Show & Tell** and editors of this volume wish to thank and commend the authors for their contributions to our understanding of how to effectively and efficiently help our students learn. We wish to thank them for their professionalism by examining teaching in higher education in a scholarly manner. We wish to encourage them to continue their important work, we have much to learn and are willing to learn with them.

Thom Herrmann
Coordinator
Show & Tell '88

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Optimum Instructional Methods Using Microcomputers

George H. Abdou
Department of Industrial Engineering
University of Windsor

CONVENTIONAL INSTRUCTIONAL METHODS

Analyzing present teaching methods, educational institutions are facing many serious problems. These problems can be divided into four major areas:

1. **Delivery Style:** The two primary learning modes are the textbook and the lecture. The instructor either writes down all the lecture material or reads prepared lecture. These teaching modes have three limitations:
   a. Lack of facilities to present complicated visualizations in class. In any science or engineering course lecture, less than half the scribblings can be represented by ASCII characters. Instead, a skilled instructor throws a set of sketches, graphs, equations, symbols and arrows, with no effort in conducting the class.
   b. Lack of facilities to refer back to earlier lectures.
   c. Student inconvenience due to less than clear instuctor's handwriting.

2. **Class Size:** The class size is limited to about 30 students. It has been estimated than in a typical class, only about 50% of students learn the present material. Today, inability to increase class size for some courses, is the dominant visible problem of educational institution. Such problem can be the restriction of admission of new students.

3. **Student-Teacher interaction:** Most students would prefer the interaction environment, rather than courses taught via teleconference. But, instructor takes about 50% of class time to write down the lecture on the blackboard, 30% to present the material, and 20% to interact with students. For three office hours a week, instructor can interact with about 15 students. Two problems are developed due to less student-teacher interaction:
   a. Insufficient number of assignments, quizes and examinations.
   b. Lack of learning experience to all students regardless to their background and learning speed.

4. **Instuctor's Time Management:** Too much repetitive efforts are involved in preparation for lecture and laboratories, year after year. A typical instructor's time management, can be 2 hours preparation for a lecture, 3 office hours for students' questions about the lecture or assignment, and 2 hours for grading the assignment. So, for a 3 credit hour's course (2-1.5 hours lecture a week), the time effectiveness (productivity) is 33% (3 hrs/(2*2hrs+2+3)). This figure does not include the TA's (teaching assistant) time to prepare and grade for the laboratory experiment.

CURRENT ALTERNATIVES

Alternative methods have been applied, using the following facilities: overhead projectors, slide projectors, and audio and video recorder. They increased convenience, more contact with professors, better display of graphics and texts. Instructors have better control in conducting the class and provide more assignment and project work.

However, these methods generate more work and time involvement for each instructor in preparing for the lecture. They still carry some of the limitations of conventional methods, such as for delivery style.

Recently, other methods, using computers were applied. These methods are "telelearning", "electornic university", and "education outside classroom". They exist in mainframe computer and are managed by either electronic mail, a computer conferencing system or both. Students interacts with instructors and other members of the class by using a microcomputer and modem. Course are delivered electronically, using telecommunications as the link between instructor and students.

Among the advantages cited by students are increased convenience, motivation to learn and more opportunity to participate in discussions. However, the major problem is lack of the effective feedback provided in live conversation, by facial expressions, postures, gestures, etc. That sort of information is what good teachers uses to monitor how a class is reacting to what is presented.

MICROCOMPUTERS IMPACT ON LEARNING

A microcomputer is a computer employing a microprocessor. It is composed of a keyboard, a video display terminal, electronics and floppy disk drive(s) and/or hard disk drive(s), integrated into a complete, self contained computer system. Peripheral devices include joysticks, paddles and printers.

In some universities, courses are delivered on disk, with associated hard copy reading and study materials. The course disk contains a fixed set of assignments, and projects for the student to complete and upload to the instructor. This is classic microcomputer-based instruction. An element of telecommunication thrown in can make the process more convenient.

Software development is expensive. However, some institutions invest a great deal of money, faculty time, and programmer time in producing programs for specific subject areas. General use (commercial) software has been developed for students and researchers who need real time programs to communicate with laboratory devices. The packages provide scientific calculations, statistics data analysis, data acquisition, terminal emulation, laboratory interfacing, graphics and animation for most common applications.

As computers and associated technology stimulated major changes in an education system, the question became how should instructors present and introduce students to powerful graphics (CAD), programming languages, simulation and animation. But access to powerful software applications is not the fundamental need. Rather extension of computers to greater numbers of classes, expects the design of different varieties of instructional software that give clear demonstration to students for using computers in these applications. If microcomputer-based activities are to improve the teaching effectivness, these activities should take into account the complexities of instructing a different mixture of students in large group settings.

MICROCOMPUTER-BASED INSTRUCTIONAL METHOD

Most universities began using microcomputers in teaching different subject areas. The typical university has more than 80 microcomputers. Although, these numbers are less than the resources needed, the university can provide, for all students, a substantial degree of computer-based instruction.

The following discussion with regard to some features of the microcomputer-based methodology highlights the significance of this paper. For a lecture presentation, Instructor can:

1. gather all types of picture images and text image files, by storing the contents of the active color and screen buffer into a specified file in a disk.
2. create professional display of inter-mixed high resolution, low resolution graphic and text frames on any microcomputer.
3. provide very interesting color graphic animation.
4. set colors for each frame with different background colors.
5. use the keyboard, paddles and joystick to show frames in forward and reverse order, or skip frame(s), if necessary.
6. add, delete, modify graphics and texts during lecture.
7. alter the display order of frames and the length of exposure, to accommodate unexpected changes in lecture material.
8. switch screen between high and medium resolution display mode.
9. reverse displayed image producing the effect of a negative image.
10. print hard copies of any frame.
11. select different dissolve types for the transition from frame to frame.
12. run the presentation in manual or unattended mode.
13. store up to 100 frames in one floppy disk.

The proposed method is to deliver college courses by using software application for presentation. Probably one of the biggest shortcomings of the current computerized conferencing systems now being used for education is the lack of graphics. It is currently difficult to deal with equation, diagrams in these text oriented systems. This application has potential advantages compared to other modes of educational delivery, including more active participation by students, increased number of assignments and quizzes, and

presentation of complicated visualizations.

HARDWARE

The true portable computer, which the instructor can carry to a classroom, is called the Lap Top microcomputer. Because of their small size and weight, I found these microcomputers to be more portable than the many desktop machines. All of them uses double-sided 3.5" disk drive(s) that store 720K bytes. The processing speed varies. They include a composite port to connect a monochrome video projector. An RGB exists in some models to connect a color video projector or monitor. They includes a parallel port and a serial port, to connect a printer and a joystick, respectively. Table 1 shows a comparison of some of the Lap Top microcomputers.

SOFTWARE

While few software has been created expressly for use for instruction, much of the existing software, including the most sophisticated, can be brought to the active screen and saved in a disk with the little software we have. Storyboard and Present are the two softwares that I can consider for general presentations (see table 2).

APPLICATION

Similar studies have been conducted by the author at Northern Illinois University, Dekalb, Illinois, and the results look very promising. In view of increasing awareness of modern technology and its application in education, the ever decreasing cost of technology, and the possible shortage of faculty in areas like engineering, this method assumes phenomenal importance while also being feasible.

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TABLE 1: Lap Top microcomputers

Company	Model	Weight lbs	RAM bytes	Storage 720K bytes	Clock Speed	RGB	Price $U.S.
Bondwell	Bondwell8	11.5	256K	1 3.5"	4.77	Y	1295
Data General	DG's 2T	12.0	512	1 3.5"	4.77/7.16	N	1695
Grid Systems	GRIDlite	9.0	128	1 3.5"	4 77	Y	1750
IBM	Converter	12.5	512	1 3.5"	4.77	N	1995
Kaypro	2000	11.0	256	1 3.5"	?	N	1995
NEC	Multispeed	?	640	2 3.5"	4.77/9.54	Y	3695
Sharp	Sharp	10.0	256	1 3.5"	4.77	N	?
Toshiba America	T1000	6.5	512	1 3.5"	4.77	N	995
	T1100Plus	10.0	256	1 3.5"	4.77/7.16	Y	1999
	T3100/20	15.0	640	2 3.5"	4.77/8.0	Y	4699
Zenith Data	Z-181	12.0	640	2 3.5"	4.77	Y	2399
	Z-183	15.5	640	1 HD10MB	4.77/8	Y	3499
Wang Lab.	Lap Top	14.2	512	1 HD10MB	4.77/7.16	N	?

TABLE 2: Software

Company	Product	Computer	Price
Harvard	Harvard Presentation	IBM & Comp.	?
IBM	Storyboard	IBM & Comp.	369.00
MLS	Present	IBM & Comp.	40.00
Software Publishing	Click Art	IBM & Comp.	185.00
Thirdware Computer	Finger PrintIIc	AppleIIc	149.00
Xerox Corp.	Destop publishing	IBM & Comp.	895.00

TABLE 3: Projectors

Company	Type	Weight lbs	Color	Price $ U.S.
ASK Lcd	flat screen	3	N	1050
Eastman Kodak	flat screen	12	N	1270
Telex	flat screen	10	N	900
Barco	video projector	82	Y	15000
Electrohome	video projector	22-65	Y	?
Sony	video projector	51	Y	6400

From Reading to Writing:
Making it Happen in the University Composition Classroom

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What classroom techniques will encourage first-year Composition students to develop better writing processes and products? In the English Department at Laurentian University we have developed a set of pedagogical and logistical practices to help students get from reading to writing, which of course is the process basic to university essay writing as well as to much employment-related writing. This set of practices helps us deliver a composition course based on two complementary theoretical principles: 1) good writing develops out of good reading; 2) good writing products develop out of good writing processes. We teach a simple method of critical reading, and we use a combination of techniques well-known in composition: heuristics, journals, peer editing, conferencing. Perhaps what is new in our methodology is just the combination of pedagogical and logistical techniques by which we integrate the teaching of <u>process in critical reading</u> and <u>process in composition</u>. Our text based on this combination, <u>From Reading to Writing: A Reader/Rhetoric and Handbook</u>, will be published shortly by Prentice Hall.

We came to our present approach to first-year composition via long experience and a concurrence of complementary critical stances among faculty interested in Composition. For many years we taught standard, grammar-based Composition: "bonehead English," with its handbooks and workbooks, rules and drills, and essays based on set topics and "modes" of writing such as comparison or cause and effect. We knew students were making many basic errors in sentence structure and other grammatical errors; we did our best to help using current/traditional approaches to the teaching of writing. After several years of part-time teaching, however, I was puzzled and frustrated by the readily apparent failure of my students to transfer their correct drill answers to their writing. Overall, their writing did not seem to be improving through the session.

In 1983-84 I embarked on a doctoral programme in composition and rhetoric at the University of British Columbia. After a year of studies I returned to Laurentian committed to an expansionist, neoclassical rhetoric defined as the study of effective communication, to modern composition theory stressing process in writing, and to rhetorical criticism in the tradition of Kenneth Burke, Wayne Booth, and my own teacher, Andrea Lunsford. I was surprised to find a new, process-oriented textbook in use in first-year Composition at Laurentian, and a new full-time colleague, Dr. Lawrence Steven, with an interest in Composition based on his own studies in critical theory and hermeneutics.

In 1986, after I was appointed full-time to teach first-year Composition, Dr. Steven and I, along with a group of interested full- and part-time colleagues, began to develop a new approach to the course which was "top down" rather than "bottom up." That is, it began with the rhetorical situation or "occasion" for

a piece of writing--its subject, audience, and purpose--and worked down to revising errors at the sentence level rather than starting to teach writing by working on sentence-level errors. As we worked, we realized that many of our students' problems began even farther back: they were not comprehending the reading materials out of which most of their essay writing at university level and beyond would develop. They could not write because they could not read. We would have to teach critical reading skills before we could even get to writing.

Then we began to see that we could put reading and writing together by showing students how parallel the two processes were when approached rhetorically. If the student attempted first to understand the rhetorical occasion out of which a text developed--its subject, audience, and purpose--she could work through various stages in that understanding to an interpretation of the piece which would emerge into a piece of writing of her own developing out of <u>its</u> particular rhetorical occasion. Many of the same steps in a critical reading method or tool could be used to organize the student's own piece of writing.

We teach critical reading, first of a single text, then of a group of thematically-related texts, using an analytical tool we call the "Active Reading Method." Since we have discovered that many students' idea of reading something is to move it passively before their eyes, we teach "active reading" (analagous to active listening, as taught in interpersonal communication theory); that is, we demonstrate in the classroom how students should mark up texts they are reading right on the page (something past schooling may have discouraged), not with highlighter, but with pencilled-in arrows connecting repeated ideas, images or key words, stars, question marks, division marks and numbering, marginal paraphrases of key points. Thus active reading marks the beginning stage of a working understanding of a text.

Next, we ask students to complete their active reading by making a page or so of notes for each text they read; they keep these notes in a special notebook, the Reading Workbook. Each entry in the workbook consists of six steps constituting a critical analytical method or tool that can be used on any piece of expository writing. In the first weeks of our course, we demonstrate each stage or step of the analysis in the classroom using a simple, straightforwardly organized single text. The first step asks students to identify the subject, audience, and purpose of the text as specifically as possible in relation to the particular text. Secondly, students find the thesis statement of the piece: the sentence or small group of sentences that either open up the rhetorical occasion of the piece or encapsulate its controlling idea. The third step is to identify and supply instances from the text of "developmental strategies"--the old modes--such as example and illustration, definition and so on, by which the thesis of the text is developed. Fourthly, students outline the piece diagramatically, dividing, numbering and titling main sections and subsections of the piece, so that they create a two-level outline which distinguishes between main and lesser ideas in the body of a text, ideas in support of its thesis.

The fifth and sixth stages in the "Active Reading Method" are climactic and pivotal. The fifth stage is a summary, in which students are asked to reduce the text to its essential points: probably paraphrasing the thesis and main supporting points, as discovered and recorded in previous stages of the analysis. The summary thus gathers up the student's understanding of the text. The final stage, the response, a minimum of 100 words in length, moves the

student from reader to writer, towards overt assimilation of his understanding of the text with his own experience: in other words, towards interpretation of the text. The response may be tangential ("That reminds me of"), stylistic, evaluative; it may supply further examples or illustrations, comparisons, implications, or other forms of reply. The response may be narrative: a history of the student's response, moving, perhaps, from immediate, emotional, negative reaction, to later, more rational response. A student may respond to only part of the text or to the whole. Students are expected to support assertions in their responses with evidence from the text. Both summaries and responses are read aloud in the classroom or written out on the board for comparative purposes. Students are amazed by the variety, the conflicts in summaries and responses. Instructors must handle these carefully, guided, as must be apparent by now, by the very evident potential for conflict and confusion, and by their own critical stance. Note, for instance, that summarizing assumes that, "pace" deconstructionist views, discernable meaning does reside in the text to some extent, while asking for individual response assumes that reader-response, if persuasively defended, has validity.

We find that demonstrating the Active Reading Method can be effectively augmented by having students examine student examples of Reading Workbook Entries for particular texts, and by having them do exercises in which they practice the individual stages on other texts. Early checking of the students' own Reading Workbook and eliciting students' own work in the classroom also help ensure that students understand what is required of them for each stage.

As stated earlier, the response is the pivot. To move from the reading occasion into the writing occasion (the assumption being that the student is going to write an expository piece of her own after completing the reading of a text or texts), the student actively reads her response, treating it as a text. This reading will highlight key words, images and ideas, suggestive and germinal examples, comparisons, or implications which can become the raw material for her own essay.

Now teaching of the process of expository writing has begun. Rediscovery of classical rhetoric is one factor promoting the active teaching of process in writing (Empirical studies over the last two decades of writers in process of writing have been another.) The "canons" --parts or stages--of classical rhetoric as set forth by Aristotle in the Rhetoric and elaborated by Roman rhetoricians like Cicero and Quintilian began with invention, a stage forgotten over centuries as the province of rhetoric contracted, until rediscovered in the twentieth-century renewal and made part of composition theory, principally in the American discipline of composition. Our method for teaching critical reading combined with expository writing in introductory Composition courses thus uses the response as one inventional technique; one technique, that is, for generating material for an essay. Earlier composition textbook pedagogies, born in mid-nineteenth century American colleges out of a new need, because of growing numbers of university students, to replace earlier oral examinations with written, stressed the second classical canon, organization of the essay("Find a topic, narrow the topic, write a thesis and an outline) while ignoring invention completely. Few Composition texts before the mid-nineteen seventies gave any hints as to where the material to be organized was to come from or how it was to be generated.

To teach invention we add to active reading of the response other "heuristics" or exploratory tools. Some are by now well-known, such as the journalistic pendad "W5," brainstorming, and freewriting. Others, such as Kenneth Burke's "dramatistic pentad" and the "tagmemic heuristic" of Young, Pike, and Becker, are less widely suggested in texts but equally useful. Still others derive directly or indirectly from classical rhetoric, such as Aristotle's "topoi," or Richard Weaver's hierarchy of topics. We teach and demonstrate these methods to students in the classroom, showing them, for instance, how quickly several blackboards or overhead acetates can be filled up with ideas generated by brainstorming.

We then move to organization (always remembering that the entire composing process has been demonstrated by a generation of empirical composition researchers to be recursive, moving in the individual writer's composing process constantly and idiosyncratically backwards and forwards among the stages and levels of the process). Now we are able to show students that the same analytical tool, the Active Reading Method, which they used to understand a text or group of texts can help them organize their own piece of writing. Once they have accumulated a great deal more material than they can possibly work into their essay using a combination of inventional heuristics as well as their responses to readings, they can begin to construct the rhetorical occasion for their own piece of writing by deciding on their own subject, audience and purpose, their thesis statement, the developmental strategies they will employ, and the outline of their piece. This preparatory work, all done in writing in contrast to earlier textbook directives to "Think it out, then write it out," is referred to in composition theory as Prewriting. We get our students to do it collaboratively in the classroom at first, then individually for every piece of writing they do. Often we ask them to talk about their prewriting in class or put TS and outline on the board. Sometimes we use small groups to vet this work; at other times we use what I call a "go-around," in which every student in turn is called upon to describe his planning.

We teach drafting principally by requiring it to be done before a final version of the essay is handed in. This requirement has many implications. First, it creates the possibility, considered essential by professional writers, for student writers to "incubate" their essays, i.e. sit on them (!) for a while, so unconscious processes can have time to work and come to consciousness as insights, and also to revise their work globally, i.e. not merely proofread or even "edit" their work as they produce the "good copy," but to reconsider their work from the conceptual level right through organization, sentence structure and rhetoric, and mechanics. Secondly, it creates a situation in which a provisional version of the paper has been created, which can be shared, both with a group of peer editors and with the instructor, for evaluation but not for grading.

Thus enters the scene the writing group, an essential but demanding feature of our pedagogy. The writing group offers many advantages, perhaps most obviously to less talented writers, but to better writers and instructors too. Good students learn by helping others; their own writing improves as their critical facility increases. Instructors gain when students gain and when teaching can be done without their having to stand up front and lecture. Many students of varying abilities learn better in small groups and from each other than by lectures. But the writing group is not without its peculiar pedagogical challenges.

The first set of problems in dealing with writing groups involves motivating the groups and getting them started. Groups need to be convinced that doing all this extra work will result in better writing products--and marks. Instructors can meet this need by showing some of their most convincing examples from previous sessions. Groups will also protest that they are not competent to judge the work of others: does not their presence in the intro comp class (the result of a test failure or requirement in many universities) prove their incompetence? Yet instructors can point out that in analysing a text and doing preparatory inventional work collaboratively the class has already learned a vocabulary to use in discussing drafts. Students can also be assured that they will be given limited criteria for judging each paper, that some of their most valuable discussion, according to theorist Peter Elbow will be about just the topics of their papers, and that their instructor will set them a specific process and definite tasks and be available to adjudicate disputes or suggest alternatives.

Forming the groups also requires careful thought. I have found that groups of between four and six work well; a certain critical mass is required for good group dynamics. It is also well to get diagnostic pieces of writing before forming the groups, because groups work well if they can contain at least one reasonably good writer. The instructor should also try to assess leadership potential in the class and put at least one "leader-type," meaning a facilitator rather than a dominant figure, in each group. Mature students often fulfill one or both of these functions--good writer and good facilitator. Try not to isolate these figures in groups since immature groups can be swayed against them by uncooperative types. Much depends on the atmosphere and dynamics set up in groups. Instructors can intervene to solve occasional task or process problems, but they can't be everywhere at once.

The first meeting of a writing group should probably be devoted to some group-building activity rather than, or perhaps in addition to, the first tasks they must perform on the drafts themselves. Discussing the prewriting work for the draft may fill this bill.

Instructors also need to think about the logistics of making writing groups work in the intro comp classroom. Students need to make sufficient copies of their drafts for the members of their group plus one for the instructor. This means they must have met with their writing group before having to bring their draft copies to class, or at least know how many will be in their group. They need to exchange copies with members of their group, they need to analyse those exchanged copies, and then they need to discuss them. Conceivably this activity could all be carried out in the same class meeting; say a three-hour session blocked off into periods for exchange, individual work on exchanged drafts, and discussion. But we have found it more satisfactory to separate these stages.

So we normally have first a meeting of groups to exchange drafts within groups and read them aloud. Writers may read their own or become readers while another group member reads their paper. At this time the valuable discussion of subject/topic can take place and small corrections can be made to the drafts. It is probably best to discourage detailed analysis at this stage, although initial reactions from a "live" peer audience can open many a student eye.

Then students take away the exchanged papers from their group to analyze them individually on the basis of some set of criteria established by the instructor. Once again the Active Reading Method can be put to work, or some other check-list of possible features may be used; additionally we often ask for an evaluation of some strengths and weaknesses in the papers. We find it valuable to ask students to return to class with this work done in writing on the exchanged papers. This work may need to be checked by the instructor. Its purpose is to serve as the basis for the oral discussion of each member's draft which is conducted at a subsequent (usually the next) class meeting. Arranging for the separate meetings of the groups for exchange and then for discussion with at-home time for individual analysis in between takes some careful thinking through on the part of instructors whose classes meet just once a week.

Instructors can enhance the quality of feedback given in writing groups by several means. They can ask students to consider their own experience of receiving feedback or evaluation: what kind of responses from instructors or others were more and less helpful. They can also teach students a simple system of marking symbols, perhaps most sensibly the one they use themselves, ideally that found in the composition textbook they are using. Finally they can set clear criteria for the analysis of exchanged copies: some general guidelines for the individual written analysis, and perhaps a particular emphasis for their evaluation, related to the stage or level of revision the instructor is currently stressing. Students should not be asked to do too much with the exchanged copies. Above all, they should be restrained from correcting and urged rather to point out problems they experienced as readers, indicating where the writer failed to communicate effectively to <u>them</u> and some possible options for revision.

Attendance at both exchange and discussion (drafts workshop) meetings of the writing groups is crucial. The whole concept of peer editing and evaluation can be undermined by students who in spite of all our efforts either fail to see the value, have job or extra-curricular commitments, or simply decide not to do the extra work. We have found it necessary to invoke the general attendance regulations in our own university calendar to fail students in our intro comp courses who miss more than 20% of scheduled class meetings. We also refuse final papers when their authors have not participated in the exchange and analysis of drafts.

Students do lead complex lives today, so I have found ways of facilitating he exchange of drafts. Attendance at the exchange session is less critical than at the actual workshop discussion. What is required is that students produce draft copies in time to be exchanged on schedule with their groups. I often grow a "drafts tree" which spreads across my office door, a tree of envelopes

addressed from and to individual members of groups and containing draft copies that need to be exchanged in time for at-home analysis and later workshop meetings. If I taught in a single classroom, I might arrange a file drawer system; or perhaps the Department office might be a more accessible locus for facilitating exchanges.

It isn't just attendance at writing group sessions that is critical; it's also participation. It is important to set groups specific criteria for evaluating drafts, which can become the basis for discussion. If necessary, say with your [illegible], less motivated groups, instructors can be fairly directive in moving into groups to ask leading questions, making sure no one is dominating discussion or derailing it, keeping time so that all papers get equal discussion, and setting specific tasks to be reported back to the whole class after the group workshop session. These tasks can be fairly simple and related to the area or level of revision the instructor wants groups to stress; for example, they make get groups to report an effective sentence from each member's draft and defend their choice. Instructors at the university level may want to consider giving specific marks for process-related tasks like producing drafts, analysing exchanged drafts, and effective participation in drafts workshops. This is certainly being done in process approaches to writing at the high school level; in our own case at Laurentian we have thus far resisted doing so.

Writing groups can be used in other ways besides peer editing of short essays. They can do group invention, revision exercises, group "go-arounds" to report on prewriting. They can take <u>sections</u> of essays too long to photocopy in their entirety for the group, such as the research paper, and analyse and discuss them.

When writing group discussion is complete and reporting has been done, the instructor can use a period of time to teach points that appear general throughout the class. We teach the concept of revision by stages, moving from "large" to "small" matters, i.e. from global revision of an essay to revision of mechanics.

Once final drafts are in their own good time produced, the process appears to come to an end: the product must be marked on its own merits. But it does have a few further uses in the intro comp classroom. It can be returned to the writing group to demonstrate what their work has accomplished. It can be read aloud and its effectiveness in the instructor's eyes pointed out. Ideally, outstanding products can find publication somewhere. For this reason instructors may want occasionally to move away from thematically related groups of readings found in textbooks to "found" texts related to current issues of interest to their students. In such circumstances publication of writing products can be a means of contributing to campus debate as well as making expository writing a "real" exercise in effective communication within a particular rhetorical context. It must be admitted that such topical sequences from reading to writing may be more appropriate for intermediate or advanced composition courses.

I have just described the combination of logistical and pedagogical methodologies by which we move from reading to writing in our introductory

composition classrooms at Laurentian University. Complementary techniques used in most process-oriented Composition courses remain to be discussed briefly.

Most process-oriented Composition courses require students to keep a separate notebook in which they do regular, informal, ungraded writing, usually called journal writing. The rationale for this activity is that all writers, but particularly beginning or unsuccessful writers, benefit from writing a lot, and from doing writing in which the bogey of "correctness" need not appear over their shoulders. Certainly professional writers make extensive use of journals. Entries should probably be dated; we find three a week to be sufficient. Although secondary school English courses, especially at senior levels, now stress writing (and writing process) significantly more than in the past, the change is relatively recent in Canada. As a result many of our intro comp students have not benefitted from this change, either because their high schools had not yet made the switch or because they have been out of school for a number of years. We can hardly underestimate the lack of freedom, enjoyment, and ease in writing that many of our students experience. Journal writing, although viewed as something of a burden by some students, who see the course as already very heavy, offers many a way to experience the joy and satisfaction of communicating effectively to an audience of themselves.

Journals can be used in many ways, both in and out of the classroom. In class, students can be allowed time to use their journals for prewriting activities, both inventional and organizational. Some instructors may want this kind of journal material to be separate and detachable from the more personal journal entries, so they may ask for looseleaf journal notebooks. Of course prewriting can be done in the journal outside of class time as well; it can thus count towards fulfilling the weekly requirement of three pages. There are many other uses of journals either in or out of class. Students can be asked to fill pages with lists: favourite activities, heroes, things, etc. Or they can be asked to do a more classic diary for a week: "three days in my life." The whole class can be asked to do the same topic: dreams, money, leisure, using three different approaches to the topic during the week. It would be desirable to discuss the results briefly in class; it may lead to a better understanding of the uses of the "modes" or developmental strategies (methods of development). If journal writing is done in class, especially if it relates to essay preparation, students might do it sitting in writing groups. Instructors may want to ask students to bring their journals to every class.

Some instructors find the more personal journal writing more successful than the essay-related entries. The rationale for suggesting the latter is that it kills two birds with one stone. As previously mentioned, some students find the journal one of the more onerous parts of an already heavy course; others are happy to discover how it improves their writing fluency. Allowing some class time for journal writing is another way to ease the burden. Of course if students are writing in their journals in class, it would be good if instructors were doing the same thing.

This brings up a related point. Should you introduce your own writing in the composition classroom? Opinion among composition theorists is divided on

the issue. Some advocate the practice on grounds that it shows the instructor as a working writer; others worry that it may intimidate students. Perhaps the answer depends on how comfortable the instructor is in bringing her own work into the classroom. Ontario language consultant Gwen Mowbray told a recent conference of writing teachers that she often brings in a piece of her own and asks for help (the request must be genuine, Mowbray stresses) with a word or sentence. One thing seems clear: many writing instructors in fact do not write a great deal themselves, and certainly they very seldom place themselves under the sorts of conditions they regularly impose on their students.

To conclude our discussion of journals in the introductory Composition course, it should be noted that although the journal is conceived in principle as private writing, to be shared only at the intiative of the writer, if it is a course requirement it must at least be scanned by the instructor regularly, if only to see that it has been done, is genuinely the work of the student, and was probably done on the date indicated. This requirement adds further to the already heavy marking burden in a process-oriented composition course. Some instructors have found, however, that briefly scanning the journals every two weeks or so, as well as having some journal work done in class, reduces this burden considerably.

Finally, a brief note on conferencing in the process-oriented composition course. We use brief individual conferences with students twice during a session in our intro comp course. The first conference comes in conjunction with the first short essay of the session, either after the final drafts have been returned or, on the recent suggestion of an instructor in our course, after the writing groups have discussed and analysed the drafts. Much depends on the size of the class. We suspend regular classes for a week twice during a winter session: once for the first essay conference and again to confer on the research paper draft. The conference can be used to do brief remedial exercises, reteach points students have apparently missed, impress upon students the necessity of meeting deadlines and other requirements, and above all, to answer student questions. For the research paper conference, a system of marking the draft can be used to point out places where the instructor particularly wanted to comment.

We were pleased to have had the opportunity of the Academic Show and Tell sponsored by the Office for Educational Practice of Guelph University to share with interested Ontario university faculty the classroom and logistical techniques we have evolved to move students from reading to writing. There is now ample evidence in composition research that process is an approach that can produce better student writing. But if process is going to succeed in the classroom it must be translated into workable methodologies. Pedagogy has not had high priority in Canadian universities. But instructors in Composition and many other disciplines are coming to see instruction in critical thinking, critical reading and process in writing as a way to enhance learning across the disciplines. We need to understand the importance of <u>interpretation</u> in many disciplines and the key role of writing in all disciplines and at all levels of university instruction. We hope our ideas and experience can help others.

Teaching French Conversational Classes Through Drama

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Drama has always been widely used as a pedagogical tool. Its relaxation techniques combined with voice training make it appealing for oral language classes. Faculties of Education have always included drama in their curriculum for future primary and secondary teachers. At the university level, professors such as M. Rassias (Dartmouth College, Mass.) rely heavily on acting to teach basic language concepts. However, it is only recently that teachers and professors have made the most of drama. In Germany and Scotland, the methodology varies but the idea of using drama is the same. First, we shall briefly examine how drama techniques are used in these countries. Then we shall present our methodology for French conversational courses at Waterloo, and finally, we shall discuss the results.

The principal idea behind the use of drama in teaching a second language, in the countries mentioned above, was to give the students a practical approach to the language, be it at the beginner's level or at a more advanced one.

Let's have a look at Germany, in the Centre de Didactique des langues étrangères (ZFI) de l'université de Hambourg;* the instructors wanted to reactivate passive acquisition of French, by giving the students the opportunity to use their knowledge to write a play and then perform it. They did not work on this in formal classroom meetings, but rather on two weekends. The first one was for a brainstorming session to determine the

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*Français dans le monde, No. 211, Août/Sept. 1987, p. 51.

themes for the future plot. This was followed by the elaboration of the characters, and finally the production of the first draft of the play. The second weekend involved writing the final script and performing the play. This extremely intensive approach allowed the students to use their creativity and combine it with both written and oral practice of French. The German experiment proved to be very valuable for students who had had previous instruction in French. However, such a workshop would not be as valuable to students who have absolutely no knowledge of a second language. So, how can an instructor of beginners use drama to serve his or her objectives?

Charlyn Wessels of Stevenson College, in Edinburgh, has developed such a method for beginners. She describes it in her book entitled Drama.[1] By using acting techniques of relaxation, vocal training and games, she creates an atmosphere of friendliness that gradually makes the students' initial shyness and fear of being ridiculous disappear. Once this positive atmosphere has been created, she works on role plays and finally on excerpts from famous contemporary dramatic works (for example, Twenty One-act Plays: An Anthology of Amateur Performing Groups, (Garden City, New York: Doubleday, 1978)). According to Ms. Wessels: "A drama project can build appreciation and understanding of the culture and codes of behaviour of the target language -- so it can reduce resistance in the learner towards that language."

Having seen two different approaches to drama as a tool for language teaching, both with such excellent results, I was convinced that our department could offer something similar. We had already worked on a play

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1 Charlyn Wessels, Drama, Oxford University Press, 1987.

for "fun" with some third and fourth year students. We were so impressed by their performance that we decided to create a more structured course that could offer the students valuable communication skills (in French), a certain confidence, and a taste for French contemporary drama. FR 208(D) was born.

The course is not a literary one, even though drama can be used in teaching literature as Charlyn Wessels has shown in her book. What we wanted to do was to take a conversation class and transform it into the production of a French play (or plays). There were several difficulties along the way. First, we needed to find students looking for something different, because the evaluation of the course would not be as "mathematical" as other courses (no tests, no midterm). Second, they should have had some exposure to French before, and should have a relatively good reading knowledge and understanding. Third, it is difficult to find a short contemporary play with plenty of conversational interaction, many parts of equal lengths, and which is, as Charlyn Wessel says, "large enough to justify the language-learning aims of the project." Finally, finding rooms that can be re-arranged easily is sometimes a problem. Ideally, the use of a drama studio is best. Once we had overcome these difficulties, the course could take place. The students must attend all classes (four hours a week) divided as follows: three hours are dedicated to the production of the play, and a one-hour seminar on "Drama from ancient times to the XXth century." This part of the course offers the students general background on the topic. The class is given by Faculty members of different departments whose interests in literature, including drama, cover all centuries.

Each session starts with relaxation techniques, breathing exercises, and

warm-ups, ending with games involving physical contact.

Warm-up exercises

A. Most people are familiar with these exercises. They include shoulder rotations, posture exercises: stretching (for example, "apple picking"), rotation of the waist all done very slowly.

B. Posture and breathing exercises, such as: standing up, legs apart, breathe and lift the arms on the sides, breathe out and lift the arms above the head. Reach for the ceiling with each arm. Breathe in, lower the arms to the shoulders, breathe out, arms down. Relaxation of the jaw muscles is very important. Any tightening of the jaws will interfere with proper breathing and sound production.

The following exercise combines both muscle relaxation and sound production. Take two long deep breaths. Breathe in through the nose and out through the mouth. (Breathe in and count 1, 2, 3. Hold the breath for 1, 2, 3. Breathe out 1, 2, 3.) Breathe in and out saying 'ahhhhh.' Same thing with 'ouhhhhh, ihhhhh, euhhhhh.' Now, add an m - 'mahhhhh,' n - 'nihhhhh.' Then let your voice go up in pitch with the 'mahhhhh' sound on one breath. Same thing down. Repeat 3 times.

Another exercise which the students find amusing helps to release the tongue tension. Open your mouth, pull out your tongue and count, or try to count, to ten with your tongue out. Finally, relax your whole face, screw it up very tightly, release, repeat. We end this muscle relaxation by massaging the whole face with the finger tips.

It is now time to move on to tongue twisters, such as: "les

lentilles ragaillardissent-elles? Pourquoi les lentilles ne ragaillardiraient-elles pas?" Such exercises help the students to open their jaws, and give better sound production. The instructor starts with one and the whole group repeats twice. Then at random, students are chosen to repeat it alone, in pairs, or in threes... Later, the students take turns inventing their own tongue-twisters.

Charlyn Wessel has mentioned a particular exercise that I like very much. It is poetry reading. Choose very short poems (ten to fifteen verses maximum) and have each student recite one verse. The whole group moves freely about the room, each student reciting one verse in turn. This gives the students time to practice diction, enunciation, rhythm, and pronunciation. Charlyn Wessel suggests that "it can also be read as choral poems (some lines given to female voices and the others to the male voices of the class)."[2]

C. For the final segment of the warmups we include some aerobics.

a) Kick one leg, then the other in front of you, arms stretched in front of you pushing some imaginary wall.

b) Then, in a circle, each participant chooses an action (jumping, pretending to be an aeroplane, a train, a lumberjack and so on). One person goes to the centre and does his/her action, everybody mimics it and he/she leaves the centre, goes back to the circle and someone else comes into the centre. There should be no interruption in action and the pace should be fast.

c) When everybody is really wound-up we play a couple of games.

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2 Ibid., p. 71.

"The wall," for instance. Students divide themselves in two groups (three minimum). They line up beside each other, arms spread out, fingers touching each other. There is a caller who determines if there is a wall or a street. By pivoting their bodies to the right or the left they make a wall or a passage. Now, two students (cat and mouse) chase each other. The caller should make quick changes of the wall or passage. The mouse can enter the wall and take the place of one of the "stones." The stone becomes the mouse.

An other game is "The hare and the fox." In pairs, people nake bridges with their arms. Each bridge represents a hare's burrow. Every time the hare jumps into the hole, it is safe, and one of the bridge holders becomes the hare, and so on.

Finally in a circle, students run on the spot very slowly, then faster, closing the circle at the same time. When they touch each other, everybody bends towards the centre and shouts at the top of his lungs a single word chosen prior to the exercise. This exercise is excellent as a final release of tension.

It may seem silly to do the games mentioned above, but these students live in a society that allows very little physical contact and consequently find it very difficult to touch each other on the stage. All this preparation should not be neglected: it is very important to do it at each session. After the physical warm-up, students find that they are ready for action, so to speak, and it is then that we move on to the brainstorming sessions.

These sessions are very valuable for defining the characters of the play,

who they are in real life, what they look like, what their hobbies are, their favourite author and so on. After such sessions the students have a better feeling for each character which helps them to choose the part they want to play. These brainstorming sessions last only the first two weeks of classes, and are later replaced by actual rehearsing of the various scenes. (It is very important to write out a detailed schedule of who is rehearsing what, when.)

Each rehearsal starts with reading the parts aloud, and students should be given the opportunity to try each one. Then they improvise freely on what has just been read; this helps determine how each student feels about the part by showing spontaneity, humour, emotion, and so on. Following this improvisation they read the scenes again keeping in mind what has been said and felt about the characters. At this time, I also ask them to exaggerate everything. This part of the rehearsal lasts about an hour and a half.

Preparing a play is not only a matter of learning a part and performing it. It involves also the technical aspects of the productions. Usually we spend a few minutes at the end of each class discussing these aspects (for example, posters, advertising, and programs). The students are entirely responsible for the advertisement for the play, the costumes, sets and props. In Waterloo, we are very fortunate to have a Drama Department that helps with lighting equipment and props.

After the eighth week it is necessary to have extra rehearsals. Those are done in small groups (two or three students) to give each student individual attention and help her or him overcome certain problems (for example, pronunciation, or use of space) and add finishing touches. The dress rehearsals are essential and should be considered as seriously as the performance itself.

Finally at the end of the term, the students perform the play. It is very important to do it more than once. One or two days before the performance we invite other classes and teachers to see the play. This gives the students even more confidence.

We try to build that confidence during the twelve weeks of the course. Being together for four hours a week is not usually sufficient to create strong enough emotional ties between the students. One of the reasons for the success of such a course is that students know each other well. The only way to achieve this is to get them together as often as possible outside the classroom environment. Full participation in all the activities is compulsory. Students know this when they register for the course. These activities are of two kinds: social ones, such as potluck dinners and going out for dinner, and the drama-related ones, such as plays in Toronto (Théâtre français de Toronto), French films at a local theatre, Ballet and Mime shows. These are always followed by a sharing of impressions. In being together we create an intimacy that will help the students on the stage.

Because students receive a credit for the course, there must be some formal evaluation of their work. Seventy percent of the mark is based on participation. Participation involves being present at all classes and all activities, memorization of a part, creativity and involvement in the technical aspects of the production. Thirty percent is based on a project in French related to any aspect of the Theatre Arts. It is presented orally, and the mark also reflects the student's linguistic achievements in vocabulary, syntax, and phonetics.

Having discussed the course and the evaluation, we come now to the results. They are of two kinds: tangible and intangible progress made by

the students in the target language.

The most noticeable progress was in the pronunciation. The tongue twisters combined with intensive repetition of the lines and constant correction from the instructor, helped the students master certain pronunciation related problems (correction of the l, the r, and of certain vowels). All this helps not only the pronunciation, but also prosodic features such as rhythm and intonation. In regular conversation classes we often have to deal with students with these problems, and it is not always easy to correct them. Learning and repeating the lines helps the students immensely. If one particular student does not seem able to overcome the difficulty, it is possible to tape the part for him/her and ask him to listen to it over and over at home. This is also recommended in case of a character having a distinctive accent (southern France, for instance). Although we have emphasized pronunciation, rhythm, intonation, the students also gained a lot from the lexical and syntactic points of view.

Acquisition of new grammatical structures, new vocabulary, a better pronunciation and good prosodic features were all acquired by the students at different levels; but what they really gained was confidence, and, to me as their instructor, that was the true objective. It is true that some were more at ease than others at the beginning but they all benefitted from it. It gave them a taste for French contemporary drama; but also a feeling that French was not only a tool to get a job, not only words to memorize, and rules to learn, but something one would have fun with and love to use.

Education and International Development
The Black Dragon River Consortium

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INTRODUCTION

In a recent issue of the Financial Post newspaper (November 17, 1986) correspondent Wayne Gooding wrote the following assessment of China's desire to modernize.

"China can't afford to be consumer-driven as this would mean wasting too much foreign exchange on household gifts such as televisions. Rather, it wants capital goods, resources, technology and intellectual expertise, items that will serve the cause of economic development and the well being of 1.1 billion Chinese." (1)

To this end, the Chinese government has been actively seeking assistance world-wide from governments and private companies, to carry out their massive scheme for gradually blending the best of two systems, "socialism and capitalism."

"Canadian academic relations with the People's Republic of China began to develop soon after the two countries established diplomatic relations in October 1970. Since then, academic exchange activity with Canada has evolved through three phases - beginning in 1973, in 1979 and in 1983 - each of which has resulted from new initiatives of the two governments." (2)

It is the third phase which will be outlined in this report since the Black Dragon River Consortium (hereafter known as BDRC) is a direct result of this third phase initiative.

HISTORICAL OVERVIEW

"Phase One began with the Canada/China Student Exchange. The Exchange began to operate in the fall of 1973 and quickly became the most regular vehicle for academic exchange contact between the two countries." (3) Other academic exchanges did occur from 1973 to 1979 but with less formal and less successful results. English training programs were deemed necessary before the Chinese could fully benefit from future exchanges.

Phase Two began to change our relations dramatically in 1979 when the Visiting Scholars Program was introduced. This program saw over 2500 Chinese scholars visit Canadian universities and colleges "for two years of non-degree advanced study and research principally in engineering, medicine and the sciences." (4) By 1983, twenty-four Canadian universities were involved in negotiation for academic exchange agreements which would involve more in-depth exchange activity.

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(1) Gooding, Wayne. The Financial Post Division of MacLean Hunter Ltd. - Special Report China and Hong Kong Section 4. "A Tale of Two Systems". p. 37, November 17, 1986.

(2) IDRC - TS54e (vol 1) - Canadian Academic Relations with The People's Republic of China Since 1970, Vol 1 "Findings and Recommendations" by Martin Singer - Faculty of Arts and Sciences, Concordia University, Montreal, Quebec, Canada. p. 2-3.

(3) IDRC - ibid. p. 3.

(4) IDRC - ibid. p. 3.

Phase Three began when funding, the major stumbling block, became possible through efforts by the Chinese, the Social Sciences and Humanities Research Council of Canada, the International Development Research Council (IDRC), and C.I.D.A. "The result has been a proliferation of institutional linkages..." which has included several long-term projects, Chinese students enrolled in Canadian degree programs, increased collaborative research and many more Canadians travelling to China as lecturers. (5)

PROJECT OBJECTIVES

The BDRC project aims to provide both HALRU and LHTC with a package of training ,technical and material assistance designed to increase their training capacity and technical knowledge. The four components, which were identified by a project team in 1983, were established after Canadian personnel visited both institutions and evaluated needs of those institutions. The needs of the Chinese and what they wanted tended to be somewhat different depending on whose eyes one was seeing with. The obvious "wish list" and the desire of the Chinese for advanced technology was deemed as unrealistic within the terms of the project as seen by the evaluation team. However, the project set up the following four components which would allow both Chinese and Canadian scholars the opportunity to size each other's systems up and provide an initiative of academic exchange to build upon in the future.

1. Component one involves Training. This training is actually an attempt to re-educate rather than train in the true sense of the word. It seems that the M.Sc. and Ph.D. studies, as well as the non-degree courses and research visits for one year by young academics are an attempt to introduce them to our system of learning while at the same time, providing them with specializations in fields of study that will be useful upon their return to their institutions.(6)

   Senior academics will also visit Canada on four week study tours. These visits will be based on specific topics or areas of expertise but will also attempt to familiarize the Chinese with our academic and social system. (7) The hoped for result of this will be to develop linkages with institutions and individuals in China and Canada. A second affect will be to break down another "Wall of China" which might ordinarily result when the young faculty returning home meet resistance from senior faculty and administrators when they try to implement ideas they've learned in Canada. By bringing older and younger generation academics together in Canada at our institutions for on site experiences, conversations, cultural exchanges, short course programs and social relationships, the rapport, hopefully, will create a bond and mutual understanding between Chinese and Canadian participants.

2. Technical assistance includes such things as upgraded English training programs, in Canada and in China, for participants from each Chinese institution. This training will provide the Chinese with the ability to communicate verbally and in written form at a level necessary for technical and advanced lectures in the classroom. English books and journals are becoming more commonplace and in demand in HALRU and LHTC libraries. The English training facilitates a second phase of the technical assistance component. (8) In addition to allowing young Chinese the possibility to study in Canada, English training also enables us to send Canadian academics on Curriculum development visits to either HALRU or LHTC. While in China, Canadians deliver a series of 12-14 lectures on topics agreed upon by Chinese and Canadian participants in the project over a 22 day period. The purpose of these lectures is "to inject intensive doses of new curriculum for assimilation into HALRU and LHTC courses pending the training of Chinese academic staff in Canada. Canadian participants are asked to send presentations six weeks in advance for translation into Chinese and for distribution at the time of the lecture." (9)

   "Many critics would argue that a four week visit to China is too brief and that a minimum of two years should be devoted to such an input. The advantages, however, appear to outweigh the disadvantages. Short-term visits and an intense period of presentations have been well received by the Chinese who have adjusted their regular schedules to accommodate the Canadian visitor. The problems of isolation, severe winters, minimal disruption to research programs, moving personal effects, and family considerations are minimized, and the fact that more topics can be covered by more people provides strong incentives for short term and fast moving programs. The great barrier of language may only be tolerated for 4 weeks." (10)

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(5) IDRC - ibid. p. 4.
(6) C.I.D.A. - Plan of Operation (HALRU & LHTC). Black Dragon River Consortium (#282/08303) and (#282/08302) p. 4-13 (HALRU) pages 4-17 (LHTC), October 1984.
(7) *ibid
(8) ibid
(9) ibid * paraphrased extracts (9-15 endnotes)
(10) ibid

As can be seen from this evaluation by Dr. Neal Stoskopf, who was a part of the project team who visited China in 1983, considerations were definitely in favour of the Canadians regarding visits to China for lecturing. The initial identification and situation analysis work of the project team rationalized that this system was not perfect, but in conjunction with the other components, the puzzle pieces would come together at the conclusion of the project's four year term.

3. Component Three includes the transfer of equipment and materials to the two Chinese institutions. Such items as library materials, teaching equipment and some specialized equipment required for applied research were sent over or carried over by commercial transportation carriers or by Canadian lecturers visiting China. (11) This equipment benefitted the Canadians who could then deliver lectures and demonstrate principles and concepts with equipment familiar to them. The equipment on the other hand, benefits the Chinese because they witness the actual use of the equipment and the teaching techniques of the Canadian lecturers. One of the major problems identified by the first Canadian inception mission for the project, was the Chinese students resentment of "feeding the duck" teaching methods which they were subjected to in their traditional style classes. New equipment, teaching techniques and methodology are eagerly observed by students and staff alike. Because of the political and bureaucratic system the Chinese work in, not all of our methods can be used.

   For the most part, the lectures are well received and often repeated more than once to eager students wanting to interact with English speaking people.

4. Component Four includes the management of Canadian inputs by a Canadian Executing Agency and to include a mid-term as well as final project evaluations. (12) This management group has been named The Black Dragon River Consortium. The loosely knit consortium consists of the five aforementioned institutions in Heilongjiang Province, China, in Alberta and Ontario, Canada. Project headquarters are at the International Briefing Centre in the University of Alberta. Regular COSY and NETNORTH usage, facilitates communication daily for project business between management teams at each Canadian institution. Regular meetings within each institution continually monitor the project components and ensures that project management matters, curriculum development, study tours and on campus Chinese students are all being properly managed.

   Several times a year, project management meetings occur at one of the three Canadian institutions. As well, two or three trips per year take Canadian management personnel to China to LHTC, HALRU, or to Beijing for project planning meetings.

PROGRAM STRATEGY

When the Canadian project identification team went to China in 1983, they not only had to identify the problems which the project would face on a cultural basis, but also the problems of different political and education systems. Since the project was deemed "an educational development project" (13), a model had to be designed to recognize the needs specific to the region wherein the project was to be implemented.

At a national education conference in China, in May of 1985, the "Decision on The Reform of the Education System" was adopted by the Party and State leaders. (14) This, coincidentally, corresponded to the same time period that the BDRC project was in its final planning stages. The door was open for the methodology to be utilized by the project team. Implementation for innovative education was to be whole-heartedly welcomed by the two Chinese institutions who had the all important blessing of the Central Party in Beijing.

"The design of the model recognized our role as more than institutional development. Our task is to assist in the development of the province, regarded as China's bread basket. The challenge is to implement a program of development, defined as a process by which societies change so that they are able to meet the basic needs of their populations, in a way that is sustainable in the long term and which is based largely on indigenous resources and values." (15)

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(11) ibid
(12) ibid
(13) C.I.D.A. - ibid pages 4-13 (HALRU) pages 4-17 (LHTC).
(14) Hayhoe, Ruth. "Education in the People's Republic of China", OISE, February 1986. Ontario Institute for Studies in Education, OISE press, 252 Bloor St. W., Toronto, Ontario.
(15) Stoskopf, Neal C. "Agricultural Education Developments in Northeast China" - by N. C. Stoskopf - Professor of Crop Science and Director of the Associate Diploma in Agriculture Program, University of Guelph, Guelph, Ontario, Canada.

This statement made by Dr. Neal Stoskopf in a recent article, reinforces the concepts which Roland Bunch discusses throughout his book Two Ears of Corn. Although the project is by no means a small project, by Bunch's standards, it utilizes his basic outline which states that roject should 1) achieve early recognizable success, 2) start slowly, start small, 3) limit the technology, 4) use small scale experimentation, 5) and develop a multiplier effect. (16)

PROJECT ANALYSIS

Making use of the aforementioned principles as described by Bunch, as well as features of the Adoption-Diffusion Theory described by Wayne Lamble and other reference materials, decisions which had to be made for the implementation of this project will be evaluated. It is not known whether or not project leaders were bona-fide trained extensionists in the classical sense of the term. It is noteworthy, however, that the planned evaluation of the region the project was to affect, was very purposeful and orderly. The CIDA document which was written up as a result of the inception mission, and which formally identified the project guidelines, illustrates the clarity and knowledge of the team leaders.

The project, as described in the Project Objectives section of this paper, identified four areas or components: training, technical assistance, transfer of equipment and materials, and project management. Using theoretical reference materials as well as personal observations, the four components will be analyzed.

Training - In the training component there arise many questions on how effective can the project be in affecting change at the two institutions LHTC and HALRU. Decisions were definitely made which determined how training was to be implemented. An example of a Collective Decision made was the English training program. Not only did leaders in China feel this was a necessary objective, but the Canadians also felt it was a vital component which could not be omitted. Actually, not much convincing had to be done in this area since Chinese students were eager to learn English and it meant the future training of Chinese in Canada would in fact be possible.

There did develop in the training component a battle of wills between leaders of the Chinese Consortium members and the Canadian members. A one-year certificate program for all Chinese students entering any one of the three Canadian academic institutions was made mandatory. This decision was not arbitrary, but had definite purpose and rationale behind it. In order to be sure that the students sent to Canada were suitably skilled, not only in English but in academic abilities, the one year certificate acted as an adaptation period as well as a trial period for the Chinese participants.

It appears likely that our somewhat paternalistic fear that not all Chinese students would be able to cope and succeed, was a sign of our distrust of the educational background of the Chinese. Since there had been such upheaval as a result of the Cultural Revolution, our fears were not totally unfounded, but except for a few cases, the Chinese students enrolled in our programs seemed very adaptable and extremely capable. It must be noted here that the Chinese age,ranges from 22 to 32 and many, if not all, of the participants in the training program were instructors or assistants to instructors in their home institutions.

The concept of starting slowly and starting small could apply with this training component. A limited number of Chinese from LHTC and HALRU have been assigned to study for one to three year periods in the three Canadian schools. It is hoped, that upon their return, after three years, their fourth year back in China will see them adapting innovations in learning skills from their Canadian experience, into their teaching and research programs in China. The project hopes to achieve some "early recognizable success" before the five years presently contracted for, reaches completion deadlines.

The eleven study tours and four management tours, which have up to this point visited Canada, have been extremely essential in establishing the societal linkage necessary for such a project to succeed. This observation might be somewhat biased as the author of this report is the Guelph Study Tour Coordinator. However, with as much objectivity as possible, the analysis of this segment of training in the project appears to be absolutely essential for successful linkage to occur. With over 65 participants from China having visited Canada from LHTC and HALRU combined, in most areas of agricultural discipline, a strong series of links has been established. These study tour members, in conjunction with 25 Chinese presently studying in Canada, has given exposure to our system to a much larger group of individuals than would be affordable using only the advanced degree courses route which was the other option. Hopefully, a multiplier affect can be achieved using this combined study tour/academic studies format than could otherwise be accomplished.

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(16) Bunch, Roland. Two Ears of Corn, Chapter 17 "The Overall Dynamics" by Roland Bunch, World Neighbors, 5116 North Portland, Oklahoma City, U.S.A. p. 237.

Technical Assistance - Component Two, which involves technical expertise, further compliments and builds on the study tours and students training elements. When our Canadian specialists visit China, the topics they are to speak on are decided jointly by Canadian consortium team members with academics in China and Canada. The lecture series are designed to introduce technology and educational teaching techniques at a moderate rate. "High tech" methodology is mentioned, but not advocated in this curriculum development program. Each curriculum development participant from Canada is briefed prior to departure for China. Lectures are intended for faculty rather than students but some general lectures are given to larger groups including students. "Senior Canadian faculty with teaching and research experience are preferred so that presentations can be modified according to the response." (17)

This has proven to be a very wise decision because almost all faculty who arrived with prepared topics were asked to modify or supplement their materials upon arrival in China. These contingent decisions have made for somewhat frustrating, but rewarding experiences for both Chinese and Canadian participants and have proven the need to remain flexible to meet specific needs of the situations as they arise.

Transfer of Equipment and Materials - As mentioned earlier "wish lists" were apparent at the outset when the project identification team visited China. Be it paternalistic or logically determined, the Canadian decision was to introduce technology where applicable and in limited and controlled amounts. For example, when one of our agricultural engineering faculty members was asked to be a curriculum development participant, a series of events took place. A briefing took place to familiarize him with the project, the objectives, the site to be visited, the culture to be interacted with and the needs of the institution to be visited. A subsequent study tour from the institution to be visited came to Canada and included administrative faculty from the Chinese institution department of agricultural mechanics. The two weeks in Alberta and two weeks in Ontario saw the Canadian study tour coordinators arranging a diverse program which included on campus seminars, lectures and meetings combined with visits to farms, machinery companies, training, manufacturing and distribution centers relating to agricultural mechanization. Cultural tours to local shopping centers, tourist attractions, dinners in Canadian hosts' homes, etc. were arranged to develop that rapport so essential for freer communication between people from different cultural backgrounds.

Once this study tour was completed and the intended curriculum development individual became familiar with his future hosts in China, a series of lectures and a list of equipment to support his visit was established by the BDRC management team. The component which sends equipment and materials to China then came in to play. Based on all of the information from meetings with project members as well as personal experience, equipment was ordered to guarantee that a viable, basic, functional package of equipment and materials was ordered. The technology was not "high tech" nor was it simplistic in nature. The materials sent over, directly complimented the projects goal to ensure adequate training equipment for use by curriculum development personnel which would be left behind and used as a foundation for further expansion in the Chinese institution. This equipment by no means satisfied the Chinese "wish lists" but neither did it insult their intelligence, because it was equipment they presently did not have but which could be utilized immediately with introductory training by the curriculum development specialist during his visit.

Project Management - In analyzing components one through three, it is possible to see the clear and methodical development approach taken by the management team which comprised the fourth component of the BDRC project. In actual fact, one of the biggest problems in the project has been the unwieldy size of the management group. Because of the distance involved between Alberta, Ontario and China, complications can and do occur. Communication, which is the key to any project's success, was initially sometimes poor or non-existent. Not only does culture play a role, but politics and even inter-provincial rivalry at times seems to interfere with the otherwise smooth running project. The decisions to implement the programs are jointly made, the choice of technology to be taught and transferred is easily agreed upon, even the methods of teaching can be reasonably resolved. The problem arises when individual management styles and personality differences begin to surface.

Since the University of Alberta is the principal contracting agent and the University of Guelph and Olds College are invited partners in the project, differences of opinion on who is responsible for what and who controls what, began to become a problem. CIDA, which funds the project, has some say in these matters but by and large they in no way interfered. Communication almost always solves the problem, but in the interim, the large, clumsy beast is sometimes in the position where the left hand doesn't know what the right hand is doing and the head doesn't have complete control of either hands. By the second year of the project, communication links and better methods of information transfer solved many of the initial problem areas and participants began to work better as a team.

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(17) Stoskopf, Neal C. "Agricultural Education Developments in Northeast China" - by N. C. Stoskopf - Professor of Crop Science and Director of the Associate Diploma in Agriculture Program, University of Guelph, Guelph, Ontario, Canada.

SUMMARIZATION

The problem which faces 1.1 billion people in China is an obvious one of coming to grips with the challenge of ensuring that future generations are cared for. The scope of this project's mandate is minute compared to the problem. However, its objective of assisting in the training of educators who will in turn teach the future generation how to meet the challenge is an important step in the right direction. The following quotation is a profound statement of the challenge which faces members of the Black Dragon River Consortium, as it does any Western culture attempting to work together with Eastasian culture.

"Two fundamental approaches have evolved in the world as cultural norms for adapting to human situations: individualism and collectivism. Individualism is consistent with a set of values and behavioral norms that are the product of a Western world view that has been called "atomistic"; collectivism is consistent with a set of values and behavioral norms that arise within the Eastasian world view that has been called "organistic" or "holistic". Now and then, these two approaches may evolve toward irrational extremes. On one extreme, the result is "rugged individualism", which stresses the need for independence while ignoring or discounting the need for social co-operation to achieve individual fulfillment. On the other extreme, the result is "ragged collectivism", which ignores or discounts the need for individual fulfillment if larger groups are to thrive. One orientation has trouble seeing the forest for the trees, while the other views trees as no more than constituent elements of the all-important forest." (18)

This rather lengthy but perceptive statement identifies where our two cultures are coming from. In order for our supposedly "superior" technology and academic culture to meet with and to work with the Chinese, we must first eliminate our fears and our paternalism. This project seems to be generating interest in Canada and in China because of the amazing rapport the two cultures are developing within the boundaries of the project. We are beginning to realize the complexity of the "Chinese way of doing things", and are hopefully accepting the fact that we don't <u>need</u> to understand all the reasons why things are done as they are in China. As long as we keep in mind the ultimate objective, "that of guaranteeing human dignity to all humanity" the possibility exists that a project such as BDRC can have beneficial affects far beyond the realm of its mandate.

The Black Dragon River Consortium from the limited analysis attempted in this project report, seems to have set an achievable set of objectives. The situational analysis done initially seems to have been appropriately done and the resulting project strategies appear to be functioning well. Only time will tell whether or not the odds were sufficiently calculated and "stacked" in the right direction to enable the desired effects of this project to be achieved. The following is an excerpt from a presentation made by the Deputy Director of the State Farm System to CIDA while he was in Canada in March of 1988 as well as a statement by this author based on observations made throughout the duration of this project. Statements made by Zhang Furu were done so before information on the fate of this project were known by the Canadian and/or Chinese project institutions. None of the participants were aware of a CIDA decision to cancel part of the proposed project extension. The success of the project was well recognized by the Chinese and Canadians, however decisions were made based on rationale (?) seemingly unrelated to the actual project itself. The following statements and quotes are made outside the realm of the previous analysis of the project objectives, and are reactions to the situation that has resulted because of the success of the project and in spite of the successes that have been achieved.

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(18) Walls, Jan W. "Cultural, Economic and Political Dimensions of the Chinese Modernization Effort", Jan W. Walls, Asia Pacific Foundation of Canada, November 1986. p. 5 & 6.

AUTHOR: ZHANG FURU
Deputy Director Heilongjiang State Farm Bureau
March 13, 1988

Ladies and Gentlemen,

The Heilongjiang Agricultural Education Project, under the leadership of the Chinese and Canadian governments, has been progressing very well due to the joint efforts, especially CIDA's effective organization and supervision and the project is actually doing better in many aspects than previously expected. It has had significant influences over the development of both Heilongjiang August-First Land Reclamation University and Liu He Management Training College. Here, on behalf of the General Bureau of State Farms and the two institutions, I would like to express my wholehearted thanks to the Canadian Government, CIDA, Canadian executive body, and all of those who have made contributions to the projects.

Heilongjiang State Farm System is an area with 2 million ha. of cultivated land, 700,000 workers and a total population of 1.7 million people. The agricultural land and the grain production account for 50 per cent that of the National State Farming System. The location of the Heilongjiang State Farm System, which is remote from big cities, attracts very few university graduates. It mainly relies on HALRU and LHTC to provide their graduates to take on those administrative, management, and technical positions and 80 per cent of these positions are filled by those graduates from HALRU and LHTC. CIDA's aid will assist to a great extent the development of the two institutions, which in turn, will contribute substantially to the prosperity of the State Farm System. Therefore, after preliminary studies, CIDA made the decision with long term concerns and chose these two institutions which are in great need, to offer their assistance to. The three years development of the project is a good proof by itself for this decision. The progress of the project is fully in accordance with each annual plan as well as the Memorandum of Understanding signed by the two governments on Dec 28th, 1984.

Since this presentation and report was written, a dramatic policy change has occurred in China as well as in the policies of The Canadian International Development Agency. It appears that politics are again interfering in rural extension policy and development because of the large quantities of money now involved, as well as the political gains which can be made from supporting highly visible foreign assistance programmes. Unfortunately, the Black Dragon River Consortium participants are going to be cut off from this source of Canadian funds as a result of negotiations between the Canadian and Chinese governments. For the first time, a foreign government will apparently be dictating to us how they want our money spent in development progr nmes in China. As a result the Liu He Cadre Training College will be dropped from the project at the conclusion of the five years. This has come as a great shock to the Chinese in Liu He as well as to the Canadian executing institutions who have seen some dramatic and recognizable improvements since the inception of this project. The comments made by Zhang Furu to CIDA in his presentation appear not to have had any effect in Canada or in China. The powers that be have deemed it politically unworthy to continue supporting the BDRC efforts in North China and lobbying efforts by Chinese and Canadian participants have fallen on deaf ears. Such is the uncertainty of dealing with an agency which seems to be no more than a political tool for our government and for Canadian business interests dealing in foreign trade and assistance packages. No more is left to be said except, "C'est la vie!"

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Digestive Motility Videotape

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I teach digestive physiology in two third year courses: a DVM course and a BSc course. In each we have used a laboratory project on motility involving an anesthetized rabbit. Although I believe that the learning experience justified the use of the animals in the DVM course, where the students need to learn some basic principles of surgery and anesthesia, I am less comfortable about using live animals in the BSc course. Moreover the DVM students have other laboratory projects in which they use anesthetized animals so that a case can be made for eliminating the use of the live animals in the digestive laboratory provided that the other objectives of the laboratory can be met.

Apart from the general concern about minimizing the use of animals in teaching laboratories there are some specific objections that can be raised about the in vivo motility laboratory. In order to study motility the animal must be maintained at a light level of anesthesia so that there are concerns about the possibility of the animal feeling pain. Furthermore the observations that can be made with the equipment available in the student laboratory are only qualitative. In vitro or test-tube experiments can be carried out that avoid the anesthesia problems and provide quantitative data as well as clearer responses to various manipulations, but these experiments do not provide a picture of the normal patterns of motility in the intact animal.

With this background I started to design a videotape to be used with a test-tube experiment as a replacement for the rabbit experiment. Initially I envisaged a videotape that would simply depict the experiment as carried out by the students. I quickly realized that this approach, although succesfully used by instructors in other laboratories, would not work in this case. For one thing contractions that could be seen with the naked eye could not always be seen on the video screen because of problems with contrast and definition.

A more important consideration is that the laboratory exercises for teaching undergraduates are usually a compromise between the instructional needs and the practical limits to what can be done in the laboratory. In this case, for example, our interest was in the motility of the digestive tract of the dog but we used rabbits in the laboratory for reasons of cost and availability. In many respects the rabbit does not differ greatly from the dog but it seemed likely that we would improve student motivation if we avoided using a model and used the real thing - and of course, by using the dog, we would be able to avoid having to describe the differences between the rabbit and the dog.

Freed from these constraints we returned to the basics: the objectives of the laboratory exercise. The main objective was that the students should be able to describe the patterns of motility of the digestive system and that they understand the control of motility. We decided to make two videotapes dealing with normal motility. The first would cover the events of swallowing, following the food from the mouth to the stomach. The second would deal with gastric and intestinal motility. If possible, we would make a third tape dealing with diseases and abnormal motility. A test-tube or in vitro experiment was introduced so that some direct hands-on experience would be retained. The objectives of the in vitro experiment are to make one aspect of motility more concrete for the students and also to give them some exposure to the difficulties of laboratory study of motility and the extent of the biological variability in the function of the intestine.

In making the videotapes we had access to a valuable resource - videotapes of fluoroscopy of swallowing and of gastric and intestinal motility. These images are obtained by feeding conscious dogs food mixed with barium. X-rays are passed through the animal and detected on a fluorescent screen. Initially I had planned to use these tapes in conjunction with short tapes of the surgical preparation of the rabbit - but as mentioned we found that the definition of the structures on the screen was too poor to be usable. I also had planned to use as supporting graphics some simple pen and ink drawings. In discussion of my needs it was suggest that I consider using computer generated graphics and as a result I met with Doris Burnfield of the Instructional Technology Support Group.

Out of our first meeting came the idea of using animated graphics. This was a tremendous advance because it meant that we could show in diagrams events that could not be captured in tne fluoroscopy. It also meant that we could make relationships much more vivid -for instance, arrows connecting structures in our diagrams could be made to flash on and off. In our first tape we have a combination of scenes of a dog feeding, animated graphics of the movement of food through the mouth, fluoroscopy of movement through the esophagus, and one shot of liquid entering the stomach of the anesthetized rabbit. We also have diagrams of the reflex control of swallowing and of peristalsis in the esophagus and its control. For teaching this combination of different types of images seems to me ideal. The feedback I have had from the students indicates that they find the videotape extremely useful.

<u>To sum up</u>: the videotape and modified laboratory in my opinion do a better job of achieving the relevant objectives. At the same time they meet the humane objective of reducing the number of animals used and in the long run will cost less.

I would like to acknowledge the work of Doris Burnfield, the artistic director and Mary Nairn, the computer graphics artist. Dr Paul Pennock provided the fluoroscopy facilities. Financial support was provided by the Office for Educational Practice.

Computer-Aided Instruction in an Undergraduate Mechanisms Course

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1. Introduction

Since 1982, the author has participated in the development of various programs for microcomputers related to mechanism analysis and design, in the Mechanical Engineering Departments at the Universities of Manitoba and Toronto. These programs were specifically designed for tutorial and laboratory use in undergraduate teaching [1-3]. Most of them originated from term projects in an elective course on mechanism synthesis, and from undergraduate theses. Others were developed or enhanced by undergraduate students, hired during summer sessions. In 1987, appropriate programs were integrated into one package. This package, entitled UTLINK , is designed for use on IBM PC/XT/AT computers, and is intended to complement lectures in undergraduate mechanisms courses.

Parts of the package were implemented during the past few years in undergraduate tutorials. An overview and discussion is included in the use of these programs in classroom demonstrations.

The package includes:

(i) kinematic and dynamic analysis of four-bar and slider crank mechanisms

(ii) determination of the cognates of four-bar and slider crank mechanisms

(iii) kinematic and dynamic analysis of generalized planar mechanisms

(iv) kinematic analysis of multiple stage planetary gear trains

(v) kinematic analysis of disc cams

(vi) function synthesis of four-bar mechanisms

(vii) rigid body guidance synthesis of four-bar mechanisms.

All programs in the package are user-friendly and menu driven. Users respond to simple questioı . using the keyboard or mouse. Animations of mechanism motions are employed in most programs. Functional data can be generated in tabular and/or graphical form. Hard copy printouts may be obtained for graphs, tables, and mechanism images. Details of UTLINK capabilities are given in Appendix A. Hardware and software requirements for running UTLINK are listed in Appendix B.

2. Implementation of UTLINK in Tutorial Sessions

UTLINK has been installed in the CCIE (Computer Centre for Integrated Engineering) laboratory at the University of Toronto, Faculty of Engineering. This laboratory consists of some 50 IBM PC/XT/AT computers. A timetable was prepared for the undergraduates which would allow each student to spend 90 minutes a week with a computer in the CCIE laboratory.

To date, four assignments using UTLINK have been implemented. For each of these assignments, up to four versions are distributed. However, only one version is assigned to any given student, to reduce the tendency of students copying each other's work.

In general, these assignments are more involved than those given in previous years when UTLINK was not available. Completing the current assignments would not be practicable without the use of a computer.

2.1 Assignment #1 - Kinematic Anlysis of a Two-Loop Mechanism

Students are asked to analyze a two-loop mechanism using GNLINK (see Appendix A). They are required to compare results with those obtained from analysis of velocity and acceleration polygons. This assignment helps students acquire an appreciation in the stick diagram representations of mechanisms, and an appreciation of the essential need to use computer algorithms when making multiple analyses of a mechanism.

2.2 Assignment #2 - Design of a Multiple Stage Planetary Gear Train

This assignment calls for a two-stage planetary gear train to be designed, using PGTANAL. The arrangement of gears is given for each stage along with the connections of components between stages. Most of the numbers of gear teeth are given. Students must select the numbers of teeth on the remaining gears to generate two prescribed speed ratios by alternately immobilizing two components of the gear train.

Lower and upper limits are specified for the numbers of gear teeth. A percentage tolerance is set on the difference between calculated and prescribed speed ratios.

2.3 Assignment #3 - Design of a Disc Cam

Program CAMPRF is used by students to design a disc cam. A displacement diagram is prescribed. Students must design a cam so that the maximum absolute value of the pressure angle does not exceed a specified limit. A constraint is also imposed on the overall size of the system.

2.4 Assignment #4 - Rigid Body Guidance Synthesis of a Four-Bar Mechanism

Students are required to use RIGID to synthesize a four-bar mechanism which will guide a rigid body through three positions. The coordinates and orientations of the rigid body in the three positions are given. Also prescribed are limitations on the area which the motions of all links must not exceed.

3. Use of UTLINK for Classroom Demonstrations

Early lectures in the mechanisms course at the University of Toronto introduce graphical algorithms to analyse mechanisms. This instruction is followed by analytical methods, suitable for programming on a computer, forming the basis of some of the algorithms in UTLINK.

Demonstrations of UTLINK are made during lectures using a projection video system. Using this system, computer graphics images may be readily seen on an enlarged screen, in color, by an entire class. Students are thereby introduced to the programs of UTLINK, and shown how to run them. Of particular benefit is the use of graphic animations of mechanisms, which enhance descriptions given by the lecturer.

4. Discussion

The UTLINK package has given students an improved understanding of various types of mechanism motions. Feedback from students on the use of the programs has been encouragingly positive.

Use of these programs in teaching mechanism courses complements traditional techniques that have been employed in the past. The author also uses physical models of mechanisms, where the links are made from coloured translucent plastic, which are mounted on a clear plastic base. In this manner, projection of moving parts is possible when placed on an overhead projector [4]. Students are thus able to compare these physical models with the computer graphics demonstrations. They then proceed to investigate the effect of changing the parameters using the computer model.

5. Summary

A description on the use of a package of programs entitled UTLINK has been presented for teaching mechanism courses to undergraduates. UTLINK is now in use and has been distributed to some other Canadian Universities. A copy of UTLINK may be obtained by contacting the author. A charge will be incurred, to cover only the costs of materials and handling.

Acknowledgments

The author thanks the following students from the Universities of Manitoba and Toronto for their valuable contributions to the development of UTLINK : C.J. Bartlett, J.J. Dueck, B.J. Glowa, W.E. Glowa, C. Konzelman, D.W. Ohlsen, R.P. Podhorodeski, G.J. Smid, D.R. Strang, A. Sun, W.L. Tse, G. Tyc.

The use of computers in the Computer Centre for Integrated Engineering at the University of Toronto is also gratefully acknowledged.

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Appendix A Capabilities of UTLINK

A.1 FOURBAR and SLIDER (analysis of FOUR-BAR and SLIDER crank mechanisms)

FOURBAR and **SLIDER** are interactive programs for kinematic and dynamic analysis of four-bar and slider crank mechanisms.

Input data may be entered either interactively or submitted through a text file. For kinematic analysis, users are required to specify all link dimensions and the rotational speed of the input link. For dynamic analysis, users must also provide locations, directions and magnitudes of the applied forces. The mass moments of inertia of the moving links must be given by the user.

Users may generate numerical and/or graphical outputs. Numerical results may be generated for any desired size of increments within the 360 degrees of crank rotation. Outputs for kinematic analysis include angular displacements, velocities and accelerations of the coupler and output links, and the linear displacement, velocity and acceleration components of a specified point attached to the coupler. For dynamic analysis, an option exists to calculate pin forces and input torque. Users may choose to send the outputs to either the screen or printer.

Mechanism animations, with or without accumulated images, may be generated. Alternatively, users may generate the path traced by a coupler point throughout a complete cycle. An option to obtain a hard copy of the mechanism images is available. A typical mechanism and some of its corresponding function graphs are given in Figure A.1.

A.2 GNLINK and FAME (kinematic and dynamic (Force) Analysis of GeNeralized planar LINKages)

GNLINK is an interactive program for the kinematic analysis of multiple loop, multiple input, planar mechanisms. Output options include mechanism animations, and trace paths of a specified point on any link, and kinematic function graphs. Graphical and tabular outputs for several functions are also available.

Kinematic models are interactively input as a sequence of vectors which form vector loops. Users must supply the input variable(s), dependent variables, and the vectors which are common between vector sequences. The four-bar driven piston in Figure A.2(a) is an example of a multiple (two) loop mechanism.

Its corresponding vector representation is given in Figure A.2(b), and a summary table corresponding to this model is shown in Figure A.2(c).

The iteration procedure in this program adjusts the dependent variables to form closed vector loops. The user must specify a tolerance value to obtain the level of accuracy desired.

An option is available to portray the mechanism in a single configuration, and trace paths of selected points throughout a cycle. The user may select any combination of vector heads and tails for trace plotting. A trace path plot for the four-bar driven piston example is illustrated as Figure A.2(d).

An example of a function graph is given in Figure A.2(e) for a four-bar driven piston. The horizontal and vertical axes are scaled in fractions of the maximum absolute values listed.

A tabular output of the kinematic results can be generated. Values of displacement, velocity and acceleration for all dependent and input variables are listed.

FAME is an interactive program for dynamic force analysis of planar mechanisms. Program output capabilities include tabular and/or graphical outputs of reaction forces, and applied forces, applied torque on any specified nodes and links. It employs calculations stored in data files from **GNLINK** .

From the vector representation of a mechanism, the program automatically numbers all nodes and links. Most of the user interface is menu-driven and makes extensive use of function and cursor keys. The user must supply the externally applied forces, masses, centroids and mass moments of inertia for the links. Externally applied forces or torques to the mechanism are interactively specified using graphical displays of individual links.

The user has the option to store the results obtained from either **GNLINK** or **FAME** in a data file.

A.3 **FCOGNATE** and **SCOGNATE** (COGNATEs of Four-bar and Slider crank mechanisms)

FCOGNATE SCOGNATE are interactive programs for creating cognates of four-bar and slider crank mechanisms. Output options include tabular output of link lengths for the cognates, graphical output of primary linkage, Cayley's triangle, cognates, and a trace path of the coupler point.

Input is required at the beginning of the program to specify all parameters for the mechanism. Users may display the mechanism at any desired input angle. A typical four-bar mechanism and its two cognates is shown in Figure A.3.

A.4 **PGTANAL** (kinematic Planetary Gear Train ANALysis)

PGTANAL is an interactive program for kinematic analysis of multi-stage planetary gear trains. Output options include the absolute and relative rotational speeds of each gear, in every stage. The speed ratio of the gear train is output by the program.

Gear trains are formed from Lévai's twelve types of planetary gear trains. The user is required to specify the numbers of gear teeth, connections of components between stages, and rotational speeds of the input components. The planetary gear train in Figure A.4(a) is an example of a two stage gear train, with stage 1 being type A and stage 2 being type B.

Input is required at the beginning of the program to specify the total number of stages in the planetary gear train and the gear types corresponding to each stage. The user is required to enter the number of teeth for all gears. Typical graphical displays obtained using this program for the gear train shown in Figure A.4(a) are shown in Figures A.4(b) and A.4(c).

The user must specify which links (gears or cranks) are the input and output of the gear train. Constraints are specified by matching the speeds of components between stages. Figure A.4(d) illustrates typical outputs obtained from this program, for the gear train shown in Figure A.4(a).

A.5 CAMPRF (CAM PRoFile)

CAMPRF is an interactive program for the kinematic analysis of plate (disc) cams. Output options include tabular and/or graphical kinematic output of follower displacement, velocity, acceleration, jerk and pressure angle. A display of the mechanism profile (cam contour) is also available.

The shapes of followers include knife edge, flat face, and roller face. Follower motions may be either pivoting or translating with an offset. Displacement motions of followers include dwell, constant velocity, constant acceleration (parabolic), simple harmonic, cycloidal and modified trapezoidal.

The user is required to specify pertinent dimensions of the cam and follower, including the base circle diameter, offset, and for roller followers, the follower diameter. The user must select the cam rotational speed.

The displacement of the follower is specified by breaking the motions of the follower into the desired number of intervals. For each interval, the range of rotation angles and the corresponding type of motion is specified. Besides the dwell, the user is required to specify the rise and fall displacement of the follower. A tabulated input summary is automatically provided after having input all parameters. Figure A.5(b) illustrates a tabular summary corresponding to the cam and follower shown in Figure A.5(a).

The user may choose to see output results either numerically or graphically. Graphical outputs

include function graphs of kinematic parameters, and a display of the cam profile at any desired degree of rotation. For the cam contour, the user has an option to include the follower in the display. Also, two cam contours from different data files may be superimposed.

A.6 FUNCSYN (FUNCtion SYNthesis of four-bar mechanisms)

FUNCSYN is an interactive program for function synthesis of four-bar mechanisms. Output options include tabular outputs of synthesized link lengths, kinematic relationships and structural errors; and, graphical outputs of the actual and synthesized function plots, and a structural error plot. A typical set of graphs for a synthesized mechanism is shown in Figure A.6.

Types of functions that are available for mechanism synthesis include exponential, sine, natural logarithm, common logarithm, and $y = x^i$. The user is required to input the angle ranges for the input and output motions. The user-specified set of angular locations relating input and output motions may also be given. The program will indicate when a synthesis is impossible.

Tabulated results may be output showing actual and synthesized function values, and the differences between these values.

A.7 RIGID (RIGID body motion synthesis)

RIGID is an interactive program for synthesis of a four-bar mechanism for guidance of a rigid body through three positions. Output options include tabular output of all link lengths and angles for the three positions, and the pivot point coordinates, and clockwise or counterclockwise animation through the designated positions, with or without accumulation of mechanism images.

The user has the option to select one of the following means of specifying the information:

(i) three positions of the coupler end locations

(ii) coupler end locations for the first position (and capability to guide a rigid line segment through three positions)

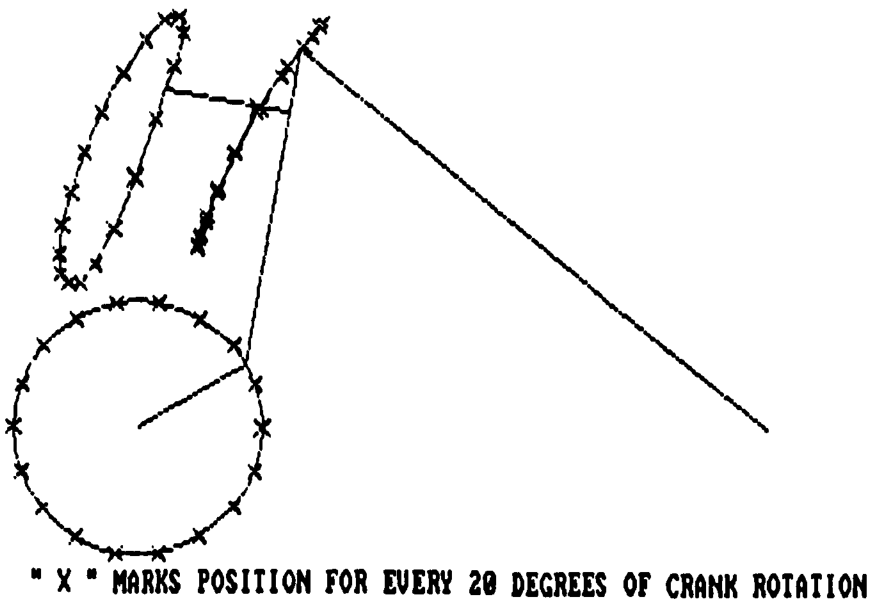
(iii) three positions and the two base link pivot points.

Data are input using either the keyboard or mouse.

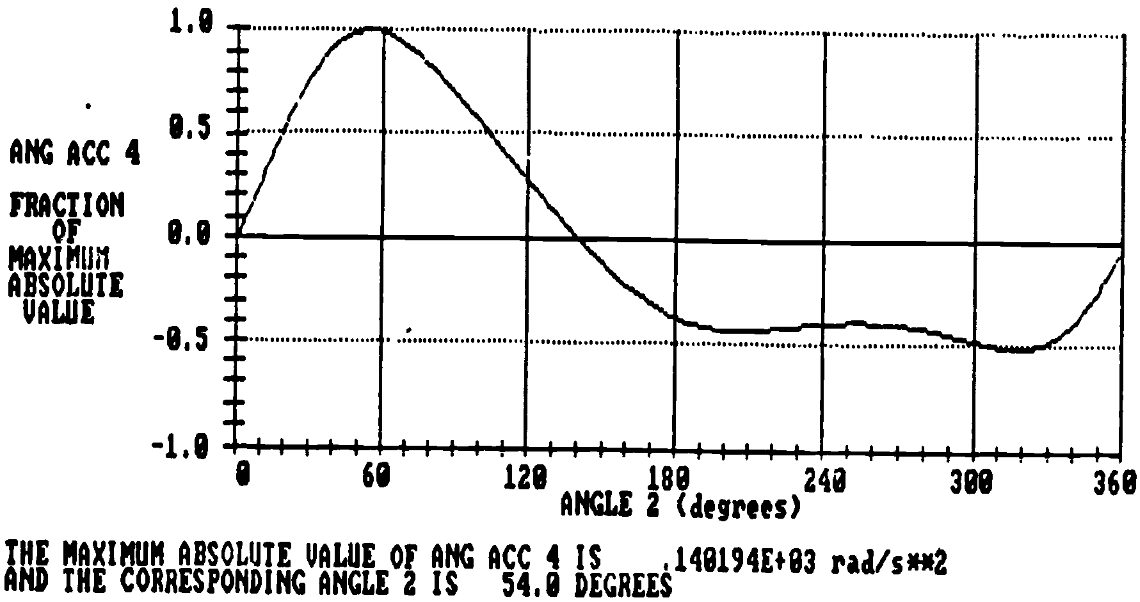
Figure A.7(a) shows a typical tabular summary of a synthesized mechanism. Figure A.7(b) illustrates three outlines of the mechanism corresponding to the three desired positions of rigid body guidance.

Appendix B Hardware and Software Requirements of UTLINK

Hardware Configuration:	IBM PC/XT/AT, or compatible
	CGA or EGA color monitor
	Epson MX-80 or MX100, or compatible
	mouse (optional)
Memory:	640K minimum
Operating System:	DOS

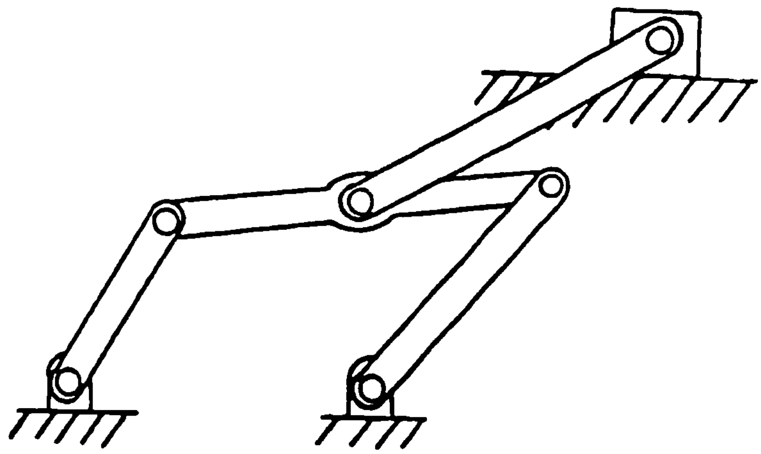


(a) Mechanism

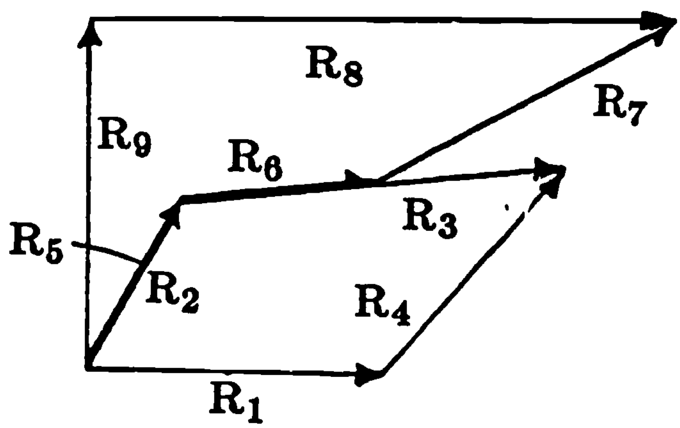


(b) Function Graph

Figure A.1 Four-Bar Mechanism



(a) Mechanism



(b) Vector Representation

Figure A.2 Two Loop Mechanism (page 1 of 3 pages)

****

MECHANISM MODEL-

INITIAL VECTOR INFORMATION

VECTOR NO.	LENGTH	ANGLE
1	3.0000E+00	0.0000E+00
2	1.0000E+00	4.5000E+01
3	3.0000E+00	2.0000E+01
4	2.0000E+00	7.5000E+01
5	1.0000E+00	4.5000E+01
6	1.5000E+00	2.0000E+01
7	3.0000E+00	6.0000E+01
8	2.0000E+00	0.0000E+00
9	2.2500E+00	9.0000E+01

DEPENDENT VARIABLES

DEPENDENT VARIABLE NO.	VECTOR NO.	A or L
1	3	A
2	4	A
3	7	A
4	8	L

COMMON VARIABLE PAIRS

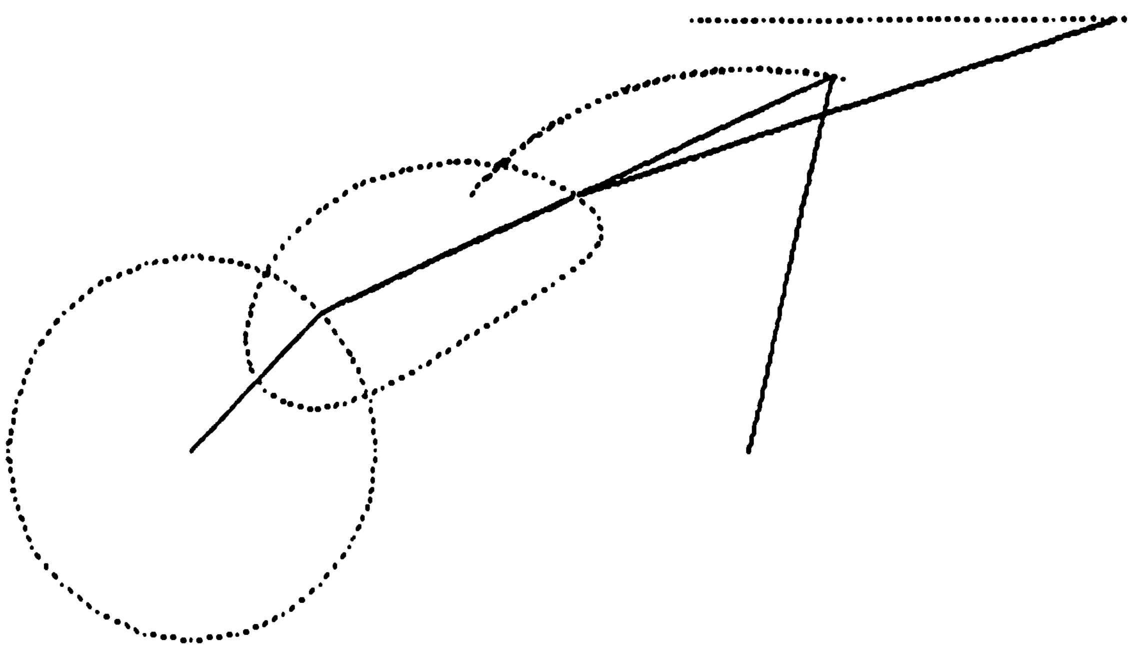
PAIR NO.	PRIMARY	SECONDARY	A or L	DIFFERENCE
1	2	5	A	0.0000E+00
2	3	6	A	0.0000E+00

LOOP SEQUENCES

LOOP NO.	SEQUENCE				
1	2	3	-4	-1	
2	5	6	7	-8	-9

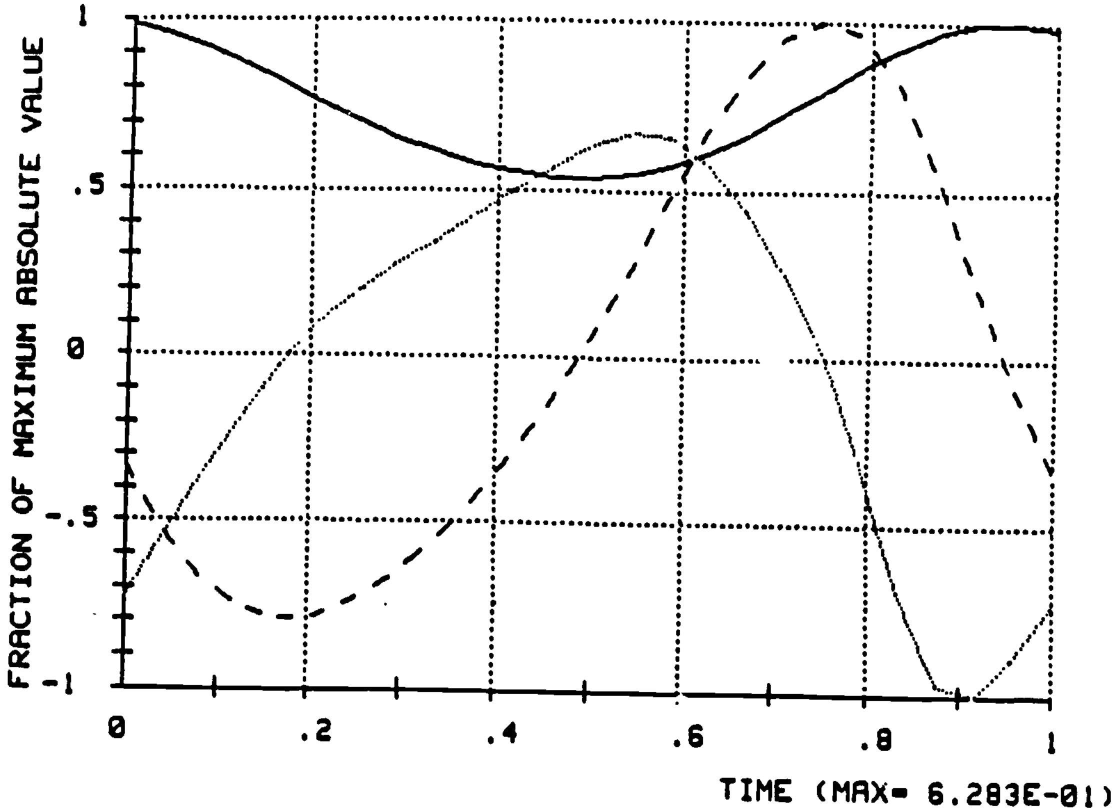
****

(c) Vector Model Summary Table



(d) Trace Path Plot

Figure A.2 Two Loop Mechanism (page 2 of 3 pages)



FUNCTION	LINE TYPE	MAX AT	ABS MAX
DEP 4	————	6.02E-01	5.00E+00
DEP 4D	— — — —	4.71E-01	1.31E+01
DEP 4DD	------------	5.76E-01	1.57E+02

(e) Typical Function Graph

Figure A.2 Two Loop Mechanism (page 3 of 3 pages)

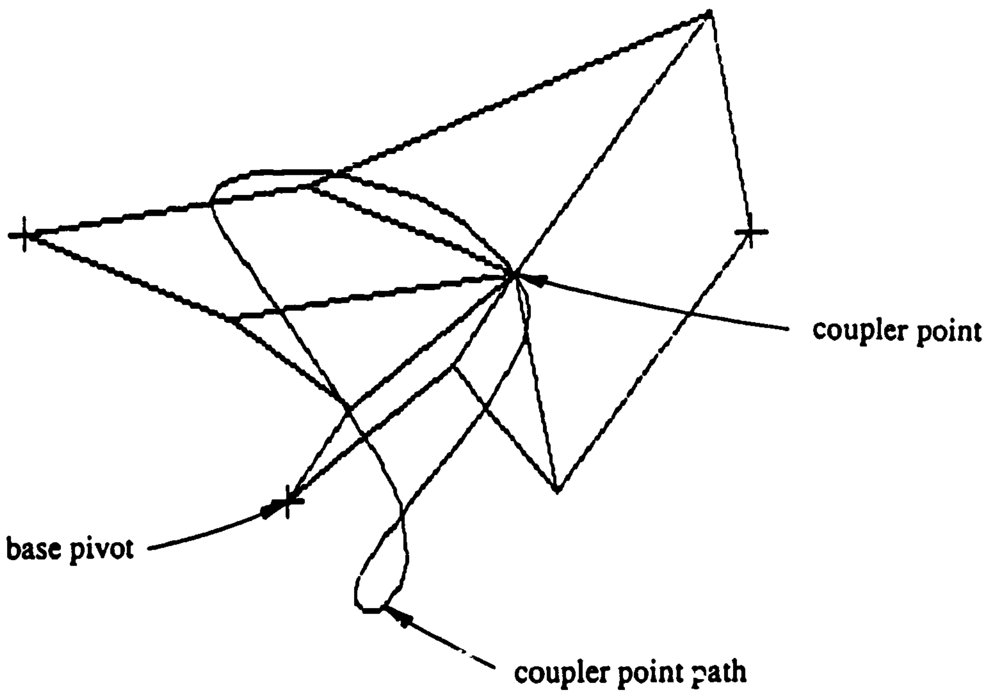
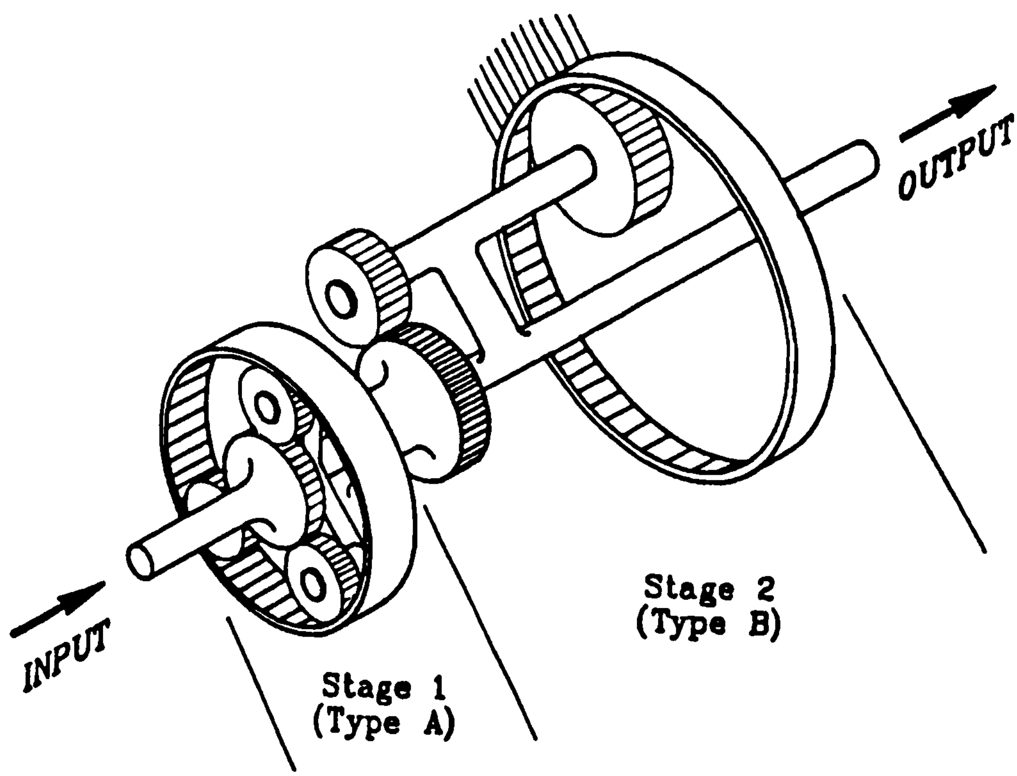
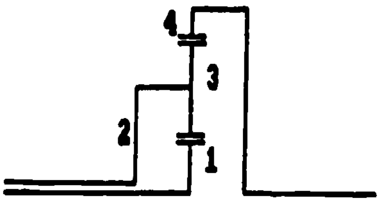


Figure A.3 Cognates of a Four-Bar Mechanism



(a) Gear Train

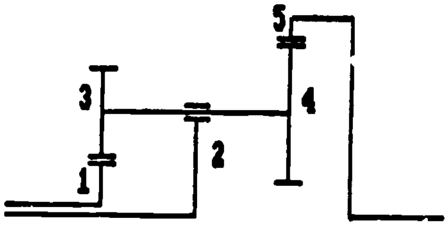
Figure A.4 Two Stage Planetary Gear Train (page 1 of 2 pages)



ENTER THE TOOTH NUMBERS OF EACH GEAR FOR :
GEAR TYPE : a
PLANETARY STAGE : 1

N1 = 20
N3 = 25
N4 = 70

(b) Stage 1 Parameters



ENTER THE TOOTH NUMBERS OF EACH GEAR FOR :
GEAR TYPE : b
PLANETARY STAGE : 2

N1 = 15
N3 = 15
N4 = 35
N5 = 80

(c) Stage 2 Parameters

RESULTS
========

INPUT = COMPONENT 1 OF STAGE 1
OUTPUT = COMPONENT 2 OF STAGE 2

INPUT ROTATIONAL SPEED = .20000E+03
OUTPUT ROTATIONAL SPEED = -.28571E+02

SPEED RATIO = -.14286E+00

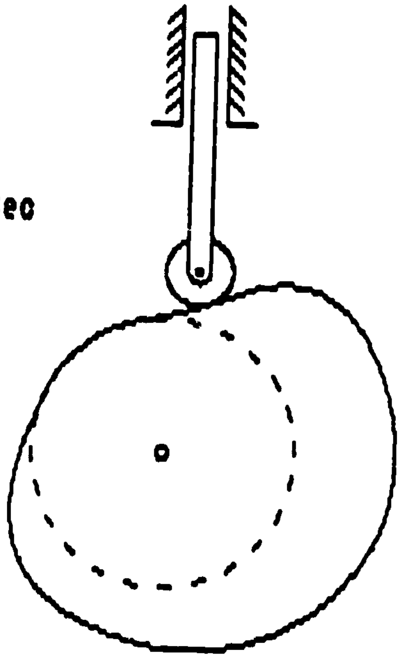
ROTATIONAL SPEEDS

STAGE 1 PLANETARY GEAR TYPE (a)

COMPONENT	ABSOLUTE VALUES	RELATIVE VALUES
1	200.000	200.000
2	-28.571	-28.571
3	-211.429	-182.857
4	-93.878	-93.878

(d) Typical Output Results

Figure A.4 Two Stage Planetary Gear Train (page 2 of 2 pages)



(a) Mechanism

SUMMARY OF INPUT GEOMETRY

TYPE OF FOLLOWER : TRANSLATING, ROLLER

BASE DIAMETER, Bd = 4.00

OFFSET, S = .50

ROLLER DIAMETER, Rd = 1.00

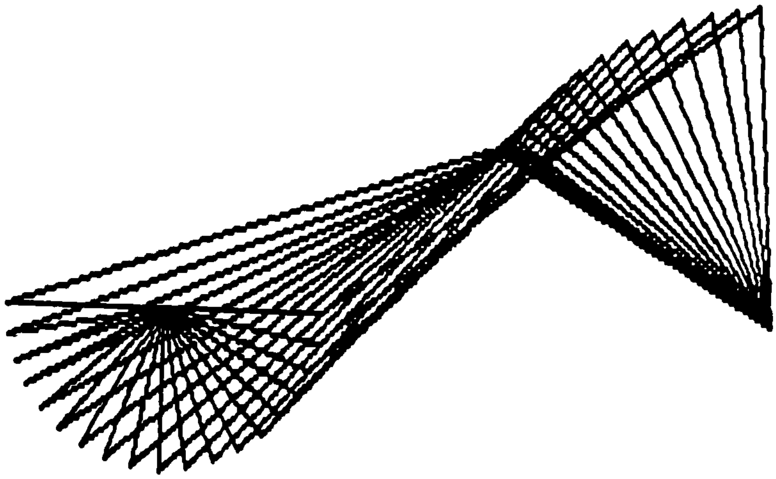
CAM ROTATIONAL SPEED (rad/sec, + for ccw, - for cw) = 10.00

SPECIFIED FOLLOWER MOTION

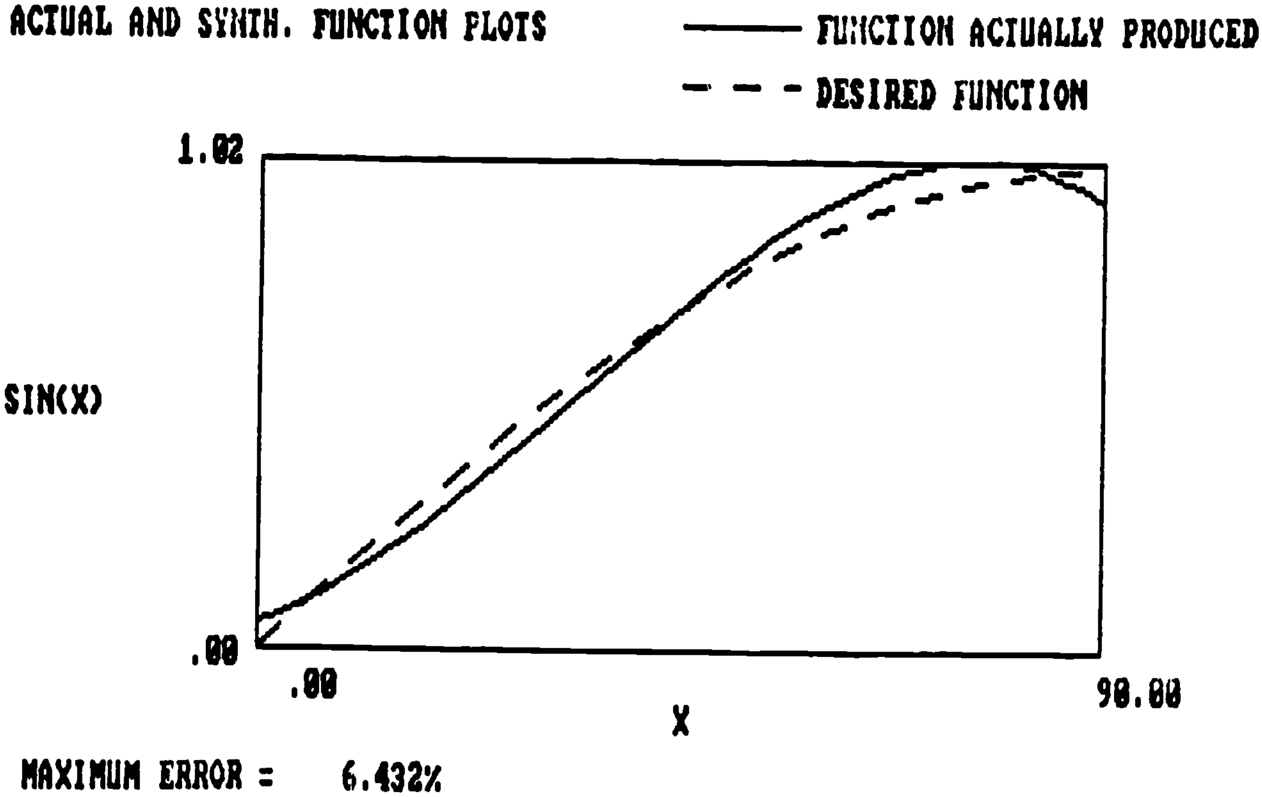
INTERVAL NUMBER	INITIAL ANGLE FOR INTERVAL (degrees)	FINAL ANGLE FOR INTERVAL (degrees)	TYPE OF MOTION	RISE (+) or FALL (-)
1	0	50	Dwell	.000E+00
2	50	120	Const. Acc.	.150E+01
3	120	160	Dwell	.000E+00
4	160	270	Simple Harmonic	-.700E+00
5	270	360	Cycloidal	-.800E+00

(b) Input Summary Table

Figure A.5 Disc Cam

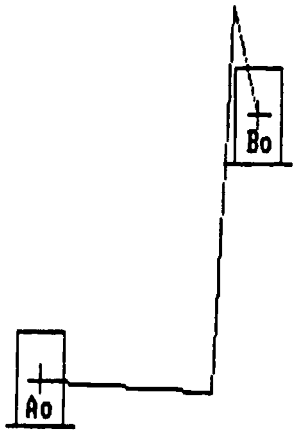


(a) Mechanism



(b) Function Graphs

Figure A.6 Function Generating Mechanism



(a) Mechanism

RIGID MOTION RESULTS: A:templ.RGB ROCKER-ROCKER

LINK LENGTHS:

Base Link, AoBo	2.649	Link 2, AoA	1.312
Coupler Link, AB	3.015	Link 4, BoB	.862

PIVOT COORD S: AoX: 3.250 AoY: -1.007 BoX: 5.163 BoY: 1.071

LINK ANGLES (degrees):

For 4-BAR Links (measured from horizontal):

POSITION 1:	LINK 2, AoA	116.557	LINK 4, BoB	74.036
POSITION 2:	LINK 2, AoA	205.225	LINK 4, BoB	215.983
POSITION 3:	LINK 2, AoA	297.875	LINK 4, BoB	309.269

(b) Summary Table

Figure A.7 Rigid Body Guidance Mechanism

Competencies for the Educational Developer

Robert D. Cook
Sheridan College

The technology to design and deliver effective computer-based instruction in education, business and industrial training environments is becoming more widely available. But good quality software is still too rare a commodity to allow this medium to achieve its potential for providing solutions to educational problems.

The major reason is that there are too few skilled educational software developers.

In this paper I would like to suggest some developer competencies which can contribute to the production of more effective instructional software. My observations will be based upon the experiences of the Courseware Design & Production Program at Sheridan College, Canada, and the successes of its graduates.

First, however, it is important to acknowledge the contribution of those who have been producing materials in this still very new learning technology. The successes and failures of the past.

Let us consider, then, directions for the professional development of ourselves and our colleagues, objectives for courses we may teach to prospective developers, and skills to look for in those we hire.

CURRENT DEVELOPERS

Who has been developing computer-based instruction so far?

Current developers come from a wide range of disciplines, each bringing many strengths and weaknesses to development work.

Many are computer specialists--programmers and analysts. Their materials are coded economically and usually give good demonstration to the "bells and whistles" of hardware. But with no foundation in Instructional Design methodology, the computerist's programs are often weak in content and pedagogy.

The content expert in business or industry, reassigned to the training division from the shop floor, usually gets the content right and knows the learners well. But she, too, often produces materials with educational flaws. The difficulties inevitable as she changes roles from doer to teacher are exacerbated when the new task is not just to teach, but to teach with a computer. Some hardware, an authoring system, and perhaps a bit of poorly written documentation are inadequate resources to allow the subject matter expert to generate good courseware.

Experienced teachers or trainers, proficient in traditional delivery methods, often know best what experiences students need, have excellent ideas for courseware, and may know how to integrate computer-based materials into a learning system. However, they may not have the complete range of instructional design skills required to bring an overall design to completion. And the hackers among them may encounter insurmountable execution problems owing to the size and complexity of interactive lessonware.

Skilled instructional designers, in business or education, transfer to CBI design a wide range of essential skills. But without experiences focussed on CBI, they lack sufficient knowledge of the medium's special capabilities and how to use them. Unfamiliar with resources already available, they may reinvent the wheel. And if required to execute their own designs, they commonly underdesign the materials, anticipating the limitations of their programming skills.

Some linear television producers have made the leap to interactive video production with tape and laserdisc. Their work can show lack of experience with a medium allowing more complex user/material interactions. And concepts of continuity take on totally different meanings in an environment where variety of visual and audio juxtapositions are not only possible but desirable. The task is not simply to drive a linear videotape by a computer, but to develop an interactive package from the ground up.

A review of the strengths and weaknesses of each of these, and other, developers, including computer graphic artists and audio technologists, confirms that while none has the full complement of skills required to produce top quality computer-based instructional materials, each has a specific perspective or skill which could contribute to a successful package.

Should not the model courseware developer, then, be someone who by extensive study and experience has developed the expertise of each of these developers? Perhaps, but one is unlikely to find many of that breed.

TEAM APPROACH

The alternative, of course, is to assemble a team of experts each with her own specialty. A skilled project manager would assign tasks, maintain communication links, provide dispute arbitration services, and generally co-ordinate the project to a successful close. This is a highly desirable, and effective model, and has resulted in some of the most effective computer-based materials produced.

It is also an expensive, time consuming, and often totally unavailable option as when the budget can simply fund only one developer. And the model lacks any one individual who can communicate with each team member if not as an equal, at least as someone who has an intimate understanding and appreciation of the expert's special craft.

COURSEWARE DESIGN GENERALIST

Here, then is the role for the courseware design generalist - the "Renaissance Man or Woman" of computer-based instruction: able to converse with specialists in the specialist's jargon; able to appreciate and encourage their potential contribution, listen sympathetically to their problems, and be wary of their hyperbole; and in the absence of one, several or all specialists from the team's composition, able to judge when to cancel a project or when to substitute her lesser, but adequate skills in order to bring the task to a reasonable, quality completion. Simply put, the courseware design generalists knows what is possible, and when to get help.

The most effective generalists are likely to come from the classes of developers or potential developers named above. Working from a base of valuable expertise, the task before them is to expand their competencies.

SKILLS INVENTORY

What specific skills should the developer generalist acquire?

She should be skilled in instructional design, able to take a systems approach to the development of instruction regardless of subject matter. Particularly important skills would include the specification of objectives, audience analysis, choice of instructional strategies, and performance evaluation. Design decisions should be informed by an understanding of developmental and educational psychology principles.

A good educational software developer should accept that the first question to be considered is whether to use CBI at all. She should know when and how to use CBI and when not. Familiarity with the full range of other instructional media, an understanding of their greater effectiveness with different learners, content and learning environments will lead to the development of better, but not necessarily computer-based, learning materials. She should understand the options of creating stand-alone computer materials, or those which anticipate extensive wrap-around materials or activities.

For the instances when CBI development is agreed upon, the developer should have familiarity with existing computer-based learning materials, so as to avoid duplication of efforts, as well as to benefit from the successes and failures of our colleagues. The possibilities for synthesis of new learning solutions are greater when one's base of experience is wide.

The educational software developer should enjoy general computer literacy. She should be able to converse with computer specialists; cross-pollinate her designs from a knowledge of computer applications in other disciplines; be alert to social issues which should most likely be addressed in her designs, for example: invasion of privacy; the isolation of computer users; economic factors in computer accessibility; women and technology. She should know the resources available to improve both the development and delivery of instruction; the variety of hardware, software, and non-computer-based materials.

The developer generalist should have a knowledge of two-dimensional visual design as applied to the layout of text screens, computer graphics and computer animation, as well as knowledge of how visuals are used in education - what's most effective and when.

One of the most difficult, she should be developing an understanding of the nature and possibilities of meaningful interaction in computer-based instructional materials - the difference between what Dr. Larry Brink (1985) calls "hands-on" and "minds-on" learner activity.

She should have developed at least introductory, transferable skills in design execution, including storyboarding, flowcharting or its alternatives, coding, and debugging. If she is to be able to communicate with specialists, a good developer must have had the experience of taking her paper-based design step-by-step through the complexities of getting it to the screen. Was T.S. Eliot (1963) thinking of CBI development when he noted: "Between the idea/ And the reality/ ... Between the conception/ And the creation/ ... Falls the Shadow"?

The designer generalist should have a knowledge of various execution alternatives, the advantages, and disadvantages in given circumstances of general programming languages, authoring languages and authoring systems.

She should be skilled in formative evaluation, in order to test a product in development.

She should have documentation skills to prepare comprehensive instructor, student and system installation guides.

If she is to work with interactive video, she must acquire familiarity with the technology of linear video production. She must augment it with an understanding of the new potentials interactivity affords educational television, and the differences it suggests to conventional concepts of continuity.

She must develop a range of problem-solving, consulting, and change-agency skills. Skills in proposal writing and project management techniques would clearly be beneficial.

And above all, the computer-based instructional designer must be able to apply all of these competencies in a real environment, confronted by deadlines, budget limitations and, most importantly, real learners.

IS IT POSSIBLE?

The expectation that one person could within a reasonable time develop all of these competencies may appear unreasonable. But remember, the task is not to develop expertise in each of these areas, but to have sufficient experience and knowledge to converse meaningfully with experts, and to substitute one's lesser skills when there is no alternative.

Five years operation of the Courseware Design & Production Program at Sheridan College has shown us that the efforts of individuals to develop such a wide range of competencies are both possible and useful.

Our students have included educators from pre-school through post-secondary, business and industrial trainers, computer programmers, technical writers, media producers, a bush pilot, and a lawyer. They have followed either a nine month fulltime program, or enrolled for summer or part-time evening and day study.

Employers concur that our graduates[' range of skills is desirable. Over ninety percent of graduates are working in their chosen field. Many have assignments in the recommendation or development of computer-based materials at levels from pre-school through post-secondary education. Others do analagous tasks in corporate training environments. Still others provide contract services in documentation, the design and scripting of interactive video materials, or the independent formative evaluation of materials under development. Two graduates have worked in marketing, one in educational software and the other in authoring systems.

No two are doing the same work. Some have specialized in a single field; but through the breadth of their study experiences, they are better equipped to understand their role on a CBI development team. Others are practicing generalists, either team managers or lone workers in environments which cannot support more expensive alternatives. Many of these are introducing new groups of learners to the advantages of computer-based learning.

In this paper I have outlined the developer competencies which our experience at Sheridan College has suggested can enhance the prospects for better computer-based learning materials.

Clearly any list of competencies must be dynamic and ever changing. I look forward to hearing your ideas on the directions we should be taking to improve the potential experiences of future computer-based learners.

Brink, Larry. "What's so special about CBT? - Making the most of the medium". Data Training, March 1986.

Eliot, T.S. "The Hollow Men". Collected Poems 1909-1962. London: Faber & Faber, 1963.

* *Earlier versions of this paper were presented to the International Conference on Courseware Design & Evaluation, Ramat Gan, Israel, April 1986; and the Annual Conference of the Association for Media & Technology in Education in Canada, June 1987.*

Studying the Dictionary

Joyce T. Forbes, Ph D.
Department of English
Lakehead University

It is now almost axiomatic to state that a large number of first year university students have major difficulties with writing. It is also common knowledge that many of the students, if at all familiar with the dictionary, know it only in an abridged or concise form.

Though the old British system of learning language skills in English through conjugating verbs is outdated, the type of mental discipline it taught is not. A modern preoccupation only with newness has severed our contact with educators like the Roman Quintilian. It was from his writings that some Renaissance writers derived the conviction that all study, and especially that of mathematics, should be made to seem like play. Euclid had first popularized the study of geometry by making it a kind of game.

Instructional "Show & Tell" which aims at "a sharing of innovation," seems to have some of its roots in a venerable tradition. But, just as importantly, it affirms the need to make this game-like, cooperative effort appropriate to technological society.

1. Aim of Assignment

This assignment called "Studying the Dictionary" aims at doing several things:

A. It requires students to consult the dictionary, to spend some time playing with words and hence ideas, and to share that experience with someone else.

B. It demands that students attempt a project that calls for the management of time and the expression of their imagination and creativity.

C. It rewards all students in several practical ways: through a grade; with exposure to a different way of learning; and with an individualized assessment of personal growth in the learning process.

D. It rewards the instructor with tangible proof of the effectiveness of the method while also revealing student attitude to the experience. Equally important is the feedback on how worthwhile was the experiment. A special bonus is its accomplishing of the unexpected by appealing to that within the individual psyche that wants to grow.

II. Approach Used in Assignment

The Assignment also makes use of a variation of the "Case Study Approach."

Guided by personal interest or discipline enrolied in, students choose the particular case they want to research. They consult at least one unabridged dictionary. Many students consult other dictionaries and encyclopedias.

They choose 1 letter of the alphabet, and locate 20 words that they find interesting. They find the meanings of these words and write sentences using ;the words. Of the 20 words they locate, they choose one and pursue its history.

In effect, the study of the history of this word involves a bit of detective work as well as the analysis, in some degree, of how a particular word came into being. The study also reveals to students that words are live things. That words have a kind of parentage and belong to a family. That words can also become outdated and worn out.

And so in studying the particular case history of a word, Students may study themselves. (See Letter on History of word Heather). Or, it may provide the more imaginative student with the opportunity to indulge his fancy. (See Copy of Interview.).

III. Formal Presentation through Role Playing

The third part of this assignment involves the writing up o an exercise making use of the facts students have unearthed. This material has to be formally written up.
Students are asked to write a short exercise of about 1 type-written page. To keep the element of "fun" alive, role-playing is introduced here. This is considered important in an assignment designed to be completed over several blocks of time. Students could approach the written part of the exercise from one of four different perspectives. They could write as the author of:

1) a letter
2) a proposal
3) an article
or
4) an interview

The element of choice is an essential part of both phases II and III of the assignment. An assignment like this caters both to the interests and needs of a variety of students.

The students who have worked on this assignment majored in a variety of disciplines and areas:

Computer Science	Psychology	Biology	General Program
Nursing	Library Tech.	Chemistry	
Geography	Social Work	Mathematics	

In addition, these students varied in ages--from mature adults in their early fifties to young adults in their late teen years--and hence in their living experiences. Then, too, there were several students whose first language was not English. And even among those whose native tongue was English, and who said that they had written several essays during their last years at High School, there were few shining stars.

IV. Proof of Student Approach

The final task in this assignment involves the submission of evidence by students that they have handled the exercise themselves. They were told during the second week of classes when the assignment was given that they should keep a file. Here they detailed and documented their handling of the assignment.

This assignment helped to demonstrate to students the necessity of handling the demands of one course to fit in with those of other courses. It also reinforced a central point discussed as part of the writing process--a final paper is rarely a first attempt.

The file that was submitted as part of the assignment provided a journal type record of:

a - time spent and periods allocated for work on the project

b - draft(s) written of formal presentation as in III

The information provided through this file is also useful in other ways. It could indicate whether the project was too complex; how it could be improved or perhaps streamlined; and whether the mark allocated to this task was in just proportion to the work done by students.

In addition, the absence of the file as a component of the assignment, was itself an index of many things. For example, students' ability to organize their time, or follow directions. It also made it possible to identify the specific stage at which a problem arose, and possibly provide the opportunity for the student who is willing but weak to work again at a specific task.

History of the word Heather

by Heather Manty

The word "heather" which has also been known as "hathir", "hadder" and "hedder" originated in northern Scotland. The first appearance of the word was in the 1300's and was spelled 'hathir". It is not known for sure exactly when today's spelling of "heather" came into being, but it is believed to have been sometime during the 18th century. Although experts are not positive, it is quite likely that the present literacy form is derived from the word "heath".

The word heath refers to a type of plant or shrubbery, including erica and ling, which when looked up in the dictionary are described as heather. Heath is also defined as open, cultivated ground clothed with shrubby plants known as heath or heather.

In Scotland. heather is a very versatile plant. Its beautiful flowers are commonly used for decorative bouquets. The roots of the heather plant are used to make smoker's pipes called briar pipes. Heather is also used to describe a type of fabric with mixed or speckled hues, thought to resemble heather.

T.. re are various phrases used in Scotland which include the word heather. The most common of these phrases is "to set the heather on fire". This means to cause a disturbance or create confusion. Another common phrase is "to take to heather" which means to become a bandit. The latter phrase gained popularity years ago when bandits hid under the heather bushes to escape from the police.

In doing this study, I found that heather has a unique and interesting history. There is, however, one more use of the word which I have not yet mentioned. Heather is also a nice name for a girl, and because it is my name I found this exercise quite intriguing.

INTERVIEW

by Kevin Viklen

Narrator: Welcome to another edition of "Words Worth", the weekly interview series which each week examines a certain word and its history. Todays guest is Jackson Queen, noted author of such bestselling works as "A Housewife's Handbook of Headless Husbands". Our interview takes place in the home of Mr. Queen. And here is your host, Dick Shunery. Take it away, Dick.

Dick: Thank you and welcome to another edition of "Words Worth", and thank you for being here, Mr. Queen. I know your policy about not giving interviews but I'm glad that you decided to be with use today.

Queen: You're quite welcome, Dick. And as the audience may have been able to figure out, today's word is "horror". Horror is defined as a strong feeling of aversion mingled with dread. This feeling is excited by something shocking or frightful.

Dick: That's quite an accurate description; at least, I think it is. But how exactly did the word horror originate?

Queen: The word horror, in terms of its association with fear, arose from another definition of the word. The word horror also refers to shuddering or shivering as a symptom of disease. When someone realized that the same shuddering occurred

as a result of fear, it was applied to this as well. Thus, horror has come into its own. Strange as it may seem, horror also used to mean roughness or ruggedness. Through extensive use, however, it was eventually replaced with the word "horrid".

Dick: That's very interesting, (the arms of the chair that Dick is sitting in transform themselves into long, muscular arms ending in two monstrously large claws). And how do you, as a horror author, view this definition of horror?

Queen: I believe that it is completely accurate and boas the intentions of my books upon that definition.

Dick: Then, how can you call yourself a horror author when all that you write is simple "hack-and-slash and slice-and-dice" novels which aren't scary or horrifying, but only sick and disgusting?

Queen: One man's disgusting is another man's terrifying. And I believe that you have overstayed your welcome!
(Queen snaps his fingers and the arms make their way towards Dick's throat).

Dick: This interview isn't over yet. You . . .
(Dick's words are cut off in his throat as the two claws take hold and quickly cut off his air supply, as well as his life).

Queen: This is Jackson Queen, signing off another week's episode of "Words Worth". And please remember that when talking to a true master of the horrific arts, one man's fiction is another man's fact. Also, the next time that you are at the bookstore, pick up a copy of my latest book, "Killing Kids for Kicks" or, you might be my next houseguest.

Video to Slides - Quick and Cheap

Terry J. Gillespie
Department of Land Resource Science
University of Guelph

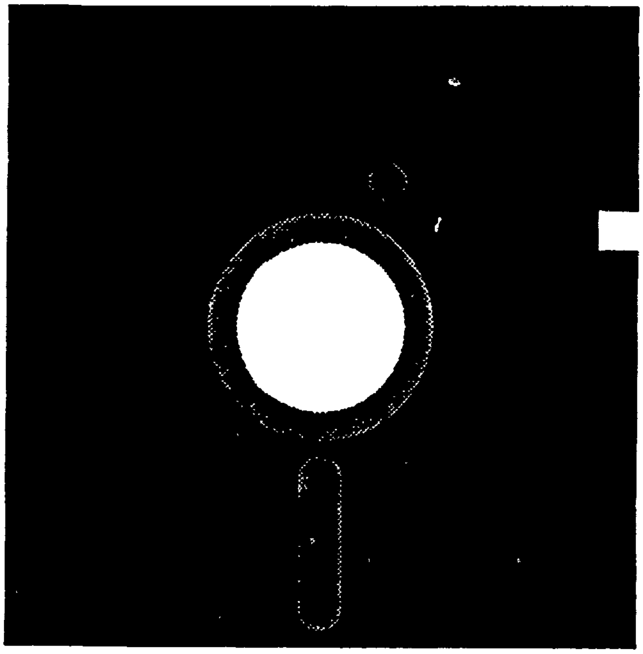
Do you have a need to transfer tidbits from a video presentation onto 35mm slides for classroom use? This can be done with quite reasonable quality using a colour television monitor and a 35mm camera.

My particular application is in the teaching of meteorology. I strongly believe that an immediate connection between classroom experience and the current weather outdoors is a powerful teaching tool. So I need today's weather in slide format... today! Although I have an urgent requirement for rapid creation of my slides, the transfer of video to slides may be a useful technique for any teaching application where low cost is desirable.

Each morning of the week I videotape the excellent Public Broadcasting System program called A.M. Weather, making notes about particularly interesting features of the maps or satellite images. Early on Friday I photograph the screen images I want to use from these tapes and rush the film to the photographic section of the Office for Educational Practice, where it is processed by about 11:00. This gives me ample time to prepare a slide-illustrated review of the week's weather, and the weekend forecast, before my afternoon class.

A high-quality television monitor should be used, and the 35mm camera should be capable of focussing close enough to fill the whole frame with the television picture (a "macro" lens may be required on the camera). In order to get an evenly "painted" slide, the camera shutter must remain open while the video screen is refreshed several times in an otherwise dimly lighted room. Screen refreshment occurs at 1/30 second intervals, so a shutter speed of 1/8 second works well. With Ektachrome 100 ASA film, a meter reading on my screen suggests an aperture of f/11, and this produces good results.

Slides of very acceptable quality for classroom use may be produced quickly from video in this way, using a readily-available 35mm camera. The weekly weather map and forecast discussion built around these slides has become a valuable component of my course presentation.



Research and Development

Software Development Guidelines

by Jim Greer, Manager of Interactive Information Systems, R&D

This guide was produced for those developing software through Sheridan College's Research and Development function.

Photocopying of this material is encouraged, as long as the original source is noted and the reproduced materials are not sold. For information about R&D, or for additional copies of this booklet, please call (416) 845-9430, ext. 277.

February 1988

Research and Development

Software Development Guidelines

Introduction

This is a a guide for project managers who are planning to develop computer software. It provides an overview of the software development process, describes some of the problems that you might encounter and explains what is expected of you as project manager.

Developing computer software requires a fair amount of planning. As you will note in these guidelines, most of the planning process should happen long before the programming has started. By doing this you will reduce the problems during the programming phase and be better able to complete your project on time and within budget.

R&D staff are available to assist you with any aspect of project management and software development.

Software Development Phases

1. **Initiation:** Clarifying your idea.
2. **Requirements Analysis:** What are you going to need?
3. **Design:** Specifications of requirements and production planning.
4. **Programming:** Coding of the design.
5. **Testing:** Does it work?
6. **Operation:** Using the software.
7. **Maintenance and Enhancement**

Deliverables

Once your project has been completed you will be required to provide Research and Development with:

- one copy of the final **executable software** product (on disk)
- a copy of all **source code** (on disk)
- a copy of Makefile (if you have used one) or **written instructions on how to compile software** and what order modules have to be in to compile and link
- copies of all supporting documents, such as **user guides, workbooks, installation guide, etc.**
- copies of all **documentation, flowcharts, pseudo-code etc.** as outlined in the guidelines.

Phase 1. Initiation: Clarifying your ideas

What is it you would like to do? Try to clarify your idea by talking with R&D staff or someone on the R&D committee. Talk to your Dean, Director and associates to get initial feedback and support for your idea.

Phase 2. Requirements Analysis: What are you going to need

Objectives - what are the **objectives** of the software?

Choice of medium - have you thought of alternatives to developing this software? Is it appropriate to computerize, or can your goal be achieved more effectively in another way?

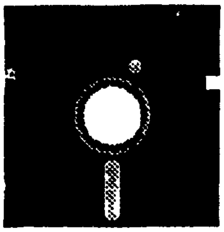
Technical requirements - list what is required to develop your idea, such as:
- **hardware configuration** (minimum and ideal)
- what **peripheral devices** are needed (ie. printers, hard disk, color monitor etc.)?
- is **special software** required (ie. libraries, spreadsheet or database)?
- what **special interfaces** are required?

Market - what market are you designing the software for (college, high school, primary school, general public, etc.)? What are the characteristics of the market?

Production management - how is the project to be managed? Make sure there is a proper reporting system between all involved in the development.

Tasks - who are the **people and skills** that will be needed for production of the software? (R&D staff can assist you in identifying skilled people for your needs.)
- for how long will these people be required (you need to know this for budget preparation)
- consider using a contract when hiring programmers, instructional developers, computer graphic artists, etc. (Manager of Interactive Information Systems Jim Greer can provide assistance and sample contracts.)

Document all of this; you will need to refer to it later.



Phase 3

Phase 3. Design: Specifications and production planning

Specify the automated and manual functions and procedures, the computer programs, and data storage techniques that meet the requirements identified in Phase 2.

Software Libraries -specify what **software libraries** you will be using (if applicable).

Graphics Standards -if graphics are required, what **graphics standard** is going to be used?

File Format -what **file format** or data structure are you planning to use? Make it simple.

Portability -Have you considered the possibility of porting the software to other types of computers (e.g., Apple, IBM, Atari, ICON, etc.)?
-are there any **special dependencies**, on a certain piece of hardware or an existing piece of software? **Try not to make the software machine- or terminal- dependent.**

Design -consult with an instructional designer and graphics specialist to get tips on **screen design and content structure.**

Flowchart -with the help of a systems analyst or your programmer, prepare detailed flowcharts (or **pseudo-code**) of the process. (A flowchart is a flow diagram of how the program is going to work, where processes lead, and which screens appear after certain decisions are made, etc. Pseudo-code is basically a plain English version of the steps that will be required to write the program.) Your programmer will need this information.

Scripting/Storyboarding -with the help of an instructional designer and/or writer you should prepare a script of what **will be on each screen.** This is necessary if you are developing courseware and would be of help if you are developing other types of software.

Check -check the flowchart : **make sure that it is viable and that error checking procedures are included.** This is important, as it is the last check before the programs are coded.

Production Schedule -what is the duration of the project? Set a production schedule and try to stick with it.

Document -document all this information; this is an important phase in the software development and **your programmer(s) will need all the information that you can give them.**

Phase 4. Programming: Coding of the design

Check for completeness - make sure flowcharts or pseudo-code is complete and that your programmers understand what is required. Make sure programmers work from the flowcharts (or pseudo-code).

Follow plan - stick to the (instructional) design of the content. Try to modularize the code; it will be much easier to program and to document.

Check for efficiency - is the code efficient? Try not to get too fancy. The best code is clear and easy to follow. Make sure you are using the appropriate programming language for the software that you are developing and that you can meet all the design criteria with it.

Choosing the appropriate programming language - There exists a great selection of programming languages and solutions for your programming needs. Most languages are designed with a specific task in mind. Here are two areas for consideration.

Data type
- Are you working mainly with text? If so you may want to consider a language that has an instruction set and library rich in string handling routines (such as C, Basic).
- Do you need to manipulate individual bits of data? Certain languages are better adapted to this task (Assembler, C...).
- Is most of the data that you intend to work with numeric? Scientific languages may provide the solution (FORTRAN, Pascal, PL/1, C...).
- Graphics are becoming more prevalent in computer work. Tools for effective development are available.

Process
- Presenting frames of text or text/graphics can be accomplished with a number of products:
  - native programming languages (ie. Basic, FORTRAN, Assembler)
  - authoring languages and systems (Natal)
  - database languages as found in dBase
- Do you need to control external processes such as a videodisk or some other hardware device? Special languages have been developed to incorporate this capability. Some native languages give access to the full range of I/O control (C, Assembler...).
- Complex calculations or number crunching can be successfully programmed in a scientific language as well as in spread sheet programs. (There may be additional costs if using a spreadsheet.)

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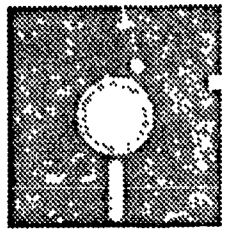


- Data base languages provide simple solutions to the problems of accessing wide ranges of data that can be tapped by computer. Expert system shells provide another useful solution.
- In certain applications speed is critical. Machine level languages (such as Assembler) may be the solution.
- If there is a high degree of interaction between the user and the software, a screen and keyboard oriented language may be the solution.

Other points to ponder

- Often there is no one language that fits all your needs. It is possible to connect modules developed in different languages to produce the most effective solution.
- Identifying the available resources may narrow the choice of language. Be wary of choosing a solution for which there is little on-site support.

NOTE: There are several books on programming standards and style available from the R&D library. One that you may want to refer to is *The Elements of Programming Style* by Kernighan and Plauger. (Also, see the list of reference books at end of these guidelines.)

●●

Document source code

- Document all source code, especially special routines or modules within your programs.

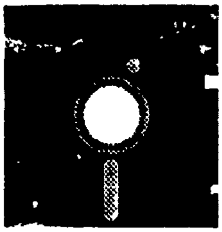
Some other hints for documenting programs:

- try not to put too many comments in the header of the program. Concisely explain what the program/ subroutine/ module does in general.
- put descriptions of variables as close to the variable declaration as possible. This will help eliminate some of the overly long descriptions at the beginning of the program.
- emphasize the documentation of the variables and the data-structures rather than the algorithms.

Contract

- Helpful hints: Think about putting your programmer(s) under a contract. This may help solve some problems you may encounter later in the development of the software and would spell out what is expected of everyone involved. Make sure the contract states that the College will retain ownership of all computer programs and modules developed by the programmer(s) unless specifically stated. (See Jim Greer for more information.)

If you are using students to do the programming, consider their school work load as well as their ability to do the programming. It would be a good idea to have someone from R&D meet with them and explain what is expected regarding the style of programming and the documentation required. It may also be helpful to have an R&D staff member assist with the supervision of the programmer(s).



Phase 5. Testing: Does it work?

Test
- make sure that your software works as intended.
- thoroughly test for any possible **combination of data** that could be entered. Make sure error routines are working properly.
- have an **instructional designer** test the software. They check the instructional design, and can evaluate a variety of aspects including sentence structure and overall look on the screen.
- it is important to have **someone outside of your project team** test the software. They may find something that you have overlooked or taken for granted.
- document test results and any other findings; you may need these for your final report to the R&D Committee.

Phase 6. Operation: Using the software

Protection
- once the product is ready for use you should consider **security, protection and copyright** of the software, if you have not already done so.

Documentation
- you should, by this stage have a full set of documentation for the software. You should have further documentation that shows the **procedures** that are required to **compile the software** and **link modules**, etc. This is important for future maintenance and enhancements.
- consider using a **build.com** or **makefile**, not only to make the compile and link processes easier, but also to reduce the risk of errors when updates are made.
- you should have a complete set of **installation** and **user instructions** for the product, keeping in mind how the user is likely to use your software. For example, different installation instructions may be required for running your software on a single computer and on a network.

Phase 7

Phase 7. Maintenance and Enhancement

Updates

- as the software is used, you may find that you will want to make changes in order to enhance its performance or increase its capabilities.
- make sure that the software is easily maintainable. Make sure your documentation is complete and that you have copies of all modules that were developed for use in the software.
- are there software modules that were developed that could be put into a library so other software projects could use them?
- complete copies of all source code, final executable code and documentation will be required when the project is completed. These copies will be kept in a fire-proof safe for protection and safekeeping by Research and Development.

Resources:

Partial Listing of Reference books:

The Art of Software Testing - Gelford J Myers
The Elements of Programming Style - Kernighan & Plauger
Computer Based Instruction - Methods & Development - Alessi & Trollip
Making CBT Happen - Gloria Gery
The Computer Documentation Kit - Diana Patterson
Programming in C - Stephen Kochan
A Workbook in C - Joseph Sant
The Instructional Design Process - Jerrold E. Kemp
Principles of Instructional Design - Gagné & Briggs
The Human Factor: Designing Computer Systems for People - Rubinstein and Hirsch
Guidelines for Learner-Computer Interaction in Independent Learning Centre Courseware - Robert Jones

Educational Delivery Models Using Computer Databases

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Introduction

The amount of information presented in most disciplines can easily overwhelm a student who is either unprepared or unable to manage that information for learning. To assist the student in mastering a field of study, we must thus educate our students in information management until they become deeply rooted in an effective educational paradigm.

In 1985, the University of Windsor entered a Joint Effort Agreement with IBM of Canada Limited. This allowed both extensive prototyping and in-course applications of educational delivery models that incorporated database concepts. The purpose of this endeavor was not only to obtain a higher level of learning for students through the use of this technology, but also to provide insight into the practice of teaching. (Hogue, Sands, Habowsky and Stager, 1987)

Database Concepts

The database represents the use of forms for information storage, search and retrieval. All information in the database is treated as being of the same level of organization. An example application of such a database would be the names and physical features of the planets. A database of this nature can be created with most popular database programs.

In our work, we have used the IBM Filing Assistant* and 3by5‡ to create such a database. It was found that students could become better acquainted and subsequently more proficient with the database if it first involved data that they were not responsible for learning. Furthermore, questions by students would be more related to the method of teaching, the nature of the database, or the computer system in general, rather than the information content of the database.

Student Database Development

Once students mastered concepts associated with the database, they then used it to assist them with their course content. In Biology, students enrolled in Cytology are presented with a pre-defined form on which to categorize different types of animal cells on the basis of their structure and function.

Similarly, students in Histology used the same database concept, with a more complex course content. Information obtained from the prerequisite course in Cytology was quickly and effectively organized. Throughout the course, information related to the histology of animal cells, presented by lectures, was added to the database by the students. The end product was a detailed and dynamic summary of course content that was readily available and accessible.

Students in a first year Engineering course (Computer-Aided Analyis and Design) also created databases as an integral portion of the design work. Students were asked to manage not only collected facts, but also ideas generated as a part of open-ended problem solving.

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* IBM of Canada Limited

‡ Softshell Corp

Prepared Databases as Resources

Suitable databases can be created and maintained by an instructor and used as resource material. Students in Cytology also have at their disposal a database of plant tissue and cell information, compiled by S. N. Postlethwait. This resource was coupled with a computer controlled videodisc (BioSci). Software created at the University of Windsor by C.W.V. Hogue allowed the botany and histology sections of the laserdisc to be accessed as a database of images.

Students in Engineering developed their own database resources. The entire first-year class prepared an extensive database of articles on bicycles, to be used in conjunction with a major project. The work of several groups was merged into a single database available to all individuals. This resource can be used for future classes.

Conclusions

Media technologies have been implemented into the practices of teaching and learning for approximately the last thirty years. During this time, continuing developments of the technologies and their applications have resulted in successful, technically innovative, teaching regimes. We have found that an introduction of computers, videodisc and database software into the teaching environment most effective. The use of the Interactive Audio Cassette (IAC) has proven to be a simple and effective means of introducing the software, hardware and its use. Databases show much promise as learning tools for students. Although their creation and use has provided a future rescurce, the proper integration of these tools into the learning environment are the key to their success.

Hogue, C.W.V., Sands, T. W., Habowsky, J.E.J., and Stager, R. A., Database Creation and Use in a Learning Environment. Presented at the Ontario Universities Instructional Technology "Show and Tell", University of Guelph, May 1-3, 1987

The Evolution of Individualized Instruction Using Electronic Media Technologies

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Preface

In North America in the early nineteen sixties, INDIVIDUALIZED INSTRUCTION (II), emerging from developments in media-technology, was born: the student applies himself/herself on an individual basis by means of various media (closed-circuit TV, audio-cassettes, video, computer and more recently the video disk) according to his/her rate of learning, level of knowledge and receptivity.

The author is of the opinion, that this system which proved its worth in Canada and the USA also presents a solution to high enrollments as well as a means of improving the quality of education in Germany. The impact of distance learning is not dealt with in this paper.

1. The Use of the Monitor
(a) Development

Towards the end of the fifties some reasonably-priced combinations of TV-Cameras and monitors became commercially available. It is more than likely that not only the Zoologist Prof. Beckel thought of the idea to put such technological devices into teaching; in 1959 he introduced a closed-circuit TV-system into the laboratory portion of the first year zoology course, Department of Zoology, University of Toronto, Ontario, Canada. Since I was a Ph. D. student of Prof. Beckel and assisted in this laboratory course, I got also involved in the use of this teaching aid.

One was of the opinion that the students are not only better served to learn hands-on work in the laboratory, but also that this closed-circuit TV-system, can cope with increasing enrollments. The monitor made it possible not only to present the pre-laboratory discussion, demonstration and on the spot help during the laboratory period, but particularly to demonstrate minute details (for example portions of a cell seen through the light microscope). This system also enabled information to be delivered to any location within the laboratory, thus finally avoiding crowding around demonstration tables as well as the need for an instructor to repeat a demonstration again and again to successive groups of students.

Because one could instruct via this system in several physically separated laboratories, it was now possible to also stay within the financial budget, heavily burdened from increasing student enrollments: the use of closed-circuit TV permitted the liberation of instructors from unnecessary repetitions of presentations and allowed an instructor to address all students from a central location, simultaneously. The subsequent practical part of the laboratory period was mediated by means of teaching assistants. In principle the central location of delivery comprised two TV-cameras, one directed to the instructor, the other supplemented the instructor's demonstrations or experiments (equipment, pictures through the microscope, trick-demonstrations). Besides Prof. Beckel, Profs. Friend and Riggler also participated in these laboratories in part as guests, or used this system in their own courses.

In summary: the use of the closed-circuit in TV-teaching and learning opened up a new era in education for both teachers and students alike. The success of this introduction of media-technology at the University of Toronto, led to its adoption by other Universities. A similar system of instruction was started in the laboratory course of first year biology in the Biology Department of Queen's University, Kingston, Ontario; it was technologically improved by the use of a "feed-back-system", by means of which the student was able to communicate with the centre desk. In 1962 Scarborough College, a satellite campus of the University of Toronto was in the planning stages. Prof. Beckel, future Dean of the College, incorporated the closed-circuit TV-system as an integral part of the teaching and learning approach to the College. Further, in a new building of the University of Toronto, the Ramsay-Wright Zoological Laboratories, monitors were installed in lecture rooms as a teaching tool.

Translation of a German paper distributed to all Ministries of Education, Industry, and Universities in the Federal Republic of Germany.

Thanks are expressed to Dr. Lullies, Director, Bavarian State Institut for University Research and Planning; Munich, Germany, for inviting me to write this position paper (Beiträge zur Hochschulforschung, Nr. 4: 255-266, 1983).

(b) Present State of Developments

Towards the end of the sixties the application of closed-circuit TV to instruction had passed its peak; initially it was thought to be the only practical answer to the teaching dilemma, imposed by ever increasing enrollment; this system was thought of as intermediate channel between teachers and students, by which to improve costs and effectiveness in teaching. This became particularly apparent: enrollments continued to escalate. which made this system again a limiting factor, mainly because technology for video RECORDING was at the time in its infancy.

Developments in other Universities looked for media applications which enabled re-play of teaching programs once they were recorded; these developments took place parallel to that of the closed-circuit TV-system and were so successful, that gradually the TV-monitor lost in significance as a primary teaching aid. Regardless the closed-circuit TV-system remains a useful teaching tool at many Universities in Canada and the USA, since video-recorders (although expensive) now provide convenient storage and re-play of programs, while "life" presentations are important for teaching (e.g. surgery).

2. The Use of Audio Playback
(a) Development

In the Department of Biological Sciences, Purdue University, Lafayette, Indiana, USA, the Botanist Prof. Postlethwait was concerned about the high failure rate in his basic Plant Science course; he thought that three factors seem to relate to this problem: high enrollments, the variable levels of knowledge of incoming students and individual differences in learning ability. To assist those less successful students, Prof. Postlethwait initially had his lectures recorded and provided tapes to students, who wanted this extra help. This possibility of repetition of the lecture became so popular, that a majority of students in his course requested the opportunity of listening to the recorded lectures. Because of this positive attitude of students to the use of a tape recorder in learning, Prof. Postlethwait introduced this medium in 1961 in a portion of the laboratory part of the first year botany course for further testing; based on the positive results he fully implemented and developed the use of the tape recorder into the entire course*. This new "Audio-Tutorial" method in teaching is composed of the following elements:

- a Learning Centre with study carrels and extended open hours, allowing individual students to develop their own timetables, or to repeat each lesson as often as they require;

- audio visual programs in which the subject matter was organized with great care, using illustrative and written material are provided at these study carrels;

- especially defined learning objectives allow the student at any time to monitor his/her progress;

- a tutor is always on hand to help immediately to discuss, with the student, problems as they arise from the learning material.

In particular it should be pointed out that the student is now in the position to individually control/adjust the delivery rate of the new subject matter according to his/her background knowledge and according to his/her ability. Additional advantages are that a program can be repeated as often as the student wishes and that the variable level of knowledge of the incoming student can now be accommodated. Due to the extended opening times of the Learning Centre, the student can evolve his own timetable. Of economical importance is the fact that a relatively small number of study carrels can accommodate a large number of students.

While in the conventional mode of mass-teaching students play rather a passive role, in "Audio-Tutorial" they are the centre of the teaching-learning process. Postlethwait formulates his fundamental thesis as follows:

"Learning is an activity done by an individual and not something done to an individual".....

It was soon recognized that the Audio-Tutorial System (AT) is applicable not only to the natural sciences, but also to other disciplines; further it was realized that this system is ideally suited to accommodate the increasing enrollments at Universities and simultaneously improving the quality of education. Other advantages were the overwhelming acceptance of this system by the students and - in the long run - the savings in costs, accomplished through the use of media-technology.

The Learning Centre at Purdue University was frequently visited by scientists and teachers from all levels of education; visitors were interested in studying AT and in assessing possible implementations of this system at their own Institutions.

In 1969 Prof. Postlethwait initiated the "Mini-Course", which is a well defined topic developed as a learning module, for example, "Mitosis" as part of a biology course; it was thought that centrally produced AV-programs in fundamental themes in Biology, would assist instructors and could be tailored to specific needs or requirements at different Universities. Towards the middle of the seventies minicourses for most topics in Biology were completed and became commercially available.

In 1971 the "International Audio-Tutorial Congress" was started; at the annual conferences of this Congress, held in various parts of the USA and Canada, workshops were organized to introduce teachers at all levels of education to this mode of instruction. Additional applications of media-technology to teaching and learning were also reported. In 1976 this Congress adopted the name "International Congress of Individualized Instruction" in recognition of the central role of individualization as a goal in teaching and learning. Since 1982 the Congress named itself "International Society of Individualized Instruction" (ISII), because other interest groups joined: Computer Assisted Instruction, Guided Design, Feed-Back Lecture, and Personalized System of Instruction.

(b) The Present and the Future

The application of media-technology to personalized teaching and learning that is "Individualized Instruction" has over the years permeated Universities in North America, with an emphasis on the core courses for the different programs; given the fact II has become a standard method, it is not too presumptuous to expect, that present enlistment of the computer as an interactive learning aid and the incorporation of the video-disc, will continue to liberate teachers to some extent from routine mechanical tasks, making them more available as TUTORS in this individualized format of instruction. As was stated earlier, II not only proved itself as an economic "delivery system" at high enrollment levels but could be used simultaneously to improve the quality in education.

3. Developments for Multiple Use of the Learning Centre

In 1969 Prof. des S. Thomas and I developed the first Learning Centre in Canada, in the Department of Biology, University of Windsor. Due to increasing enrollment not only were we limited in space, equipment and even scheduling of the laboratory portions of certain courses (cytology, histology) but also faced declining qualities in the "hands on" learning activities. In the planning (different from Postlethwait) we combined the laboratory portions of several courses: cytology, histology, plant anatomy, mycology, and electron microscopy into a single Learning Centre. Using funds from the "house-keeping budget" from the Department, we ourselves converted (with the help of Mr. H. van der Burg) the conventional laboratory (Fig. 1) to the Learning Centre (Fig. 2). It consisted of six "Tut-stations" (study places, in contrast to Postlethwait's were equipped with inexpensive Panasonic audio cassette play-back units), one "video corner" to view slides, film strips etc. (some of which we produced ourselves), integrated into modules, which we called "Tuts". These tuts were produced over a period of one and a half years and consisted of a "Tut-Book" (adopted in 1976 by the University of Cologne, Germany). Each Tut-Book is designed around a defined topic, and incorporates illustrative and written material, experiments or exercises all integrated by the audio tape into an AV-learning package (the "Tut"); at intervals the student is asked to view slides or film lo os at the "video corner" or other appropriate materials. These "Tut-Books" were freely available to the students, so they could proceed at their own rate through the program (Fig. 3).

In 1972 we also developed a concept which we called "Textape", where instead of the Tut-Book a standard well illustrated textbook is used. In 1974 we also started using variable speed play-back units; in this way the student can also determine the rate of speed (= learning tempo) of the audio cassettes, based on a higher rate of compression. In 1982 we began to use the computer in individualized instruction.

Based on the program of studies, the students could develop their own timetables, or work in pairs (Fig. 4). Also of significance was that a Tutor was present when the centre was open. Weekly discussion in small groups and a test, as a control mechanism, helped us to implement individualized instruction.

From 1970-75 we also tested a variety of combinations in II; for example we replaced the lecture with discussion of problem questions; factual information was transmitted to the students in the form of homework, in its total concept similar to the principles of learning in the "Harvard Case Method". From the tests conducted it was obvious, that "Tut-Stations", in combination with the "Tut-Book", "Textape" and "Tutorials" are the framework of individualized instruction; it is also an economical combination. Regarding the success of this method in learning, I would like to cite one example: students who received an A or A+ in histology were exempted from this course if they went on to study medicine or dentistry in Ontario.

In 1976 we developed plans for an enlarged Learning Centre; also the basic course in Biology (where II was also implemented in 1971 in a separate area) was to be included. The new Centre has been in use since 1977. At present the number of student using this facility corresponds to approximately 700 course units annually distributed among seven different laboratory portions of courses and scheduled concurrently within th year; a total number of 53 Tut-Stations are sufficient (Figs. 5 and 6). Demonstration tables for dry and wet experiment are placed in such a manner that they are easily reached from our Tut-Stations. Of particular importance to us was the aesthetic aspect of this Centre; carpeting, a friendly colour scheme throughout the laboratory, plus plants and animals (aquarium) were included (Fig. 7). In the "Video-Bar" (a small room equipped with AV play-back units) students watch video-programs; this Bar is also used by students for programs in senior courses. A cozy corner next to the video-bar (Fig. 8) has a mini-library and contains reference books, integrated in the program of studies; this corner is often used for discussions of just to take a break. An "antique" electron microscope adorns this area and is to be merged into the learning programs.

In the Federal Republic of Germany the principle of II was introduced in 1974 at the University of Cologne in the course "Biology for Medical Students". The successful use of the "Video-Album", totally identical with the

concept of our Tut-Book, which Dr. Hoffmann got to know when he visited us in the Department of Biology, University of Windsor (November 24-25, 1976); further it also presents a direct transfer of II into the German milieu*. Also at the Technical University of Munich I initiated in December 1983 a pilot project in the Department of Physics, Mathematics, and Botany.

Addendum

In the spring of 1971, Prof. W. G. Friend and other members of the Ramsay Wright Zoological Laboratories, University of Toronto, visited me, to acquaint themselves with "Individualized Instruction" and its implementation in our Learning Centre. According to a report (Globe and Mail, January 27th, 1972) this mode of learning was started in 1972 and has operated since then.

November 30th to December 1st, 1982 Prof J. MacLachlan, External Consultant to the Ontario Council on Graduate Studies, on the Graduate Program in Biology at the University of Windsor, in his final report states:

> "Windsor University, and Biology in particular, is well-known in Canada for its innovative procedures in teaching methods. It was one of the first to develop cost-efficient and effective teaching devices which allowed students to pace themselves with audio-tutorial and computer-aided methods. These techniques have been well-publicized and adopted by many other Universities in Canada. They are appropriate for and have been applied to Undergraduate instruction,.... Windsor is to be congratulated on achieving distinction in this area in Canada...."

* B. Hoffmann und E. Eickhoff, 1977. Individuelles Lernen mit AV-Programmen, Hochschuldidaktische Materialien. Heft 63.

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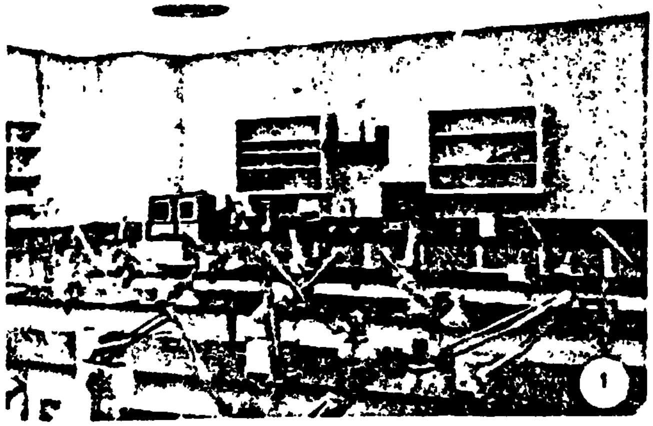
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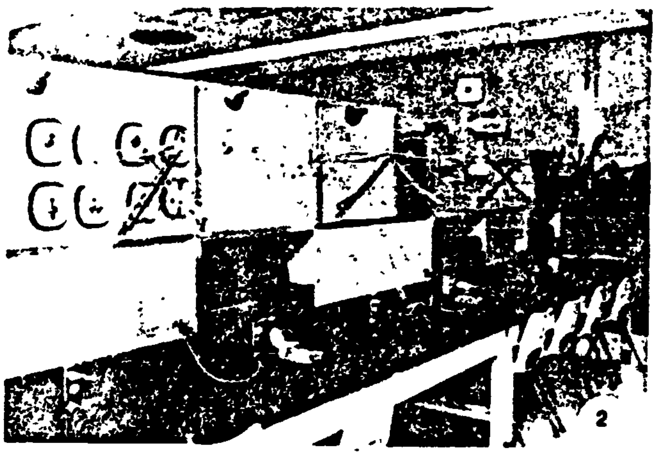
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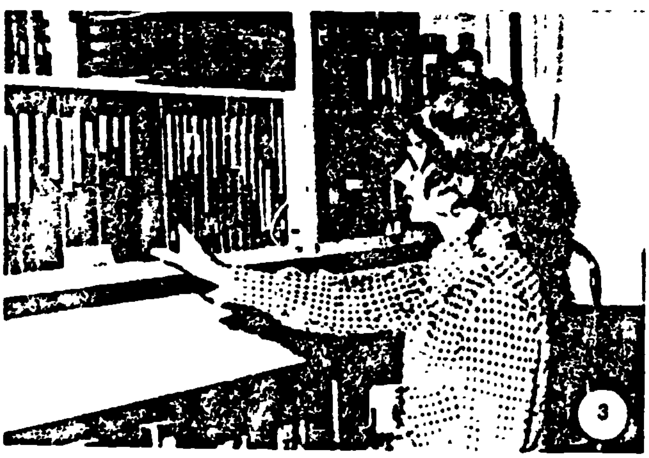
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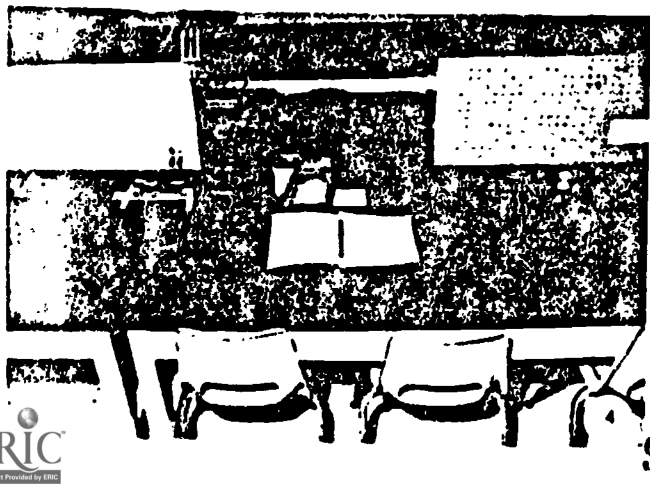
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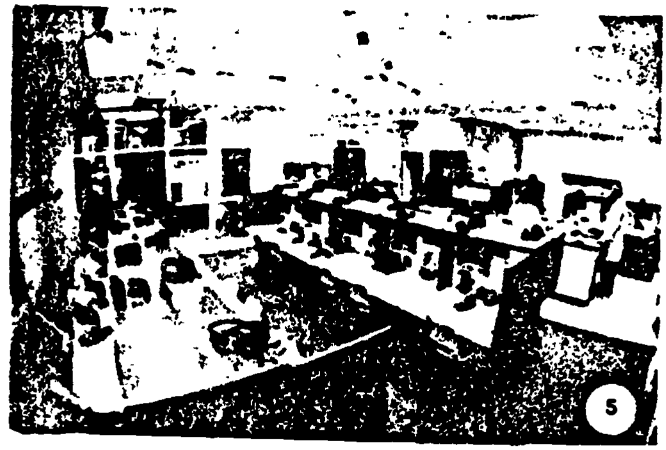
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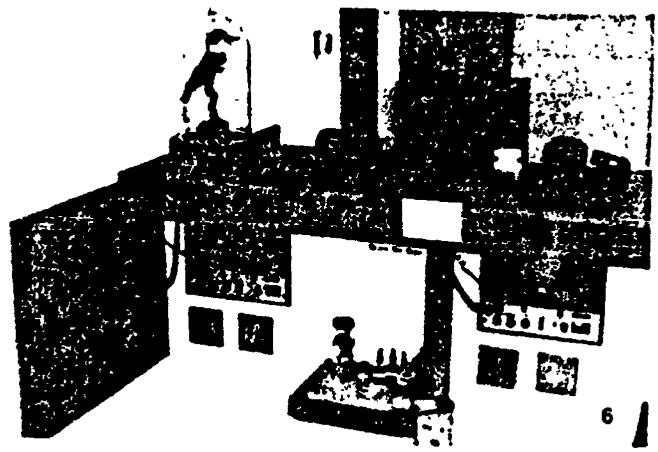
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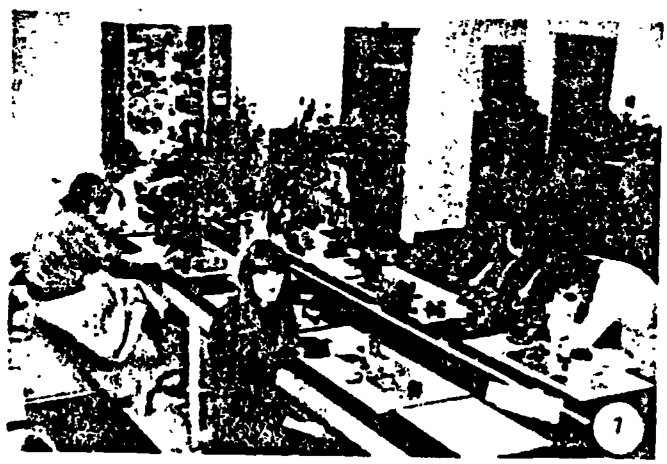
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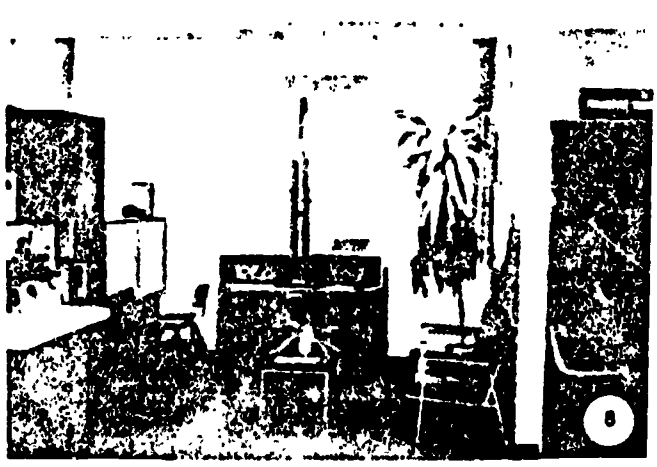
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Interactive Audio: The Unifying Thread in Multi-Media and Computer Assisted Instruction

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Introduction

Over the past 30 years, the evolution of media technology has provided education with exciting new electronic technologies for the delivery of information. Three notable applications were Instructional Television (ITV) in the late fifties (Habowsky, 1983), Audio-Tutorial (A-T) in the early sixites (Postlethwait, Novak, Murry, 1964), and Computer Assisted Instruction (CAI) in the early eighties (Bork, 1981). Such applications have brought forth new instructional paradigms and each in turn was praised as the ultimate in teaching and learning.

Since 1969, at the University of Windsor, we have applied media technologies in the teaching and learning process (Habowsky, 1983; Thomas, Habowsky, Van der Burg, 1971). The laboratory portions of several biology courses were incorporated into a single facility for multiple use. In the Biolearning Centre students use multi-media study-stations and modularized activities. Each activity entails several laboratory skills which are presented on separate audio cassettes.

Success in such a multi-media learning centre is based on one's ability and desire to both modularly and meaningfully implement these technologies (Habowsky, 1983). A corequisite in this approach is to also provide the "personal attention" which students need, as advocated by the proponents of the "Personalized Systems of Instruction" (Keller, Sherman, 1964).

Interactive Audio

In 1985, the Joint Effort Agreement between the University of Windsor and IBM of Canada Limited, provided both computer hardware and software to further this work. We have employed the portable tape recorder to selectively integrate this computer technology with existing and successful media. In this approach the instructor has the "freedom to eliminate, enhance, or emphasize information".

The "Interactive Audio Cassette" (IAC) provides students with personalized instruction in both content and hands-on skills in specific study areas (Habowsky, Postlethwait, Stager, Hogue, Glasgow, 1987). The IAC was used to integrate: a) instructions for computer hardware use, b) commercial CAI packages for content delivery, c) instructions for traditional software applications (i.e. word processor, database), and d) specialized content delivery with the above software. These applications continue to evolve as successful tools in education.

Discussion and Conclusions

Based on our experience, no "single technology" should be implemented for the delivery of information in teaching and learning. When the computer is used as the sole delivery tool, we encountered the same problems of acceptance or expectations as with previous technologies (Habowsky, 1983).

The joining of multi-media and CAI, with the Interactive Audio Cassette acting as a unifying thread, has successfully integrated these technologies. Overall, this provides the instructor with more time to improve both the quality and effectiveness of teaching and learning. We invite more educators to become users of this unique approach.

The senior author is a Cell Biologist and has been active to improve teaching and learning since 1960, when ITV was introduced at the University of Toronto, Ontario, Canada; he has published several articles in educational research and conducted workshops in Canada, Germany and U.S.A.

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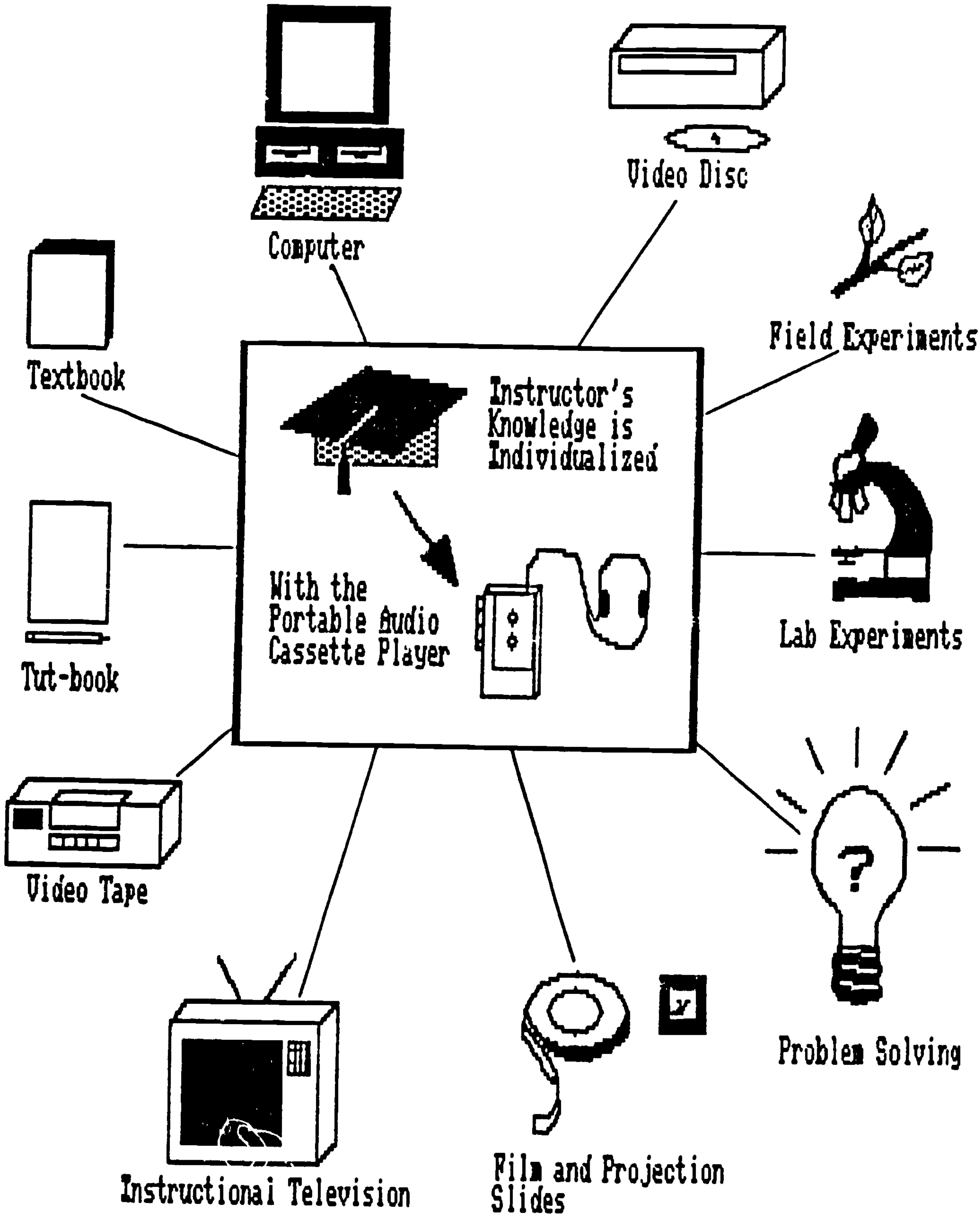

The Interactive Audio Cassette In Multimedia Instruction

Interactive Teaching in Agricultural Botany

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Teaching introductory courses at the University provides a special challenge to the instructor. There is the need to cover all the basics on which more advanced courses depend, while at the same time to motivate the students to learn and retain the basic concepts that they are being taught. Different instructors use a wide variety of techniques to encourage understanding and retention by the students.

Introductory science courses tend to have a high failure rate. The students come with a wide range of backgrounds to the subject, as well as a wide range of interests. Because the amount of factual information is often high in these courses, slower students encounter a great deal of difficulty keeping up with the class.

In subjects where there is an aversion to the material by a substantial number of students, the problems associated with instruction are exaggerated. Subject matter considered dull or uninteresting by the student is often arduous to teach and it is almost impossible to stimulate the students to learn the requisite concepts.

THE SPECIFIC PROBLEM

All the students entering the first semester of the Diploma Program in Agriculture are required to take the course Agricultural Botany. Less than half of those students will continue in programs related to plants, like crop production and horticulture. The remainder will be in programs not directly related to plant growth or crop cultivation. The majority of the students that are not pursuing careers related directly to the propagation of plants have little or no interest in botany, with some even expressing an active dislike.

The students entering the Diploma Program are frequently more diverse in their backgrounds then degree students. A high proportion are mature students who have been in the work force for some time after having left highschool from different grades and various programs. Those coming directly from highschool also come with a wide variety of backgrounds and abilities. A large proportion of the students have not been in the academic stream, and are frequently missing some basic courses.

There are students entering the program on the other hand, who have a very good preparation in the sciences. If the course is taught at the level to meet the needs of the poorly prepared students, the others will be bored with all the repetition, creating unrest in the classroom or poor attendance with its inevitable consequence of poor grades.

The task is then to bring along as much as possible those students with a weak background while not boring those with an adequate background. Remedial courses are not available in the sciences to the Diploma student.

These students are entering a practical program and on the whole they have a very practical approach to the material they need to learn. Knowledge for its own sake has limited appeal for these students. As long as there is meaning and application in what they are learning they are prepared to accept the information.

STEPS TOWARD A SOLUTION

A Suitable Textbook

One of the first steps that was undertaken was to prepare a text book and a lab manual suitable to the course. The text needed to be well illustrated with as many practical examples as possible, and written at a late highschool level.

Enter the Computer
The next step was to provide the students with an opportunity to learn at their own pace, with frequent feedback, using a format that was interesting and stimulating, but different from the other teaching methods to which they were being exposed. Modern technology using the computer, seemed a good way to go. Many students have used a computer and all the others will need to learn at some time during their program. Overcoming any fears about using the computer were anticipated to be minor.

New Terms and Concepts
In the course the student is required to learn a substantial number of terms, names of plant organs and tissues, with correct spelling, as well as a variety of concepts. VITAL offered a method of illustrating visually each new term and concepts as it was introduced. Most students are greatly assisted in learning if they write out their answers and have them corrected as they study. Therefore, a system of continual testing with instant feed-back was incorporated into the modules.

Diversity in Approach
VITAL allows for a diversity of approaches to presenting information, so that the manner of presentation need not become repetitive. With VITAL information can be presented as factual statements followed by questions to test comprehension, information can be presented graphically or pictorially, with or without animation, or it can be presented in the form of questions or puzzles requiring answers. The range of formats possible is determined by the imagination of the designer. A wide range of colors are available, greatly adding to the clarity and diversity of the presentation.

Self-instruction
The students can learn at their own pace, repeating the material if necessary. If they are fairly familiar with the material they can go directly to a test and bypass the reference material. It is possible to put in loops with remedial information for students that may be encountering difficulty with certain sections. The students can take a variety of paths through the module, according to their own level of understanding and speed of learning, i.e. the students are in control.

SUMMARY

The important aspects of VITAL are: it is interactive, it is visual, it provides testing with immediate feedback, material can be presented in various imaginative ways, it is always available, it allows students to learn at their own pace when convenient for them.

THE RESPONSE FROM STUDENTS

Several modules using a wide range of formats were developed and used in the fall for the first time. The material on the whole was enthusiastically received. Students had little trouble learning to use the computer set up for the VITAL modules. A half hour instruction was more than adequate for most students. The great majority (80%) of the students made use of the modules and found them interesting, enjoyable and very helpful. Those that did not use the modules cited lack of time on their part as the main reason.

An exam that had been used in previous years was used to evaluate the students after most of the modules had been presented. The average mark was increased by more than 5% and the failure rate markedly reduced. The second part of the course had limited information available in the form of VITAL modules and on the final exam, which was the same as the previous year, the students' performance dropped back to that of previous classes.

Many requests were received from the students during the latter part of the course for more modules, and there were frequent requests about other courses that might be employing this method of instruction.

RESPONSE FROM THE INSTRUCTOR

The creation of the modules was very time consuming, and a person with artistic talent was essential for this course. The benefits were well worth the effort. Students enjoyed the course much more as a whole, and the instructor gained greater freedom in class to digress from some of the factual information that needed to be covered in the course. In summary, the course was made much more enjoyable to teach.

Journals Across the Curriculum (Action Research Project)

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Since teachers at Sheridan College have busy and varied schedules, the opportunity to discuss, reflect and collaborate is rare. Presently, I am in the process of working on an action research project that I hope will offer one model of teacher collaboration and research.

Action research, sometimes referred to as classroom research, is not new. What makes this professional development strategy attractive and powerful is that it is teacher/student centred and initiated research: it is closely tied to the work the teacher does. Hopkins, in *A Teacher's Guide to Action Research* , refers to research as "an act undertaken by teachers either to improve their own or a colleague's teaching or to test the assumptions of educational theory or practice."

My interest in promoting and organizinging language and my committment to the writing across the curriculum initiative at the college led me to develop an R&D project that would investigate ways of achieving this goal. I settled on the uses of the journal in various disciplines as a focus. The journal has a proud history as a recorder of significant events and scientific findings, as a personal development log, as a creative book, and as a problem solving tool. It has been used creatively and effectively in both personal and professional contexts.

My action research project is involving, at this writing, 14 teachers from across the college who will have their students use the journal in a way that they think will enhance the student's learning experience. The schools represented in the project to date are Technology, Applied Arts, Business, Visual Arts and English/Language Arts. The participants will meet at the end of the semester to share their research with their colleagues.

Electronic Technologies and the Intellectual Property Enclosure Movement

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"If it's valuable it must belong to somebody."
- from "On Being", by T. Terone

INTRODUCTION

Last year my paper for this Guelph Show & Tell Conference was titled "Computer Supported Interactive Distance Education (CSIDE)". It started out as a paper on computer technologies and the learning process but ended up as a look at the potential for computers to transform the educational process. I argued that computers would be as revolutionary as Guttenberg's moveable type and the Copernican revolution. I saw the computer as placing the student and researcher at the centre of a personal galaxy of information sources, one which would break down the barriers of time and space in both intellectual enterprise and social discourse.

As I started this paper I planned to expand on the idea of Computer Supported Interactive Distance Education (CSIDE) and wed it to ways in which electronic technologies would transform participation in political and social affairs. This link between CSIDE and transformed participation in social and political affairs generated the term PICKNet in the title of the earlier working version of this paper, "CSIDE & PICKnet: The Shape of things to Come".

PICKNet stands for **Public Information to Common Knowledge Network**. It starts from the observation that much of useful information in the public domain goes unused because of the cost of access for particular interest groups. For example, the agendas of upcoming meetings for committees of city government provide an "early warning" system for issues of interest to groups in the community.

Special interest groups with a direct financial interest in city government (such as land developers) can finance the costs of monitoring city hall. Without funds or friends in city hall it is harder for other groups to keep abreast of issues coming up for action.

A PICKNet facility would envision, among other things, the routine posting of city hall meeting agendas to public access computers linked to distributed computer networks spread throughout the community. Node based networks, organized newsgroups, E-mail conferencing and the like would facilitate the dissemination of information across time and space in minimal time and at near zero cost. The original strategy of the paper was to expand on this optimistic scenario and link the Copernican revolution in education to a parallel revolution in the conversion of Public Information to Common Knowledge. As I researched the paper I again realized that the paper I wanted to write was not the one for which the title had been selected.

So, what is this presentation about? It is about dark clouds on the horizon, dark clouds brought on by the strengths, not the weaknesses in the emerging information technologies. There is not time to develope them in detail here so I will sketch out several topics and "flag" their more important aspects. Fortunately, the paper presented to the May 1987 Show & Tell Conference is a companion paper in this 1988 conference volume. It is titled "Computer Supported Distance Education (CSIDE)". This presentation deals with intellectual property rights within the context of a modern enclosure movement and begins to explore the implications for universities, society and democracy.

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I. INTELLECTUAL PROPERTY RIGHTS: A MODERN "ENCLOSURE MOVEMENT"

It is useful to view current ferment around "intellectual property rights" as a modem day equivalent of the European "Enclosure Movement" aimed at the privatization of common lands. The Enclosure Movement culminated in the enclosure of common lands in England in the 16th Century. Common lands were progressively converted to private use as technology and market forces increased their value and made "shared use" less attractive to those best able to exploit new technologies and best located to influence the rule of law by the state.

By the 16th Century the emergence of "quality" breeding stock made the co-mingling livestock on common ground less attractive. The owners of "quality" bulls could neither restrict supply, nor charge a fee, for services rendered. Likewise, owners of "quality" cows were exposed to "production losses" from the degradation of offspring through random breeding. What had been viable as common property, the common lands, was progressively removed from common access and converted into private property.

Today, the growing importance of "knowledge" as a distinct factor of production and the rapid expansion of knowledge intensive industry, are producing a similar re-definition of intellectual property and the terms of access. It involves the intellectual property rights embodied in the rapidly growing "services" sector in the Modern economy. It is fitting to call this an "Intellectual Property Enclosure Movement". Below I explore it from the perspective of an economist, but first I shall give an example of the area of computer operating systems.

For the last several years there has been a growing fight over the type of operating system that will dominate the computer market. Operating systems range from the VMS/CMS operating systems of mainframe computers to the CP/M and MS/PC-DOS operating systems of microcomputers on to the UNIX based systems operating on a variety of computer systems. Two trends are clear from the fight. The first is that a single, relatively uniform, standard will emerge to govern the design of operating systems that operate across a wide range of computers from micros to mainframes. The second is a tendency to try to "capture" ownership of the winning operating system. Most operating systems have been "private property".

One might think of operating systems as equivalent to the electrical and hydraulic systems in an automobile. Operating systems are the basic command and communication programmes through which computer and peripheral operations are regulated. Most, such as the CP/CMS IBM mainframe operating system, are machine specific and private property (in the private domain). Some, such as UNIX, are neither machine specific nor private. They are effectively in the public domain. The equivalent to private operating systems for computers would be proprietary rights over the logical structure of he electrical and hydraulic systems in an automobile. The "logic" of the system would be privately owned and sold or licensed to end users (automobile users).

The micro-computer end of the computer market has been using private domain software, the bulk of which is IBM-PC compatible DOS operating software produced by MicroSoft Software. At the mid-range UNIX public domain software has been growing rapidly. For example, the very popular Sun mini-computers were built specifically to exploit the capabilities of the UNIX operating system. For reasons we need not detail here, UNIX as a non-proprietary system has been growing in popularity and is seen as a serious challenge to the proprietary DOS operating system.

This has triggered a dispute in which AT&T (US) and Sun Microsystems have been accused of scheming to take non-proprietary UNIX private while Apollo Computer Inc, Group Bull, Digital Equipment Corp., Hewlett-Packard Co, IBM Corp, Nixdorf Computer AG, and Siemens Aktiengesellschaft have banded together to create the Open Systems Foundation (OSF) with an initial endowment of $US 90 million and a mandate to develope an alternate UNIX-like proprietary software based on an IBM property. At issue here is whether the world ends up paying license fees for a proprietary operating system or shares near free access to "public domain" UNIX-like operating systems.

II. THE ECONOMICS OF INTELLECTUAL PROPERTY RIGHTS

Economists think about the production, distribution and use of goods and services in terms of three basic types of efficiency. They are technical efficiency, allocative efficiency and dynamic efficiency. Technical efficiency is straight forward, involving the optimal mix of inputs to produce output. The supposed short term gains from the Mulroney Trade Deal with the United States are based on a technical efficiency argument. Canada is to experience lower costs from longer more specialized production runs. Allocative efficiency deals with society's choice of that basket of goods and services which maximizes some objective social function. Western economies use market forces to achieve allocative efficiency. In theory, goods are produced in competitive markets to the point where the value of the last unit produced is equal to the marginal cost of producing it. This is the so-called "marginal pricing rule".

The last efficiency, dynamic efficiency, refers to the pace and direction of technical innovation in a society. Policy directed at allocative efficiency and policy directed at dynamic efficiency are frequently in conflict. Two recent Canadian cases illustrate the point. Until recently Canadian law regarding the patent rights of pharmaceutical companies favored allocative over dynamic efficiency. Firms were required to license generic production of brand name drugs. This encouraged production levels and price competition with output based on price and the marginal cost of production. Current Federal government has strengthened the patent rights in exchange for a promise of more research and development in the future. This is a case of social policy support for the promise of dynamic efficiency over the actual gains of allocative efficiency.

The second and more ominous case involves the impending intellectual property bill, popularly known as the copywrite bill. It spent considerable time bottled up in the Canadian Senate as a result of intensive lobbying by Canadian universities and library systems. At issue are the economic rights of those who create intellectual property and terms of access to such properties. Properties range from the ownership of a song, sheet music, a computer programme or encoded chip, to the printed page. Technologies ranging from photocopy machines and audio/video recorders, through to the computer disk and chip, coupled with optical fibers and satellite communications, have reduced the marginal cost of reproduction, transmission and distribution of information to virtually zero. Allocative efficiency suggests that access to photocopies, songs, computer programmes, etc. should be available at almost zero cost.

There are, however, two societal arguments in favour of higher cost access to "intellectual properties". One has to do with equity. Many of those who create "cultural" properties receive rewards for success that fall well short of the value of their product to society. There is support for intellectual property rights that improve the economic status of those artists and writers who "produce" cultural properties. In light of the allocative efficiency arguments, it is not clear that solutions involving unit price approaches are the best. This is part of the argument mounted by universities and libraries in opposition to the intellectual property bill currently before Parliament this year.

There is a second argument, more closely allied to "dynamic efficiency" which argues that adequate rewards, as in the case of exclusive pharmaceutical patents, are necessary to promote the continued flow of intellectual properties. While there can be little argument about the desirability of a continued production of knowledge (intellectual property), there should be serious debate about the proper way to promote it. Western culture has a long tradition of producing and distributing a major share of its intellectual property via public institutions, the most noteworthy being the institutions of public education. Public support has been justified on several grounds. The high fixed cost of development and low marginal cost of supplying knowledge suggest that the supply and use of intellectual properties would be sub-optimal if left to private market forces. There is an equity argument here as well. Public support for education offers opportunities for social mobility essential to the legitimacy of democratic society. It provides a correction to those inequalities that so worry John Rawls, in his well known Theory of Justice.

There are strong forces of self interest supporting a modern "enclosure movement" in which intellectual properties become private properties. As intellectual properties become increasingly important in the production process, monopolistic control of intellectual effort carries with it monopolistic profits. The Apple Computer Company and Lotus 123 "look and feel" lawsuits against the Microsoft Company and the marketers of VP Planner Software are based on the argument that one company's software has the "look and feel" of the software of another company. It is as though Henry Ford were to sue Oldsmobile because the steering wheel, gas pedal and door knobs were similarly placed.

Policy movement on issues such as "plant breeders rights" and the recent Harvard University patent on a mouse are signposts on the road to the privatization of intellectual properties. The increased tendency of Canadian governments to provide weather and statistical information on cost-recovery terms, or to supply information gathered at public to "value added" retailers for resale to Canadian users are both moves in this direction. The pressure for universities to gain financial benefit from on-campus research, understandable in light of financial constraints, in the long run, will undercut the very mandate of the university and reduce its claim to a special public role in society.

From an economic perspective the concentrated forces behind an intellectual property enclosure movement are as understandable as were the forces behind the original enclosure movements in western Europe. The end result of this "enclosure movement" will be a major increase in the privatization of the production and use of intellectual property. In the process, the role of the university will be diminished. In the long run both allocative and dynamic efficiency will suffer at the hands of an increasingly concentrated control over intellectual property.

III. INFORMATION TECHNOLOGIES AND THE RIGHTS OF CANADIANS

An unexplored issue surrounding emergent information technologies is their consequences on the exercise of individual rights. For, example, Meech Lake guarantees Quebec the right to protect its "distinct society". Do the Quebec language police have the right to close down a computer network operating in English in the Province of Quebec? At the national level, are "newsgroup" based conferencing systems (as found across UNIX installations) operating within and beyond the boundaries of Canada subject to the rules and regulations that govern "common carriers"? Are they subject to the rules and regulations that protect and regulate the "press"? Are the liabilities of the "sysop" who supervises an electronic bulletin board or conferencing area the same as those of the editor or the publisher of a magazine or newspaper?*

These are not hypothetical questions. They are issues driven by technology. The societal responses may differ from culture to culture. Much of the debate on the relationship between emerging electronic technologies and individual rights has focused on the right of the individual to privacy. It has concerned itself with the potential for massive databases of personal records to be used to invade the privacy of the individual. To the extent that there is a threat there it pales in significance when compared with the relationship between the emerging technologies and "freedom of speech" rights.

In late January of 1988, the U.S. Government Office of Technological Assessment published a report entitled "The Future of the Press and the First Amendment". New technologies are blurring the legal and regulatory distinctions between common carriers and the press. The question this raised for the U.S. Office of Technology Assessment was what constitutional rights are enjoyed by whom in these new technologies. In Canada the question is how do these technologies fare under the Canadian Charter of Rights. Observing, for example that computer bulletin board systems can be considered "many-to-many" news channels with no identifiable publisher to be held to account, the OTA report writes:

> *"[T]he First Amendment will have to be reinterpreted in response to almost certain challenges of the government's right to regulate access to the media and ownership of new media outlets."*

As well as suggesting to abridge the right to engage in freedom of expression using emergent electronic media, the report suggests that freedom of speech and of the press may be further curbed to prevent the involuntary transfer of technology to hostile nations.

There are dangerous political and economic arguments for controlling the emerging electronic technologies. Unregulated E-mail conferencing has the potential to be viewed as unlawful assembly in certain situations. It may be regulated or suppressed by governments. The U.S. government worries about "the involuntary transfer of sensitive technology to potentially hostile nations". The OTA report extends national security beyond protection by weapons to protection of technological innovations and industrial competitiveness. This extension of the definition of national security is reflected in the U.S. National Security Council's National Security Decision Directive (NSDD) 145 which creates a new classification titled "sensitive but unclassified".

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* Remote access raises moral and ethical questions. During a university strike a student who refuses to cross the picket line routinely logs on to the campus mainframe, downloading assignments and uploading answers. Does this constitute crossing the picket line?

The U. S. experience is instructive. At the federal level the government is trying to close in on electronic communications, proposing economic, political and national security rationales for regulation.* At the state level forces are attempting to shore up freedom of speech "First Amendment Rights" in the electronic age. Bill ACA-36 before the California legislature is designed to protect "freedom of electronic speech" with a "right to electronically communicate on all subjects". It would provide that "a law may not restrain or abridge liberty of electronic communications and that rights against unreasonable search and seizures extend to personal information stored in electronic information systems and computer databases.

The U.S. experience is instructive not so much for its details. They are shaped by the U.S. approach to individual rights and freedoms. What is important are the substantive issues. Is a distributed system of linked databases nothing more than a community discussion with a reference library? Is it an electronic newsletter subject to "freedom of the press" guarantees and controls? Is a "network" subject to CRTC licensing? It is useful to recall that the inventors of FM-radio foresaw it as the basis for a minimally regulated network of low power community radio stations. It became something quite different.

In the short run it is hard to say where the struggle over the control of new electronic medial will go. It is clear that a decade ago few expected "Electronic Rights" to be contending for a spot on the political agenda of Canada. Even today there are few who would examine the Charter of Rights, the Meech Lake Accord or the Mulroney Trade Deal as they affect the role of the electronic media in Canadian society. Even the Senate debate over the copywrite bill has only begun to scratch the surface on these issues.

In conclusion, much has been made elsewhere of the promise and problems associated with the emerging electronic revolution. The first part of this paper on PICKnet uses and the companion piece on computer supported interactive distance education (CSIDE) explore computer uses for a "Copernican Revolution" that will sweep formal and popular education. The focus is on the promise in the technology. The main part of this paper focused on contentious issues that constitute the dark side of the new technologies. They are much more subtle and more dangerous than the "invasion of privacy" fears that are routinely cited as the "dark side" of the new technologies.

All of the forces on the dark side are likely to have a major impact on universities, and will likely threaten the place of the university in society. Areas of particular concern dealt with the potential for a damaging "intellectual property enclosure movement" and threats to individual freedom of expression and communication. However, in this brief presentation we have time only to scratch the surface of the issues dealt with. It is my hope that universities turn attention to the issues raised here before the forces at play do irreparable damage to universities and society.

Teaching Information Design

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Since the mid-eighties, many major university-level Fine Art departments have been using computers to help students to create images. This is, from the art student's standpoint, a great idea so long as the cost of such equipment isn't borne by the student. From an instructor's standpoint there is little to be gained educationally by using computer imaging. At best, the computer in the hands of an undergraduate can do certain things real paint and canvas can't. At worst the computer becomes another unwanted distraction from the learning of aesthetics, design and visual meaning. After some study we decided to turn from the trend of costly computer imaging to adopt a less expensive multi-image approach. This paper is an account of our experiences and observations.

We decided to employ microcomputer-based course authoring software to teach *interactive* computer art where the viewer of the work becomes an active participant. Because it is not solely visually-based but has elements of text and animation (time), this course also had the advantage of being useful to other Humanities students, particularly those in the more 'creative' or open-ended disciplines.

Information Design is an interdisciplinary course offered by the Fine Art Department at the University of Guelph. Its two main objectives are to:

1) *use computers to give life to ideas*

   and

2) *allow students to experience hypertext and hypermedia*

The semester credit course is open to advanced Fine Art, English, History, Philosophy and Computer and Information Science undergraduate students. *Information Design* presents visual, textual and contextual problems in a hands-on computer workshop setting.

From "Star Trek Adventure Game" by Doug Schaefer

In the first offering of the course in 1987, students used a "traditional" course authoring program called VITAL to create an interactive, multi-path version of the story of the "Three Little Pigs." Owl International's *Guide* for the Macintosh was also experimented with informally. Lab time was supplemented by a series of readings and discussions on hypertext (including Vannevar Bush's "As We May Think").

When Apple's HyperCard for the Macintosh (which allows for the incorporation of text, graphics, sound through associative linking) was introduced, the course was redesigned, and as a result a more acceptable fit to the learning objectives was made possible using HyperCard.

Course Format

When you begin to dream about it, you're internalizing it

Because this is still a course in development, funding could not come from the regular Fine Art Department budget. The University's Department of Continuing Education supports a number of 6-week semester-credit courses in the summertime for students who wish to get a credit in half the time. There are advantages and disadvantages to this approach. The intensity of the program allows for better reinforcement of the material learned. This is offset by the fact that there is less time for students to work out-of-class, and that a week-long absence due to illness results in a much higher catch-up penalty. Fortunately, the Macintosh Lab was available most days, and no one got really sick.

The Department of Computing and Information Science let us use their Macintosh lab, which consisted of 5 Macintosh Pluses linked through AppleTalk to a Mac Plus/20 megabyte hard disk server running MacServe. Because the Macs had no external drives, we had to partition the MacServe machine and place 5 copies of HyperCard with the Help stacks in each partition. Each student would then have to boot and run their computer with a disk holding a pared-down system and Home stack. This arrangement, while far from ideal, worked surprisingly well and ensured at least 500K free on disk for student work.

The 5 Macs which were available allowed us to accept only 10 students, as opposed to the regular 30 students admitted to a typical Fine Art studio course. I think an ideal situation would be 20 students using 20 computers. I spent most of the class time watching the students interact with the computers, lending a helping hand only when they were 'stuck'. It's been my experience (and perhaps it has something to do with my teaching style) that ten students, unless they are very bright and/or enthusiastic, rarely provide the necessary dynamic for exciting instruction. I think that twenty students would have reached *critical mass* much sooner.

The class was composed of 9 females and 1 male. All were at least at third-year level; two were mature part-time students, and two were 'Visa' students from Hong Kong.

Classes took place Monday through Thursday evenings 6-9pm for six weeks.

Course Outline

The Search

Students were required to document their search for sources of such difficult-to-locate items such as padouk, gold thread, potter's wheel and mandarin oranges. The purpose of this exercise was to illustrate the different 'media' used in the search (face-to-face, telephone, reference books, libraries etc.). Their documentation was to take two forms:

1) a linear, step-by-step listing of who or what was consulted, when the consultation took place, and what was learned by the consultation.

2) a flowchart showing the same information graphically, but using lines to link one consultation box to the next. This format is better at illustrating how a search progresses, and can show the results of a search—the dead ends, the successful conclusions.

At the end of this exercise, students are aware of the differences between the presentation of linear information and the presentation of information blocks linked to-

gether by association. This contrast provides and excellent launch into the subject of hypertext and hypermedia.

HyperTalk

The next few days introduced *HyperTalk*, HyperCard's object-oriented programming language.

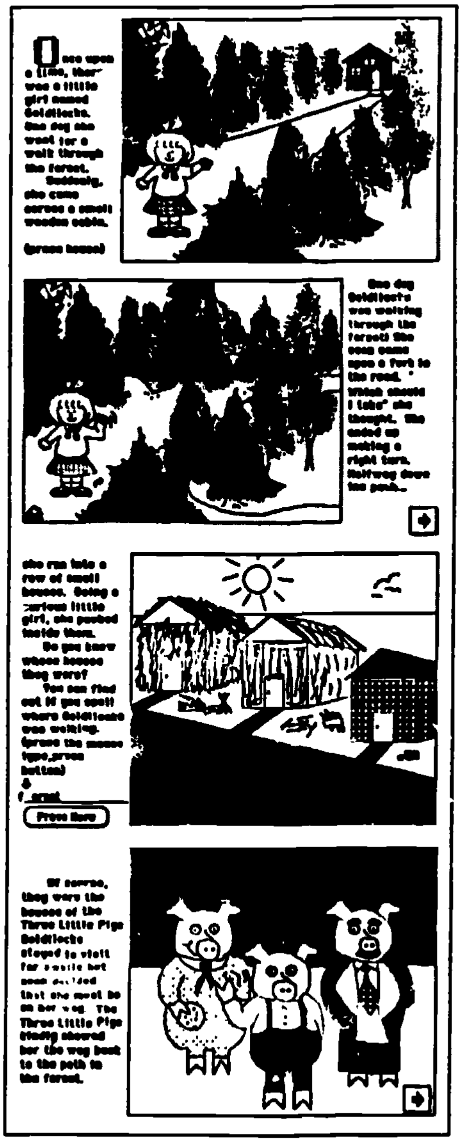
As a mini-exercise, students were required to create a working Address Stack, similar to the the one made available by Apple with HyperCard. Participants learned how to create new cards, buttons and fields, and how to link cards together with the link function within each button. Many students 'went overboard' with the painting tools, though later on simplicity and sparseness were encouraged. As part of their stack, they created a special 'bugs' card for listing programming and organizational errors.

The students took active part in the evaluation of the Address Stacks by passing around their discs to other members of the class for comments (on the 'bugs' card).

Once Upon A Time...

In the first iteration of this course in 1987, students adapted *The Three Little Pigs.* I thought it would be appropriate this time to do *Goldilocks and the Three Bears.* Using an old familiar story to demonstrate a new way to communicate is appealing to me; perhaps because it develops while it repeats makes it particularly suited to a first try at hypermedia. Or it could be the subliminal richness of the Goldilocks experience?

The requirements of this project are straightforward: create a HyperCard stack which conveys the Goldilocks story using pictures, words, sound and animation. I must be interactive—the viewer/participant's reactions must be able to change his/her path through the story. The students were encouraged, but not coerced, into making a graphical flowchart on paper before starting on the computer.



"Goldilocks and the Three Bears" by Lana Desrochie and Janet dal Bianco: In this stack, participants must be able to find their way through other fairy tales.

Observations

"With HyperCard we have designers writing programs and programmers building rock videos." [1]

There have been many collegial discussions about the appropriateness of Fine Art studio instruction in a university setting. Some feel, with some justification, that the teaching of visual art skills should not be supported by institutions concerned with scholarly research and education, that community or technical arts colleges should be responsible for this area. Perhaps the only reason creative Fine Art has survived in higher education is its important place in the traditional liberal arts curriculum.

Studio instructors are probably the first to admit that not only is their subject matter unusual for a university, so are Fine Art students. The typical Fine Art student is less literate and numerate, and less inclined to 'scholarly' study. On the other hand, they are more creative, open and playful with ideas of all kinds. They tend to be generalists with global views and concerns.

Until hypertext and hypermedia software became available, the activity of programming was limited to those individuals who could organize their ideas in a structured manner. Computer scientists refer to 'top-down' programming; breaking down a problem into smaller and smaller pieces until each piece consists of a line of code. Computer literacy was equated with the ability to program in BASIC or PASCAL. Moreover, these systems were text-based, due to the inability of many computers to handle graphics.

The result was a situation where, like non-artists telling artists "Oh, I can't draw", the artists were telling the programmers "Oh, I can't program."

Hard and Soft Mastery

In her book *The Second Self*, Sherry Turkle tells us about two children, Jeff and Kevin, who set about to individually program a space-shuttle program on the school's microcomputers. Jeff is good with machines and is able to impose his will upon the computer by employing the 'top-down' approach to programming. He 'becomes' the graphic elements on the screen which he has programmed.

Kevin is a counterpoint to Jeff. "Kevin is dreamy and impressionistic. Where Jeff tends to try to impose his ideas on other children, Kevin's warmth, easygoing nature, and interest in others make him popular."[3] Kevin's approach is tentative, experimental, and he can get sidetracked by a new graphic effect on the screen. He allows the computer to interact with his ideas. A boy-machine synthesis emerges. And where Jeff 'becomes' the graphic sprite on the screen, Kevin identifies with the *representation* of the astronaut on the computer screen; he romanticizes.

Turkle then presents us with the concept of two modes or styles of mastery, as illustrated by Jeff and Kevin; hard mastery is "the imposition of will over the machine through the implementation of a plan"[4] (Jeff). Soft mastery "is the mastery of the artist: try this, wait for a response, try something else..."[5] (Kevin).

Reductive and Projective Paradigms

As I indicated at the start of this paper, the primary objective of the the Information Design course is to *use computers to give life to ideas*. This statement presupposes that computers can indeed *represent* ideas. The hard master is able to reduce the world into black or white through abstraction. The computer is considered as a formalized representation, reduced to the interaction of constants, variables and graphical computations. This relationship to the computer is *reductive*. In the reductive paradigm, computers may give life to ideas, but those ideas are limited to the abstractions of the program listing.[6]

On the other hand, the soft master tends to identify not with the nuts and bolts of the program itself, but with the expression or projection of larger suggestions emanating from the computer. We may call this relationship to the computer *projective*. In this paradigm, the computer becomes an interactive entity at a level equal to that of the programmer or participant, and as such it can be used to represent *any* idea or con-

cept. When the computer projects its simulated intelligence, we interact with it as with any other person, and carry within that dialogue aesthetic and cultural concerns.[7]

In Figure 1 I have presented a loose comparison of three creative activities using computers: Programming in BASIC, Computer Imaging, and the Goldilocks Project.

COMPARISON OF HARD AND SOFT MASTERY ACTIVITIES		
ACTIVITY	MASTERY TYPE	ENTITY RELATIONSHIP
Programming in BASIC	Hard	Reductive
Computer Imaging	Soft	Projective
Goldilocks Project	Hard/Soft	Projective

Figure 1.

Of the three, only the Goldilocks project provides a crossover between hard and soft mastery. BASIC is a programming language that demands an organized overview of the problem at hand. Interaction with a paint program, however, requires no real programming—it is a simulation. Visual data is added, subtracted and processed using the ready-made tools provided by the software. It is visually projective, and truly effective only when approached using soft mastery techniques.

HyperCard, unlike the other two software methods, combines both hard and soft mastery styles; in the Goldilocks project, simple associative links can be done easily without programming. If bells and whistles are desired, that can be done at a later date with HyperTalk. One student who had programmed before attacked the project as a programmer would, by meticulously working out linking details while the other created the graphic content.

Once finished, the students were astounded at the amount of work they had done. Most groups (of two) had completed at least 50 cards, many of those cards having multiple links.

Computer As Instructor

With the HyperCard software, the computer does the teaching. In such an interactive environment, if something doesn't work the first time, the student knows that probably spelling is the culprit. If it isn't spelling, it's syntax. The students quickly grasped the 'rules of the game:' to push the system as far as they desired. If it worked, it was 'legal,' as long as you spelled it correctly.

The human instructor would throw ideas out when needed; a repeat structure here, or a new button there. The hardest part was getting the students' attention when it was time to close down the Lab.

Conclusion

Most of the students who enrolled in the Information Design course had little if any experience with computers. All had some Fine Art training, but for the most part they had little background in designing for a medium which combines pictures with animation, text and sound. They learned that designing information is as much a dialogue with the medium as it is with themselves. The hypermedia system acts as a mirror, reflecting the characters of the individuals who work with it.

The students made some interesting observations. After having viewed work from the previous years' class (which used the course authoring system that used colour but not sound), they concluded that sound was more important to have than colour.

The lack of resolution of the paint tools in HyperCard, compared to real paint, was not considered a handicap. For some it was a benefit, and helped them to focus on the what was necessary in the image.

In this course hypermedia is used to bring Fine Art students to the realization that the concepts of design are global; that these concepts can and should be applied to all creative expressions, regardless of medium. For students in the more "scholarly" areas of higher education, it is used to emphasize that all information must be designed if it is to be comprehended. For every student, it is a forever-patient interactive agent ready at any time to test new ideas about themselves and the world they live in.

References

1. Chris Espinosa, quoted in *HyperCard Power: Techniques and Scripts*, by Carol Kaehler (New York: Addison-Wesley, 1988), p. 264.
2. Sherry Turkle, *The Second Self* (New York: Simon and Schuster, 1984), pp. 101-110.
3. Turkle, *The Second Self*, p.101
4. Turkle, *The Second Self*, p.104.
5. Turkle, *The Second Self*, p.108. Going further, Turkle finds that there is a correlation between gender and master types: girls tend to be soft masters, while hard masters are almost exclusively male. I also find it interesting that programming books which stress soft mastery methods (type in this code, see what happens... change the code, see what changes) are sometimes referred to as *cookbooks*.
6. Douglas Adams, *The Hitchhiker's Guide to the Galaxy*. Adams tells of a supercomputer called Deep Thought, which, when asked the meaning of "life, the universe, and everything," answers "Forty-two." This quip is a perfect example of reductive identification.
7. Isaac Asimov is quoted as saying that "Any sufficiently developed technology is indistinguishable from magic." To paraphrase, if you consider the computer as a projective device, the content carried *on* it becomes independent *from* it. The 'message becomes the medium' in hypermedia.

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Multi-Media Computer Projection System for Classrooms

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INTRODUCTION

At one time or another every teacher has wished for the quality of colour slides with the flexibility of overhead projections without prohibitive expense. With modern technology, the possibility of projecting electronic overheads, computer simulations, and videotapes on the same machine during the same teaching session is a reality.

The lecture or seminar still requires thoughtful preparation, but the flexibility of random access to visuals allows the instructor to respond to the mood of the audience and clarify difficult concepts by utilizing the appropriate images.

The move to Multi Media Projection in the Department of Land Resource Science was simplified by the technical help provided by the Office of Educational Practice, and by the fact that much of the course material was already being used in other formats. Computer graphics, simulation programs and videotapes have been used for teaching purposes within the department for several years by several lecturers.

EQUIPMENT

On the market, there are, or soon will be several sophisticated methods of randomly accessing a variety of visual images. Most of these methods (such as VISION) make use of the interactive video laser disk, but at the present time they have two major drawbacks. The first and major problem is the impossibility of routinely writing material to a laser disk. This seriously limits its use in the classroom, especially in advanced subject areas where material must be custom designed by the instructor. A second drawback to laser disk technology is the high equipment cost. For these reasons we have chosen to make use of low cost and surplus equipment to assemble a system that although not elegant, has proven to be extremely useful in our department.

The main components of the Multi Media Classroom Projection System are:

- An original IBM transportable computer with
  - two 360K disk drives
  - 512K RAM
  - enhanced graphics card (PCD6)
- Sony colour video projector
- Panasonic AG-1210 VHS video cassette recorder
- Norpak Mark IV Videotex decoder
- Video interfacee between the computer screen jack and the projector
- Sony high resolution analog colour monitor

All of these components are mounted on a home made cabinet on wheels, allowing easy transport between classrooms within one building (Fig. 1). These pieces are linked, through two sequential switch boxes allowing access to all possible modes of projection at the twist of one or two knobs (Fig. 2). There are essentially five main modes in which material can be viewed using this unit.

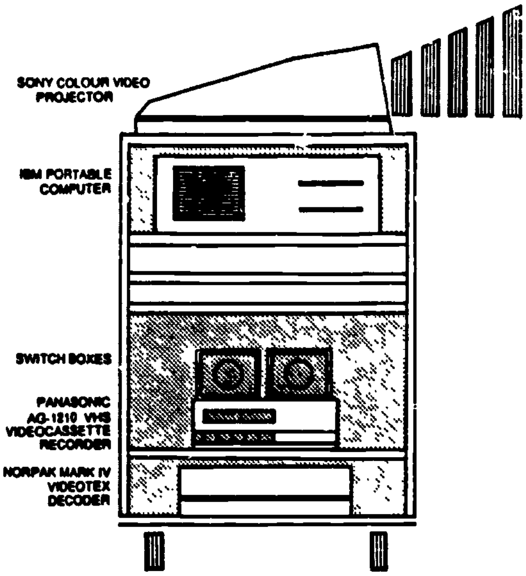

Fig. 1

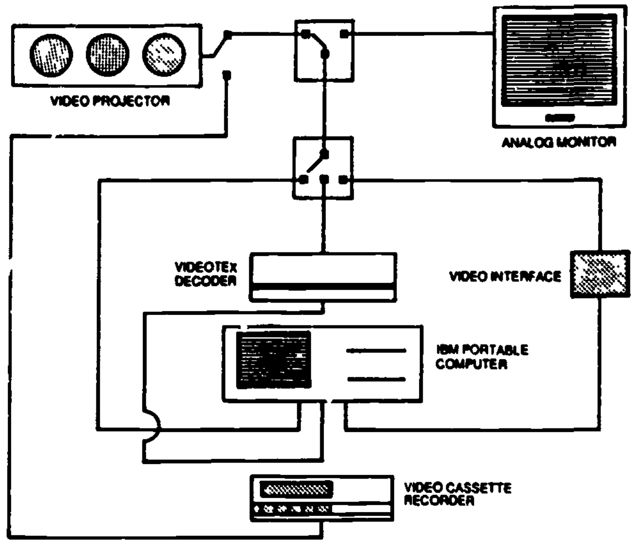

Fig. 2

MODES OF PRESENTATION

The first type of display is Videotex graphics (NAPLPS) directly from a floppy diskette, through the VITAL-S software decoder, to the graphics card and on to the projector. This type of projection is at a fixed baud rate of 9600, the advantage being an almost instantaneous display of the material. A disadvantage of the fast display is that any built in animated sequences are lost.

In order to retain the slow motion and inbuilt simple animation necessary to fully understand some diagrams, a hardware decoder (Norpak Mk IV) can be used to display VITAL (Vidcotex) frames at a variable baud rate of 1200 or 2400. Slow display is also necessary during creation of the frames, to assure correct sequential appearance of the diagrammatic elements.

Experience has shown that in a lecture format the higher baud rate of 9600 is preferred by students, who are used to seeing images displayed quickly. This type of display is also routinely used in classrooms, because our system does not yet support multitasking, and switching from the fast software decoder to the slow hardware decoder requires rebooting the system.

Videotapes can be readily interfaced with any other display mode by setting a switch on the projector itself. A typical example of a video overhead - projection link would be for the instructor to display a series of computer generated overheads explaining the processes of volcanism then switching to a narrated videotape of a real volcanic eruption. In this way the learning process is reinforced by combining static theoretical information with films showing real-life happenings.

The system can be switched from displaying VITAL frames (overheads) to displaying whatever is on the computer monitor screen by sending the screen signal through an RGB interface (transformer) to the projector. In this way material created with any computer program can be projected onto the large screen for group viewing. At the moment this requires exiting from one program and loading another. In the future this problem could be overcome with the use of new generation microcomputers and multitasking software. This type of display is particularly useful for demonstrating a specific piece of software (that is, communications, simulation) to a large group simultaneously. In one instance a teacher used the system to demonstrate the writing of simple basic programs to the entire class at once, while another instructor showed a computer simulation of the post glacial stages of the Great Lakes.

Of course anything that can be sent to the projector can also be sent to the high resolution monitor to generate a portable workstation. This setup has proven useful in generating and modifying VITAL frames and testing a presentation in a small viewing room.

CONCLUSIONS

The Multi Media Classroom Projection system used at the University of Guelph in the Department of Land Resource Science has proven to be a valuable teaching and communication aid for many faculty and staff. Some of the main advantages of the system are, ease of use, flexibility, portability, modest cost and excellent reliability. No specific training is required to operate the system other than rudimentary typing skills and of course a knowledge of the software being used. Enormous flexibility is an asset both because the projector can be transformed into a workstation and because the lecturer can switch between each of the projection modes at will during classes or seminars.

The system is readily movable within one building and can be used to service any type of room from a large lecture theatre to a small teaching laboratory. Total cost of the component parts was small ($8,000.00 in 1986) mainly due to the surplus nature of the equipment. Reliability of the system has proven to be excellent to date, however any machine can malfunction from time to time, and a wise instructor should always come well prepared and armed with conventional overheads and chalk.

Teaching Hundreds by the Scores: A Practical Solution for High Student/Teacher Ratio Situations

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At the University of Waterloo, the introductory course in Organizational Behavior (OB), originally intended for classes of 50 60 engineering students, has been inundated by students from other faculties. In addition, the size of the engineering component has approximately tripled. Consequently, one professor is currently required to handle as many as 300 to 400 students each term. To help him, four or five graduate-student teaching assistants (TA's) are assigned, but these are often students majoring in other disciplines who have taken only one or two OB courses. In addition, the TA's have often done their undergraduate work in languages other than English.

PRIOR PROCEDURES

The usual way of handling this course has been for the professor to give threelectures per week to each of two classes of 150 to 200 students. On some occasions, lectures have been given to as many as 400 students at a time. In addition, students have been required to attend five TA-run tutorials during the term in groups of 40 to 50. In these tutorials, the students have typically been subdivided into groups of 5 to 7 people for a case study. While discussion within these groups has frequently been intense, these tutorials have often received a very poor rating by students. The full reason for these poor ratings is not clear but it seems likely that at least some of the TA,s have not been in a position to handle adequately hte full class discussion following the group reports. As well as these lecture and tutorial sessions, students have been required to hand in five case-study assignments to be marked by the TA's and to count for a total of 15% of the final mark.

In the past, some instructors have prepared and sold extensive printed notes while others have adopted the philosophy that it is better not to provide printed notes lest the students rely on the notes and skip the lectures. In the same vein, instructors who provide notes, have sometimes been criticized for giving lectures which simply repeat what is in the text and the notes. A number of students have pointed out that they arequite able to read for themselves and therefore the notes render attendance at the lectures a waste of time. Of course, with anything more than about 40 students in a lecture it is esseially impossible to engage any reasonable proportion of theclass in dicussion.

DECISION TO CHANGE

It has been recognized for some time that this conventional method of instructing students in Organizational Behavior leaves a great deal to be desire d, particularly because the nature of the subject calls for much student/teacher interaction. Therefore, on being challenged by my departmental chairman to find some better way, the writer* devised the following method, and has used it successfully for the past eight terms.

* The challenge to develop this method and encouragement to implement it came from Professor M.J. Magazine. the chairman of the Management Sciences department. In developing this new method. much very useful discussion and advice was obtained from Professor Bill Sholinsky of the Teaching Resources group and from Ian Smart of the Engineering Counselling service.

THE NEW PROCEDURE

The new approach is based on a class size of one to two score students meeting for one hour per week with the professor plus the use of scored qui each week to motivate the students to keep up-to-date with thre radings in text and notes. One hour per week interacting with the professor in groups of 20 to 40 is more effective than merely listening to lectures for 3 hours per week.

The quizzes consist of 10 to 15 multiple choice questions each with 4 to 6 answers, some, none, or all of which may be correct. To allow these to be marked by machine, the multiple-choe questions are converted to true-false questions so that mark-sense cards can be used. The quiz then appears as 10 to 15 multiple-choice type of introductory statements each followed by several statement completions each of which the students are required to label as true, false, or "don't know". These are marked +2 for each correct

response, -1 for each incorrect response and zero for no response. The total of the eight or nine quizzes during the term is worth 10 percent of the final course mark. The quizzes are administered by TA's using foils an and an overhead projector. These are carefully timed, allowing 15 seconds per foil plus 15 seconds per question. The quiz therefore takes about 20 minutes to administer and is followed by an appropriate film.

In addition, the assignment load has been increased to six, the sixth assignment requiring the student to describe some organizational situation or sequence of events he/she has personally experienced and the relating of this to OB theories or techniques. This project or case-study form of assignment requires the student to think through the various OB theories and techniques and apply them to a real-life situation he/she has experienced. A number of the resulting stories have been used to advantage as case studies for turials, assignments and exams. Their use in tutorials and assignments gives students an additional insight into the views of other students.

Thus, the overall effect on the student is to reduce the required class hours from an average of 3.5 per week to 2.0 and to motivate him to read the notes and the text to be prepared for the weekly quizzes. Since the quizzes may include questions on tutorial discussions and on the non-compulsory films, they also motivate him to attend all sessions. For the first two weeks of the term, while students are still buying their texts and deciding on optional courses, the professor lectures to thewhole class. Quizzes start at the beginning of the third week as do the tutorials. The latter usually start with the professor showing appropriate transparencies from the current business press and newspapers, answering any questions and enlarging on the more important points. The class then breaks into groups of 3 to 5 people to discuss the case studies which were handed out at the previous week's quiz/film session. After the small-group discussion the students are very willing to participate in the instructor-led discussion with the whole group. This procedure has proven to be part icularly useful for developing those ideas which students traditionally have found difficult to grasp.

RESULTS

From the professor's standpoint, it is much more satisfying to meet with eight or nine groups of up to 40 once per week than to meet with assemblies of 300 to 400 three times per week. The burden of the increased student-contact time is more than offset by the satisfaction resulting from the greatly increased opportunity for interaction.

An anonymous survey of students indicated 52% see this new method as an improvement over the conventional method while 29% see it as less desirable. Fifteen percent indicated no preference and 4 percent did not respond. The principal complaint from those disliking the new format was the weekly quizzes and the attendant need to keep up with the readings on their own. Many students, however, say they regard the quizzes as an essential factor in motivating them to keep up-to-date on the readings.

Since this is the first imprecise, non-technical, university-level course which many of the mathematics and engineering students have been reqired to take, it is not surprising that some of them blame the different course format for the difficulties they experience. Another problem for a number of such students is that, like some of the TA's, Engllish is not their first language. While this language problem poses little difficulty in subject such as mathematics, it can be a very real hurdle in the study of Orgazational Behavior. As an instance, one student was completely confused by the expression "putter about" in a case study because, according to her abbreviated dictionary, "putter" was defined only as a type of golf club.

FUTURE CONSIDERATIONS

While this scheme appears to be a real improvement over the previous one, it certainly is still far from ideal. In particular, one hour per week with the professor is too little, and classes of more than 20 are still undesirably large. However, given the number of students wishing (or required) to take the course and the limited number of professors available, the scheme described is a significant improvement over the more conventional approach.

Articulation Project: Joint Venture Between Seneca College and Georges Vanier Secondary School

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ARTICULATION is a planned process linking two or more educational systems to help students make a smooth transition from secondary school to community college without experiencing delay or duplication of learning.

The **purpose** of the Articulation Project initiated between Georges Vanier Secondary School and Seneca College in December 1987 is to enhance students' opportunities to complete high school, to continue on to community college and to obtain the necessary career skills to become successful contributing members of society. This unique Canadian attempt at the co-ordination of instruction between high school and community college has great potential for improving the quality of education for students. Once developed, this model will be extended to include other schools in North York and York Region.

There are **two essential aspects** to the articulation process. The first is to co-ordinate the curricula between the two institutions to ensure that it is cohesive and responsive to students' needs. Areas of duplication as well as situations where skills are lacking must be addressed. Provision for advanced standing college credit, preferred entry to specific college programs, or enrichment can be established once the relationship between programs is clarified.

Secondly, student knowledge of career options and college programs will increase through the articulation process. Improved communication between faculty at the two institutions results in a better awareness on the part of high school teachers of college programs and academic and skill requirements for students and on the part of the college faculty of high school students' abilities and expectations. High school teachers will be in a better position to guide and direct students toward specific college programs. College faculty and resources will be utilized to heighten student awareness through visits to high school classes and field trips to the college.

When students have a better focus on what they can do and how they can achieve it, education becomes more meaningful. This process will provide motivation for students to continue their education as they develop realistic career goals.

An **holistic approach** to articulation has resulted in identification of the critical skills (literacy, numeracy, and generic) required for students to succeed in specific college programs. There is then a matching process between these critical skills and the Grade 11 and 12 subjects which will best develop the skills. Some restructuring of curricula may be required. A package of courses is then recommended to students which if taken will grant them **preferred entry** to that specific college program.

As well, articulation involves a consideration of **competency based education** since it facilitates a mode of comparing curricula. These assessments are a precise means of outlining the specific skills to be achieved and monitoring student progress. Vanier teachers in consultation with their Seneca colleagues are working to develop lists of competencies upon which the students will be evaluated and which form the basis for recommendations for **advanced standing college credits.**

Where appropriate, students will be enrolled in an enriched college course designed to build on the skills already developed in previous high school courses. In this manner, students will graduate with a higher skill level in that particular subject area.

An **institutional articulation agreement** has been signed by the Director of the North York Board of Education and by the President of Seneca College of Applied Arts & Technololgy. As well, **six program articulation agreements** have been signed as follows:

- Electronics Engineering
- Mechanical/Manufacturing Engineering
- Civil/Resources Engineering
- Travel and Tourism
- Office Administration
- Day Care Assistant

Plans are underway to expand the model to include other existing programs at Seneca. As new college programs and high school courses are developed, articulation will be an important aspect of this development.

CONCLUSION

Modification or development of new programs linking curricula which have more of a career focus at the high school level is an exciting new approach for education. Although the initial target group is the General Level, courses are being articulated for Basic and Advanced Level courses as well.

The establishment of a strong liaison between high school and community college facilitates an exchange of information and resources. As we work through the articulation process, positive opportunities continue to emerge for enhancing this relationship and improving education for students. Through the clarification of critical skills and the implementation of competency-based assessment, students will find education more coherent and relevant. With continued support and endorsement, the tremendous potential of articulation for educational excellence will be realized.

Student Pseudo-journals as a Method for Achieving Cognitive Apprenticeship in Writing in the Social Sciences

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The focus of this paper is an issue that I have found to be particularly vexing, namely the quality of writing which university undergraduates produce for me in the courses I teach. Over the years I have come to accept that much of what students write for me is of low quality. Even where I might judge content to be adequate I have often had more or less serious concerns about the form of what has been written. I assume that I am not alone in this general impression about the quality of undergraduate writing. My earlier reactions ranged from blaming high schools and even elementary schools to assuming that today's students are simply not interested. To the extent that I felt I should do something, I felt limited by my own lack of knowledge about how to teach writing and by a serious lack of resources; after all, I reasoned, how much can I do about student writing in a course on the history of psychology? I therefore settled into muddling along. I considered myself to be primarily in the business of communicating the content of the course and marked papers and exams accordingly. I assigned papers and projects and read and commented on submissions suspecting all the while that my students read only the grade I assigned their papers, ignoring my other feedback. Over the last few years, however, I have become increasingly unhappy with this approach to university instruction, which I now take to be modal. This approach seems to me to be successful primarily at communicating bodies of knowledge. In contrast, I have long felt that we educators, and perhaps especially university undergraduate teachers, should focus our instructional efforts on process rather than on content.

This paper sketches out what I have done in the last few years and what I plan to do next year in order to address this problem. First and foremost, I have been concerned with finding ways of conceptualizing how my instructional effort should be allocated. For example, I explored the distinction between "learning" and "learning to learn" (e.g. Harlow, 1949), thinking that perhaps we should be teaching students how to "learn to learn". Similarly I have been inspired by the distinction between "expository mode" and "hypothetical mode" teaching (Bruner, 1961), feeling that we rely too much on expository mode lecturing. In the end, however, I have always come back to the notion of apprenticeship, rooted as it is for me in my successful experiences as an apprentice electrician and as a graduate student in psychology. It is the idea of apprenticeship, more than any other, that has served me in my thinking about undergraduate instruction. You can imagine my pleasure, then, when I came upon a chapter by Alan Collins, John Seely Brown and Susan Newman entitled **Cognitive apprenticeship: Teaching the craft of reading, writing, and mathematics** (in press). Most importantly then, I want to offer an unabashed advertisement for their article, which has offered me a fruitful way to conceptualize what I think I ought to be doing as an undergraduate instructor concerned with improving student writing, and I want to share it with you.

In addition, I want to tell you about three recent instructional innovations I have more or less been involved with in the psychology department at Brock university. My involvement in all of them was, more or less, aimed at addressing the question of how I could foster better writing in my students without turning my courses into courses on writing and forcing me to commit impossible amounts of my instructional time to the issue. Finally, I want to close this paper with a discussion of my plans for next year which involve combining some of the advantages of each of the three innovations mentioned above into an approach which I think has the potential to create a reasonable cognitive apprenticeship environment in Social Sciences courses without requiring an inordinate outlay of instructional resources.

THE IDEA OF COGNITIVE APPRENTICESHIP

Collins, Brown and Newman, (in press) begin their paper by questioning the effectiveness of current instructional practice. They argue that "While schools have been relatively successful in organizing and conveying large bodies of conceptual and factual knowledge, standard pedagogical practices render key

aspects of expertise invisible to students. In particular, too little attention is paid to the processes that experts engage in to use or acquire knowledge in carrying out complex or realistic tasks" (p 2). Lacking in the relevant expertise - mostly processing skills - students' resulting knowledge is too "brittle" (not gene ralizable) and "inert" (not easily accessible when needed). They go on to suggest that the learning fostered through traditional apprenticeship may not be as vulnerable to these problems and identify two key features of apprenticeship learning which may contribute to more solid learning.

First, they point out that traditional apprenticeship focuses on learning methods of carrying out tasks in a domain. According to Lave (cited in Collins, Brown and Newman, in press), apprentices observe masters modelling the execution of a variety of domain specific tasks. One important outcome of these observations is that the apprentice develops a conceptual model of expert task performance. This model is successively refined over experience and serves as a basis for the development of self-monitoring and self-correction skills. Apprentices then attempt those tasks themselves with coaching from the master. A central component of successful coaching is "scaffolding": assistance the master provides which the apprentice requires in order to approximate the desired task performance. As the apprentice continues to practice the skill in question, the master gradually reduces the amount of assistance to the apprentice (i.e. "fades") until the apprentice is self-supporting.

The second key feature of apprenticeship is the social embeddedness of learning. That is, learning takes place in a "subculture in which most, if not all, members are visible participants in the target skills. As a result, learners have continual access to models of expertise-in-use against which to refine their understanding of complex skills... learners have the opportunity to observe other learners at varying degrees of skills; among other things, this encourages them to view learning as an incrementally staged process, while providing them with concrete benchmarks for their own progress" (p 4). Such a sub-culture, then, provides an intrinsic justification for the value of the skills in question and thus makes it much less likely that apprentices will wonder about why they are learning those skills.

Collins, Brown and Newman, (in press) propose that these two key features of traditional apprenticeship, a focus on expert processes and situated learning, can be extended to the teaching of subjects like reading, writing, and mathematics - something they refer to as "cognitive apprenticeship". In this context, they discuss the work of Palincsar and Brown (1984), on the reciprocal teaching of reading, Schonfield's (1985) work on teaching problem solving in mathematics, and Scardamalia and Bereiter's (1935) work on the procedural facilitation of writing.

THE NORMAL COURSE OF UNIVERSITY WRITING

From the perspective afforded by Collins, Brown and Newman, (in press), then, the problems university undergraduates have when writing papers at university, at least in the social sciences (as opposed to, say, English), are twofold:

First, students do not have an adequate conceptual model of writing. According to Bereiter and Scardamalia (1987), novice writers follow a "knowledge telling" strategy, according to which they write the first idea they think of, and then the next one, until they run out of ideas, at which point the essay is finished. Alternately, novice writers may be seen as writing essays in a single draft (Bruce, Collins, Rubin, and Gentner, 1982). For some reason, many students have never internalized the complex of skills which comprise expert writing into an appropriate conceptual model (it is interesting, but beyond the scope of this paper, to explore why this may be the case). We university instructors often do not help because we usually either assume that students already know how to write or lament the fact that they can not. That is, we may not do enough to foster the development of an appropriate conceptual model of writing. Rather, we assign papers, assign grades, and comment on those papers. The student picks up the paper, checks out the grade, and goes on to the next assignment. Normally, only extremely poor writing is flagged for extra work, which is often delivered in the form of remedial writing instruction. Thus, the skill of writing is rarely dealt with explicitly; it is really invisible to the student. We professors, the experts, rarely model the skill of writing, preventing the student from developing an adequate conceptual model of good writing. Quite often, little coaching takes place. The usual student essay is a one-shot performance which does not normally provide adequate feedback for improvement. Finally, the only thing close to fading which takes place is that marking criteria may change from early assignments to later ones - a focus on product, not process. Second, the exercise of the skill of writing is rarely socially situated. Students assume that they are writing their papers for one person only, the instructor or marker. They usually do not enjoy any access to models of expertise-in-use unless they are fortunate enough to have a friend who is both a good writer and willing to let onlookers observe. Usually sharing is restricted to sharing the products of writing, not the processes. Indeed, the student usually writes papers alone, for a single reader, the professor (or marker), and rarely, if ever, has any opportunity to read papers written by other students. The only real source of models of

writing is to be found in the books and papers which the student is assigned to read - from the literature. Such highly polished products at best offer students a very distant goal towards which to aim with very little useful information about how to get there.

It is, of course, possible to offer many more or less defensible justifications for why this state of affairs has arisen, and why we teachers of undergraduates cannot be expected to turn all of our students into expert writers. While it is beyond the scope of this paper to survey them all, I wish to highlight one of the most important: resource limitations. We do expect supervisors of masters and doctoral candidates, and perhaps of honors students, to use apprenticeship methods to improve their students' writing, but we do not expect it of undergraduate instructors because they must teach far too many students to pull it off successfully. Further, we are expected to teach all those students about something besides writing - we are responsible for teaching about some content area. Focusing on writing skills, especially in an apprenticeship mode, is simply too resource intensive - we do not have the time, energy, or support resources to carry it off and achieve our main instructional goals.

In the remainder of this paper, I wish to discuss my interest in improving the writing of my students by discussing three instructional innovations I have been, more or less, involved with at Brock University over the past few years. I will then move on to discuss what I plan to do next year in my courses. Throughout, I will try to show how I see my work as attempting to improve undergraduate writing by appropriating some of the best features of the cognitive apprenticeship approach identified by Collins, Brown and Newman, (in press), without devoting inordinate amounts of resource to that end.

BURP

The first, and most productive, innovation I will discuss involved the introduction of a student pseudo-journal which I named B.U.R.P. (Brock University Research Proceedings), after a suggestion by John Benjafield, a colleague at Brock. The context was PSYC 340, our third-year psychology methods course - the gateway to our honors program (my co-instructor in the course was Paul Tyson). Students in that course have always been required to prepare a number of research reports, in proper APA style, as part of their work. Also, the course has always provided an apprentice-like approach to learning experimental methodology. In the first term students work on group experimental projects - from conception, to design, execution and write-up. Each group is led by a faculty member who provides a model for the students to follow. In the second term, students go on to do their own projects. In the first term, several smaller write-ups of studies or experiments, complete with data, are also required. It is these first-term write-ups which I decided to handle differently (although I see no reason why this approach cannot also be applied to review-type integrative essays as well).

I told our students how academic writing proceeds for professors. I told them about how we often get comments on early drafts of our papers, how we then submit papers to journals and how those papers are sent out to other experts in the field for review. I told them about how journal editors make judgements about the acceptability of papers based on reviews and also told them of the idea that papers are often accepted with revision. I then told them that I would be the editor of their very own journal - BURP - and that they should consider themselves to be just like professors as they worked on their research reports. They were told that all reports must be submitted (by a deadline) in triplicate - with identifying information only on the cover page. My course assistant collected the papers, assigned manuscript numbers, tore the cover pages off two copies of each paper, and handed them out to two randomly selected classmates for review. Written reviews were mandatory and were due back within a short period of time. All students then got their projects back with three reviews - two by anonymous peers and one from the editor (mine), as well as a decision on the paper. All papers were either accepted or accepted with revision. Papers accepted with revision were not assigned a grade until re-submission. Students were expected to pay close attention to the reviewers' comments, especially those of the editor, in revising the paper. Resubmitted papers were judged partly in terms of how well those comments were followed in the resubmitted document. Papers accepted without revision were assigned a grade of 72 (B-) or higher and could be resubmitted, if desired. Needless to say, in light of the instructional intent of this scheme, the first-round acceptance rate was quite low. There was also no guarantee that re-submitted papers would get higher grades or that once-rejected papers would get 72 or higher upon re-submission. Due to temporal limitations, only one resubmission round was allowed for each project. In retrospect, I should also have made it clear that papers could be rejected without the possibilty of resubmission. This is because some of my more clever (if not wiser) students soon twigged to the fact that failing to hand in an adequate first paper only resulted in the requirement to re-submit. Therefore, they submitted truly inadequate first attempts, just to meet the submission deadline. Comments on these sorts of first attempts were almost impossible to make, and hence the point of the exercise had been defeated. Such inadequate first submissions should lead to outright rejection to prevent students escaping the need to undertake a serious attempt on their first submission.

I did not formally monitor this experiment but have several clear impressions of the outcome - mostly favorable. From the point of view of Collins, Brown and Newman, (in press), it is clear that BURP satisfied some of the key features of a cognitive apprenticeship in writing. Most importantly, BURP moved some distance toward situating my students' writing in a more meaningful social context. This made it easier for my students to appreciate why they were engaged in the task of writing up their reports. For example, one question I have often faced concerns why psychology papers should be in APA format. After having to review a number of other papers, students came to appreciate how deviations from a conventional format make reading much more difficult.

In general, having students review other students' papers was very successful. All student reviewers took their task quite seriously. I did not have to "edit" any reviews, to take out overly harsh comments, before handing the reviews out. Many students reported that they had never attempted a critical review of the form and content of a paper - especially a student paper. They felt that they now had a better idea of how to take a critical approach to earlier drafts of their own papers. Several poor writers who happened to review good papers spontaneously noted that they now were more aware of why they were getting lower grades for their own papers. Interestingly, several good writers who happened to review weak papers were equally enlightened and took renewed pride in their own work. Many student reviewers also developed greater sympathy for the job which professors face when they mark papers. I interpret these results as revealing how reviewing for BURP forced students out of their usual roles of "producers" of text into the relatively novel role of "critics" (Palincsar and Brown, 1984). This new perspective, in turn, lead many of my students to an awareness that their "one-draft" production-oriented model of writing may be incomplete.

Most students also reported that they had never paid quite such close attention to the professor's comments before. They were now forced to attend to the editor's and the reviewers' comments more closely in order to successfully re-write the paper. It was my impression that re-submitted papers were generally of higher quality than the first submission, both of this group and of comparable groups I have had under traditional circumstances. Some students noted that they paid closer attention to their writing because they had to keep in mind that other students were going to read their papers as well. It may have been the first time that some of these students actually tried to adopt a different perspective when they read their own papers. I suspect that these students were grappling with just what they could and could not assume their readers would know in a way which they never had to when it was the (supposedly) omnicient professor doing the marking. These students were becoming more aware of the need to worry about the form, as well as the content, of their writing, and were becoming aware of the idea that you can alternate between the roles of producer and critic across successive drafts of a paper. It was also my impression that students developed a clearer idea of why one might rewrite a paper several times before handing it in. I interpret these findings as revealing how my students were becoming aware that a multiple-draft approach to writing may be both important and feasible to undertake.

Administering BURP was not as resource intensive as I had first expected. My course assistant, Marie Davis, was quite able to assume the role of "Assistant Editor". She accepted submissions, kept track of who was reviewing what, and even marked all papers for formal and stylistic issues. Thus, although I was now reading most papers twice, I was freed to focus on content only and found that my marking time did not increase that much overall. I will confess that I also checked all reviews, which took up some additional time. Overall, I estimate that my marking effort increased by about 50%.

THE BROCK JOURNAL OF PSYCHOLOGY

Just this year, some of our senior students were instrumental in creating a different student pseudo-journal. Phil Hetherington (the editor) and Patti Kovachik (the assistant editor) worked on it almost entirely without faculty assistance. A call for papers went out to all psychology students to submit papers they had already submitted for course credit and for which they had received good grades. Nine papers were selected from those submitted.

The Brock Journal of Psychology was conceptualized from the beginning as a relatively high quality publication. The students involved learned to do desktop publishing using a MacIntosh computer and an Apple Laserwriter. They used Microsoft Word 3.01 for the body of the journal and Pagemaker 2.0 for the title page. My own role was restricted to offering minor technical advice on the use of the programs. The resulting output was printed to yield 100 copies which were made available for sale for $5.00 each.

This innovation is quite different from my work with BURP of several years earlier. This work was entirely student-driven, it actually resulted in a publication for distribution, and finally, it did not rely on usual models of journal publishing (e.g. external review, acceptance with resubmission). The first two of these differences are, as I see it, great advantages while the third is a serious liability, from the point of

view which I am developing in this article. The student-driven nature of this project is quite important. At a minimum, some of our students got an insight into journal creation, which they could not otherwise get. More importantly, the student involvement encouraged student enthusiasm and participation. Publication in the Brock Journal of Psychology was definitely seen as desirable, and hence as rewarding. If the pseudo-journal is kept going (current plans are for 2 volumes per year), it has the potential to become more and more popular, and hence more desirable to publish in. Students wanted to publish in the Brock Journal of Psychology and wanted to show off their work to others. As such, the Brock Journal of Psychology definitely serves to highlight the social, communicative context of writing. A final advantage of this project is that it required very little investment of faculty time or departmental resource.

The great liability of this project is that it is really only open to the cream of our students. There is no good reason for most of our students to be overly motivated. Further, this format may not result in improved writing, as BURP was intended to do, beyond providing an additional incentive for already motivated students. With no editorial function beyond selecting papers for inclusion, none of the advantages of BURP are obtained.

WRITING BY WORD-PROCESSOR

For several years now I have been requiring students in my two senior half-courses, the Psychology of Reading and the Psychology of Computers in Education, to create all of their papers and assignments with a word processor. I have been enabled to do this because Brock University invested funds in the development of a microcomputer facility which is open both for course booking and general student use. The facility offers both Macintosh and IBM-compatible microcomputers. The MacIntosh computers, in particular, have become quite popular with students who can gain access at a wide variety of times. Many of these students use MacWrite to do word-processing. I do not require students to use this facility if they have their own systems or access to some other system; it is there merely to ensure that everyone has access to a word processing system. There is no extra charge for access to the lab, although students must supply a floppy diskette of their own to save their work on.

At the beginning of each half-course, I use my first seminar period to take my students into the microlab and show them how to use MacWrite. It takes about an hour to get students comfortable enough to be able to get by. In about 6 half-courses, I have never had a student balk at this arrangement and find that most students go on to use the lab to do assignments for other courses as well. I have yet to hear anything but positive comments on this arrangement, either in person or through anonymous course-faculty evaluations which I conduct every year.

The last two times I have taught the Psychology of Computers in Education course, I have gone further and have made the use of computers as tools to foster writing a major topic. I have developed a framework for approaching this topic which I have presented elsewhere (Mitterer, 1985, 1986; Mitterer and Watson, 1985) based on the work of Bruce, Collins, Rubin, and Gentner (1982). In brief, what I do is to introduce students to several key ideas:

First, I demonstrate that the process of writing is a complex one which can be decomposed into three major subprocesses - idea generation, text generation, and text editing (see Figure 1). Idea generation is the first stage of writing in which ideas are discovered and manipulated into a plan for a composition. Text generation is the stage in which the ideas are expressed as words. This stage involves casting the ideas into a text structure at several levels: the level of the entire text, the paragraph, the sentence, and the word. Finally, the text editing stage involves revising the results of the earlier stages in order to make sure that the resulting text does, in fact, communicate its intended meaning. Editing also may be undertaken at several levels: the level of the entire text, the paragraph, the sentence, and the word.

Second, I claim that expert writers compose in many drafts. Early drafts are revised to clarify ideas and the overall organization of the text while later drafts are revised to change individual sentences and words. In other words, the expert writer separates out the various steps in producing well-structured text. According to Bruce et al. (1982, p.137), "Separating the various levels in producing text structure helps the writer in two ways: it simultaneously eases the number of constraints that must be satisfied at one time and it increases the probability of satisfying any particular constraint."

Finally, I point out that novice writers generally create one draft in which they simultaneously, and usually unsuccessfully, attempt to achieve all of their communicative goals. Bruce et al. (1982, p. 142) comment that " Much of the difficulty of writing stems from the large number of constraints that must be satisfied at the same time. In expressing an idea the writer must consider at least four structural levels:

overall text structure, paragraph structure, sentence structure, and word structure. Clearly, the attempt to coordinate all these requirements is a staggering job." I point out that one consequence of this difficulty is the tendency of the novice writer to "downslide"; to get pulled into lower and lower levels of the writing task while losing sight of higher level goals.

My students are uniformly happy about the lectures I give on this topic and seem to believe me when I differentiate between novice and expert models of writing. One of the major benefits of word processing for these students is, as this framework makes clear, obviously in the ease of revision. For both of these reasons, my students report that they write in more drafts than they used to. The combination of describing novice and expert writing and the use of word-processors provides a passable substitute to the modelling which characterizes cognitive apprenticeship. In addition, this approach is not resource intensive at all. I use one hour to introduce word-processing and another hour to characterize novice and expert writing. In return, I get essays which are easier to read, having been printed out on a good printer after having been polished somewhat better than they used to be.

PUTTING BURP, THE BROCK JOURNAL OF PSYCHOLOGY AND WORD-PROCESSING TOGETHER

It is my current feeling that the three instructional innovations I have described are each, in different ways, small steps towards creating a cognitive apprenticeship in writing. I also suspect that a combination of these innovations would generate an approach to writing much more powerful than the sum of the parts. Thus, I would like, in this section, to present my plans for my senior Psychology courses next year. I expect to put in place a scheme with the following components:

1) Every student will be required to use a word processor to produce each assignment or paper. I would prefer that the program be one like Microsoft's Word 3.01, with built-in idea processing, spell checking and perhaps other goodies like a thesaurus. These tools will make it easier for my students, who also face resource limitations of their own, to more easily implement their newly developing expert model of writing, with its stress upon multiple drafts, and to alternate between the perspective of producer and critic. At Brock, this component costs me very little, since the lab is already in existence and is centrally administered. My students' questions are answered by lab staff, so I need only devote an initial seminar session to bring my students up to speed.

2) Upon entering my course, I will explicitly give my students the overview of the process of writing which I sketched out above, focusing as I do on novice and expert models of the writing process. I adopt this approach as a substitute for explicitly modelling expert writing. Again, I expect to devote about an hour at the beginning of a course to this topic.

3) The Brock Journal of Psychology will be used as the motivating pseudo-journal. I will run my course as I did when I used BURP, by having students submit all papers for acceptance into the Brock Journal of Psychology. I will apply to hire a course assistant who will double as my "assistant editor" - this person's responsibility would be to manage all of the details involved in the process as well as to review papers for form and style. The feedback from my course assistant and myself, which must be incorporated into subsequent re-submissions, is expected to serve some of the functions of coaching, or scaffolding, which are a part of the cognitive apprenticeship framework.

4) All students in my course must serve as reviewers. Every student would thus have two reviews to do for every paper or project involved. I would create the opportunity for at least one iteration of every paper or project to be possible. This is expected to reinforce the process perspective on writing I will have presented at the beginning of the course. It is also expected to broaden my students' appreciation of the goals of writing. Overall, I expect this to play a role in coaching my students to a more mature model of writing.

5) Finally, I hope to see the "best" papers published on a periodical basis in the Brock Journal of Psychology. In this way, I see myself as an assistant editor responsible for locating suitable manuscripts and forwarding them to the senior (student) editors. Of course, the papers which I forward will be the best to come out of my courses. I hope that final editorial work can again be handled by students but hope also to secure secretarial and other low-level support from the Psychology Department at Brock, to support the pseudo-journal department-wide. As I argued previously, I feel that such a high-quality and high-visibility publication makes the situated, social context of writing in the social sciences much more obvious.

In closing, I have argued that the cognitive apprenticeship approach of Collins, Brown and Newman, (in press) can be fruitfully applied to the problem of the quality of undergraduate writing. I have identified resource limitations as a major reason why we cannot simply apply that approach directly to improve writing in all of our undergraduate courses. I have discussed three instructional innovations which incorporate some of the features of the cognitive apprenticeship approach without requiring an inordinate outlay of instructional resources. Finally, I have presented my plans to combine these innovations in my senior courses next year. I hope to report on the success of my attempt in the near future.

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Computer Mediated Communication

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COURSE OUTLINE: 38-629 (2) W'88
SPECIAL TOPICS: Computer Mediated Communication

DESCRIPTION

Computer Mediated Communication (CMC) represents the convergence of small group practice, telecommunications and computers into a new form of social communication. This course will examine the theory and practice associated with CMC under conditions of computer mediated communication.

FACULTY: Course Co-ordinator - Dr. Ab Moore

Guest Faculty
Dr. John Black, U. of G. Library
Dr. John Bryden, Arkelton Trust, Scotland
Dr. Maria Cioni, Consultant, Toronto
Dr. Tony Fuller, USRP&D, U. of G.
Dr. Elaine McCreary, RES, U. of G.
Dr. Harry Cummings, USRP&D, U.of G.
Dr. Wout van den Bor, Wageningen, Neth.
Ms. Madge Brochet, ICS, U. of G.
Dr. Chris Knapper, TRACE, U. of W.
Dr. Stuart Hunter, English, U. of G.

COURSE MATERIALS

- Proceedings of the Second Symposium on Computer Conferencing, June 1-4, 1987, University of Guelph
- Selected Papers

PURPOSE

This course will provide students with an opportunity to investigate the emerging area of computer mediated communication in terms of its definition, development, technical infrastructure, societal context, methods of application to a range of social concerns, adcption strategies and constraints. It will also provide students with the opportunity to participate in this study under conditions of computer mediated communication.

TOPICS

1. Convergence of technologies and definition of computer mediated communication.
2. Telecommunications context and technical infrastructure.
3. Moderating CMC sessions.
4. CMC and Rural Development - Scotland.
5. CMC and inter-institutional communication - Indonesia.
6. CMC and education.
7. CMC and course delivery.
8. CMC and adult education.

PRE-REQUISITES

- a matriculated graduate student or admissability as an unclassified student
- access to a computer terminal with modem capable of connecting to the university communication via phone, iNet or datapac. (Students on campus will be able to meet this condition through various terminal pools available.)

FORMAT

An initial on-camous meeting will be held to introduce the course, meet resource staff, discuss the first topics and receive sign-on instructions and other technical briefing.

The major discussions in the course will be carried out via computer conferencing using the University of Guelph's CoSy system. Participants will be responsible for analyzing one conference topic for which a faculty resource person will serve as the content authority.

A second course meeting will be held at the end of the course for the purposes of review, consolidation and evaluation.

A written paper will be required as the final assignment for evaluation.

KanjiCard 300 and KanjiBox

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Introduction

KanjiCard 300 is educational software being developed at the East Asian Computer Lab, University of Toronto. It is specially designed for students of the Japanese language to learn the Chinese characters or "Kanji", which are currently used in the Japanese language as part of its writing system. This project is one of the activities of the Apple Innovation Centre for East Asian Languages which was established last February in the Department of East Asian Studies with generous grants from the Apple Canada Education Foundation. **KanjiCard 300** and **KanjiBox** have been developed through the use of HyperCard on the Macintosh microcomputer with other applications such as VideoWorks and Sound Wave. We started only a few months ago and so far have completed a pilot demonstration package. The objective of this software is to facilitate the teaching and learning of Kanji at the beginner's level. It is intended for use by instructors to give a presentation of Kanji in a classroom situation as well as by students as an individual study tool. We hope that the study of Kanji, which is notoriously laborious, time-consuming and heavily rote memory dependent, will be transformed into something enjoyable and efficient by using **KanjiCard 300**. It is also hypothesized that once a student learns the first three hundred basic Kanji with this approach, it would considerably accelerate learning the remaining Kanji. Knowledge of approximately 1,800 characters is necessary in order to acquire an advanced level of reading skill in the Japanese language.

Kanji and the Japanese language

As you may know, Kanji, which literally means letters of the Han Dynasty (206 B.C - A.D.220) originated in China more than 3,500 years ago. It was around the sixth century when Kanji, along

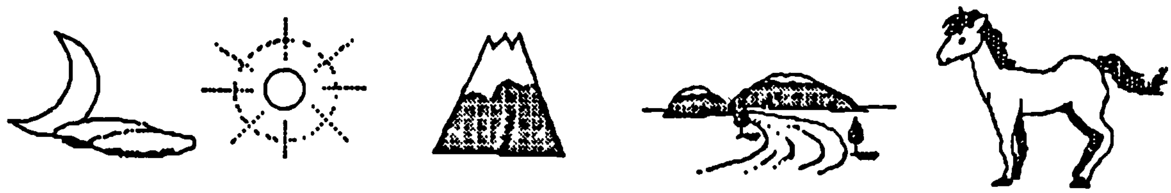
with buddhism, were introduced to Japan. Since the Japanese did not have their own writing system, they naturally tried to adopt Kanji to transcribe their language. However, this process was not easy because both the phonological and grammatical structures of the two languages are drastically different. Just to give a few examples, Chinese is a non-inflectional language whereas Japanese is an inflectional language. Chinese is a mono-syllabic, tone language while Japanese is a multi-syllabic, pitch language. Because of these structural differences, the Japanese eventually developed their own phonetic alphabets, Hiragana and Katakana, on the basis of the Chinese characters in order to transcribe the inflectional part of a sentence. In addition, the adoption of Kanji by the Japanese resulted in multiple readings among which a user must discriminate depending on the context. Surprisingly, only a few Kanji were invented by the Japanese, but they took the initiative to reduce the number of Kanji required for education and printing and to simplify the shape of Kanji in a way quite diffrent from the Chinese. As a result, the writing system of contemporary Japan is often considered the most complicated in the world. Even the Japanese complain because it normally requires nine to twelve years, almost all their schooling, for Japanese children to develop an adequate knowledge of Kanji. Therefore, Kanji has constantly been the target of heated controversy among educated Japanese since western civilization was introduced to Japan. Some people have argued that Kanji should be abolished altogether from the Japanese language, and have proposed that Hiragana, Katakana or even Roman alphabets should be used instead. Recently, as the importance of Japan as a trade partner grows all over the world, the difficulty of learning Kanji is more acutely felt. Just imagine how long it takes for a non-Asian to learn about 2,000 Kanji and nearly 5,000 readings. (If you learn one Kanji a day, it will take you about five and a half years and that's only if you don't take Sundays off.) Some new ideas to expediate the learning of Kanji are needed in this area.

With the emergence of modern computer technology, which has already made a breakthrough in the processing of Kanji electronically, the value of Kanji as an efficient means of visual information processing is better appreciated. There are unique features of Kanji that should be positively identified: (1) the greater amount of information that an individual Kanji carries in comparison with a phonetic alphabet; (2) the adaptability and word generating power of Kanji that function as roots; (3) the high level of inferencing that Kanji allow the reader. That is to say, when a reader comes across a new word or a new Kanji, he can gather the approximate meaning from the part or parts of the Kanji whose meaning is already known to him.

Kanji as Iconic Representation of Meaning

The following are some examples. Kanji are ideographic, in other words, an iconic representation of meaning. Some Kanji are pictographic representations of tangible objects.

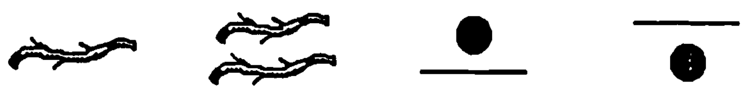
Pictographic



月	日	山	川	馬
Moon	Sun	Mountain	River	Horse

What about abstract concepts? These can be represented two ways: The first is to represent symbolic meanings with signs.

Symbolic



一	二	上	下
One	Two	Up, above	Down, below

The second way is to combine two or more meaningful elements to produce a derived abstract meaning.

Ideographic

(木) 林	(人) 囚	(女) (子) 好 姦
Tree Forest	Person Prisoner	Woman Child Good Noisy
(日) (月) 明	(火) 炎	
Sun Moon Bright	Fire Flame	

The majority of Kanji, almost 90%, are what we call Radical-Phonetic Kanji, in which a basic element known as a radical is used to indicate the general area of meaning of the Kanji, and a phonetic element is put with it to show its sound or reading. Examples are:

Radical - Phonetic

(言)	(丁)	訂	(金)	(同)	銅
Word	'tei'	Correction	Metal	'doo'	Copper

In many cases, more than one Kanji is used in combination as a compound. In other words, Kanji have a strong word generating power since they can be combined with other Kanji to create new words. When one comes across an unknown string of Kanji like the following, the meaning of an individual Kanji gives a hint, on the basis of which the reader can infer the approximate meaning. Examples are:

Compound

二月一日	休日	風力計
two, months, first, day	rest, day	wind, force, measure
February 1	Holiday	Anemometer

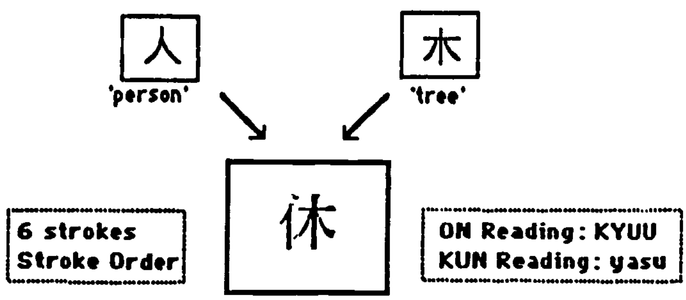
A Kanji can easily become a noun, an adjective or a verb just by adding appropriate endings in Hiragana. Examples are:

Nouns		Adjectives		Verbs	
休み	Holiday	明るい	Bright	休む	to rest
好き	Liking	姦しい	Noisy	上がる	to climb up

Five Elements of Kanji Learning

There are five basic elements that a student must learn for each Kanji.

1) Shape
2) Meaning
3) Reading
4) Writing
5) Usage



First, one must learn the generic **shape** of the Kanji. In many cases, a Kanji can be divided into smaller meaningful parts. The Kanji 休, for example (see above), can be divided into the RADICAL 亻 ('person') and 木 ('tree'). The Kanji has **meaning**, which is the semantic component. In this case, 'rest.' Some Kanji have more than one meaning (original meaning, extended meaning or borrowed meaning). The Kanji also has phonetic components, or **readings**. In many cases, each Kanji has two types of readings: one is the Chinese style or 'ON' reading and the other the Japanese style or 'KUN' reading. In this case, the ON reading is 'kyuu' and the KUN reading is "yasu'. In addition, the student must learn how to write the Kanji. He must learn its graphic components, the numbers, type, and order of brush strokes. This Kanji consists of 6 strokes. The student must also learn how **to use** the Kanji in a compound or a sentence. This is the morphological component. A few examples of the possible compounds and sentences using this Kanji follow:

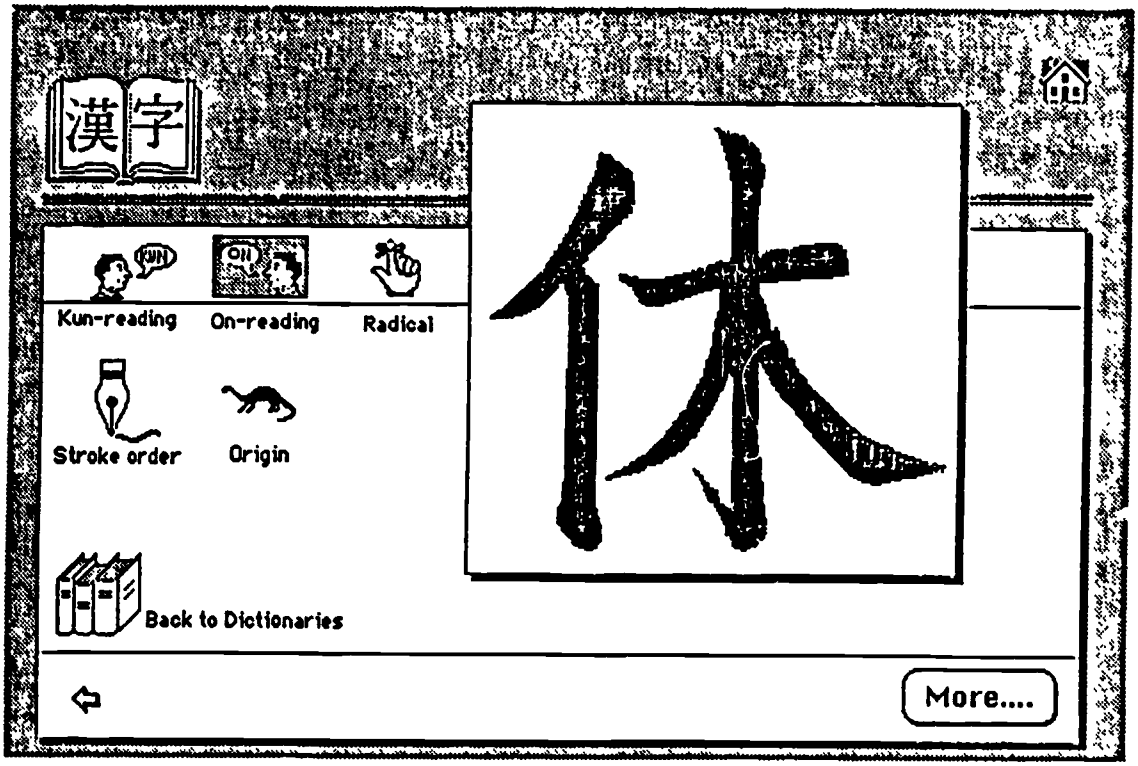
休日 'holiday'	休みです。 'It is a holiday.'
定休日 'regular day-off'	かぜで休んだ。 'He was absent because of a cold.'
現在休業中 'currently out of job'	今休んでいます。 'He is now resting.'

Outline of KanjiCard 300 and KanjiBox

KanjiCard 300 allows a user, at his own selection, to have access to the following basic information about each Kanji.

1) The generic shape

Unlike any existing Kanji dictionaries or reference books, all Kanji will be presented in a clear, large image enabling students to see adequate detail.



2) The basic meaning with etymological and historical background

In most cases Kanji can be divided into smaller meaningful parts which help a student to understand the meaning of the Kanji. The understanding of these meaningful parts is emphasized because it assists the student to infer the approximate meaning of new Kanji. Computer-aided animation techniques are used to show the evolution of the Kanji while mininizing the textual description. For example, in KanjiCard 300 the figure below is shown changing into the Kanji 'to rest".

The Kanji character for "to rest" or "to take a break" consists of two components.

The radical to the left of the Kanji character symbolizes "a man".

And the component to the right of the character symbolizes "a tree".

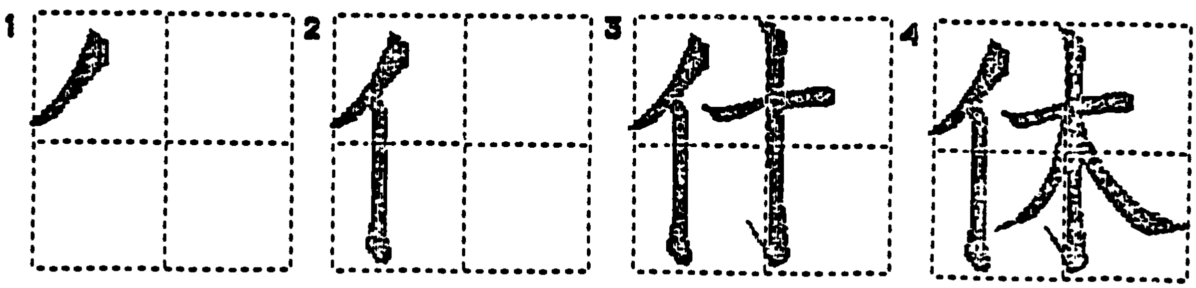
Hence, the entire Kanji character means "a man resting under a tree" as this picture portrays.

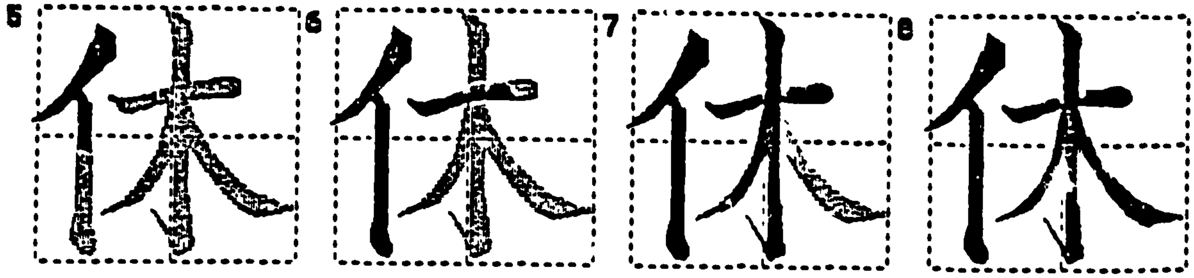
3) The reading

Each Kanji's readings are given by the digitized voice of a native speaker.

4) The number, order, and movement of brush strokes

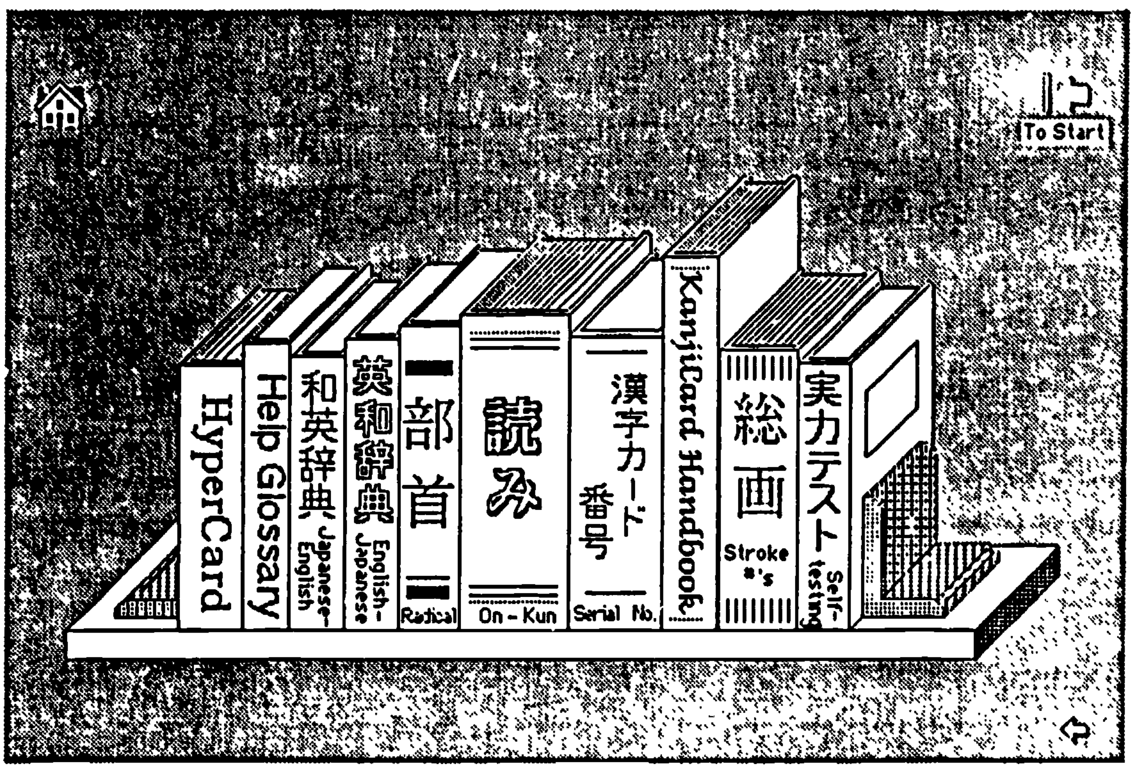
These are presented using animation techniques.





5) The use of Kanji as roots in compounds and sentences

In addtion to these five basic elements and supplementary exercises for each Kanji, **KanjiCard 300** will include "Introduction" and "Help" functions. Several indices also facilitate quick access to the Kanji. These include the Phonetic Index, Radical Index, Stroke Number Index, and Vocabulary Index.



KanjiBox is an organizational tool designed through the use of HyperCard to customize **KanjiCard 300**. It consists of various 'boxes' by which a user can sort and collect Kanji that he or she is learning. An instructor can coordinate the use of **KanjiCard 300** with the reading text by

using **TextBox**, while keeping track of the number of Kanji and their readings that are presented to students by using **KanjiCalc**. Students are encouraged to use **AssociationBox** to share ideas with fellow students, so that the study of Kanji becomes more personal and enjoyable.

Conclusion

Hypercard now enables us to coordinate graphic images, sound, movement and text, which is exactly what is needed to describe the wide range of information that an individual Kanji carries. We are confident that the **KanjiCard 300** can provide the learner with a far richer learning environment than any of the traditional instructional tools.

Computer Based Image Editing for Design Instruction

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INTRODUCTION

Design instruction depends greatly upon the use of visual images. While these images, usually 35mm slides, are useful documents, they are static complete pictures and may restrict in-depth analysis and understanding. By graphically, realistically and quickly manipulating photographic and video images, the instructor and student can visually explore design changes without using the time consuming abstract methods of architectural plans and perspectives.

Powerful inexpensive software and hardware has recently been developed to blend existing video and computer technologies. This marriage allows the student to work directly with a real image that has been digitized from a video tape.

During the design or sketch phase of a project as well as in the production of presentation-quality images, the speed and ease of this technique make it possible to readily test different designs to assess their visual impact.

HOW IT WORKS

The original slide, photograph or video tape is put into the computer via any video recorder. This image is immediately digitized and the photograph-like quality image is displayed on the computer display screen in full colour. The quality of this captured image is what sets this technology far beyond that of any predecessors.

Once the image is captured it can be easily edited using a wide range of available "mouse" driven commands. Unlike other point programs this software allows the designer to choose any of 32,000 colours that are displayed on the original image. Thus by choosing the colour, tones, and brush width the user can draw on the original. The technology also allows the user to move, erase, enlarge, reduce, change the perspective, spin and change the colour of any section of the image.

Parts of other images can be also pasted onto the original; for example photographs of trees can be stored and the memory selected from a file when needed. They can then be charged in size and moved around the screen until a suitable place is found to "paste" them onto the original. It is possible to do this with any number of images finally producing a photograph-like image of a proposed environment.

For the most part this technology only allows the manipulation of still images. Sequential editing could be used to give a dynamic realism to the final video output. The video output is readily accepted by students and the general public. The low cost of this output makes it easy for students to produce a number of images to test their design ideas.

Hard copy output is achieved through dot matrix or colour ink jet printers. Colour photographs can be made directly off the screen or through additional hardware packages.

COMPONENTS

At a total cost of approximately $20,000 the system is not yet at a stage where multiple units can be used in the classroom.

Given existing equipment found in most departments the cost is significantly reduced. The software package and the companion hard board cost approximately $6,500 and must be purchased. By using an existing commercial or institutional video camera and recorder and an AT or 286 level computer with a digitizer the technology is much more within the reach of many departments or schools.

CONCLUSION

The technology described here can not replace the traditional graphic skills of the designer, but rather it utilizes these abilities and the designers design ideas to provide a highly realistic image in a familiar medium.

The power of the system is that it allows the designer/student to explore their design ideas quickly, easily and realistically. This then frees the student from the burden of simply graphically describing their ideas and allows more time to discover new directions in design.

Desirable Classroom Confrontations

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Some students confront their professors over the perceived unfairness of a grade received or about the poor quality or degree of difficulty of assigned readings. Professors confront students about late laboratory or essay submissions or suspected plagiarism. These confrontations are characterized by friction and if emotions run high, heated verbal exchanges occur.

The type of confrontation which is considered a desirable teaching technique is presenting problems to the students and as far as their abilities and limitations of time permit, letting them solve the problems. New knowledge arises out of the problem-solving activity.

In secondary school classrooms it is very common for the mathematics teacher to begin a class with problems which move from the known problem to the challenge problem which represents the current study.

$$2\,(2x + 7) =$$
$$2\,(3b - 2c) =$$
$$r\,(s + t) =$$
$$c\,(d - 2e + 4f) =$$
$$(a+b)\,(s+t) =$$

An introductory problem may be presented in the form of a short personal story. "When I worked in Algonquin Park on the interpretative staff, the timber wolf population was 300 animals and the white tail deer population was 30,000. What further details do you need to know in order to determine the <u>frequency</u> of those two populations?"

In addition to confrontations being established or introduced by problems, they may be initiated by an attention-grabbing demonstration which requires explanations. It was the "faith-in-Physics professor" Dr. Miller who had a railway tie spike sledge-hammered into a cross section of a tree trunk resting on his chest. While still in a horizontal position on the floor, Prof. Miller initiated discussion which soon centred on the topic inertia and momentum. The lesson was well supported with other demonstrations but the initial one stimulated much thought and response to the professor's questions.

Lesson titles themselves may provide confrontations:

"They Don't Go Crunch Any More"

"The World of Edible Sins"

"Chalk Talk On Floc"

"Your Hand Is Showing"

"The Mole: Best Friend Of The Chemist

The Great Candle Mystery

These lesson titles provide initial motivation in the form of a challenge to students. Pupils ask themselves "What is the topic and focus today?" "They Don't Go Crunch Anymore" documents the decline in mayfly population and the lesson can start with the professor recalling past insect numbers around streetlights in a Lake Erie community. The life span of mayflies is short with adult life lasting only a few days and after mating and egg laying adults die. Mayfly bodies accummulated to such a degree that people walking on them produced an audible noise and at some intersections traffic accidents resulted from crushed mayflies making roadways slippery. The remainder of the lesson deals with present water quality of the Great Lakes in the 1980's.

What do you think the other lesson topics have as an affective, cognitive or psychomotor focus?

A fallacy or paradox establishes a confrontation.

$$a = b$$
$$a^2 = ab$$
$$a^2 - b^2 = ab - b^2$$
$$(a+b)(a-b) = b(a-b)$$
$$a+b = b$$

remember $a = b$

$$2b = b$$
$$2 = 1$$

A direct teacher statement may advocate a certain position that will stimulate students to then provide both pro and con positions. "Abortion appears to be used as an effective birth control measure in several countries. Let's explore the advantages and disadvantages of this intervention procedure."

A wide-ranging discussion initiated by the teacher can produce a pattern of disequilibrium and then point towards new knowledge. The discussion may start at the point where the professor has confronted students with statements contrary to their views or on account which they find difficult to believe on the basis of their past experience. "Pesticides should be banned immediately. They add tremendously to farm production costs, have only specific limited effectiveness and the long term result is likely a pesticide-resistant organism." A professor may wish to stimulate the same kind of discussion without the necessity of a devil's advocate statement. A number of case studies may be able to accomplish this.

As professors, we should be aware that students are coming to us with some background in case study analysis, some practice in pictorial reasoning and even laboratory sessions may utilize confrontation techniques at lower grade levels. The laboratory exercise which follows is mainly a rotation of stations with pupils filling as many of the blanks in the three columns as is possible.

Over half of the items which a teacher might set up at the different stations are listed. Students are told to base their response to the second column on their definition of a fossil which is recorded as the laboratory exercise begins. When the station rotation is complete, the teacher can continue the confrontation by determining that some students have called the majority of the objects fossils and others have reserved that label for only a very few items. Different fossil definitions are read and criteria discussed. Some teachers would continue the discovery aspect by assigning student reading and research on associated topics. Other teachers would make a motivational use of this introductory exercise and would then teach in a more formal fashion covering the content mainly via socratic and lecture format.

	NAME OF OBJECT(S)	FOSSIL (Yes or No)	TYPE OF FOSSIL
1	Amber		
2	Arrowhead		
3	Beeswax		
4	Bird Nest		
5	Brachiopod		
6	Cicada		
7	Coal		
8	Coral		
9	Feather		
10	Fish Vertebra		
11	Kidney Stone		
12	Pine Cone		
13	Plastic Embedded Beetle		
14	Shark Tooth		
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			
25			

Personal Definition of a Fossil: ______________________________

____

____

If educators are saying to themselves "confrontations do not appear to be innovations in teaching" they are correct.

There is something of the juggler, the magician and the medicine wagon in the origins of confrontations of this type. Good teachers have long used many methods to motivate their students and the advertising technique of seeking attention followed by proclaiming the desirable qualities of the product is a standard approach. Professors now though have access to a wide array of audio visuals which can be used in a confrontational manner.

I'll describe a few of the 35mm coloured slides to be used in the demonstration portion of my presentation.

1. Pileated Woodpecker Holes In Trees

Students would not be given the title above. They would be told that I photographed this along the Bruce trail near Shelburne, Ontario. The question I would ask to initiate discussion "Have you observed similar vandalism?"

2. Winter Kill of Conifers

Students would not be given the above title. I photographed this scene at a London, Ontario nurse.y. "Explain how many of the evergreens shown in this picture became two - tone in colour."

3. Leaf Print

No title is provided. "How did the leaf leave its shadow on the sidewalk?"

4. Corn Totem Pole: Hundreds of Corn Ears on a Commercial Exhibit

No title is given to students but they are told I photographed this at the International Ploughing Match near Lucan, Ontario in 1982. "What improvements in genetics led to the increased yield visible on this single corn plant?"

These visuals and many more serve as confronting introductions or additions to lectures. The film loop which shows the collapse of the Tacoma Narrows

Bridge is an excellent visual aid for confrontation and follow-up discussion. Good questioning techniques are essential for continuing confrontation if there is a wish to do so.

Confrontations can be initiated if discrepant events are used. Anything considered mysterious, unexpected, or unknown can be used as a discrepant event. The game "Lunar Probe" can be used to demonstrate a steel sphere seemingly defying gravity by moving up an inclined plane. What other toys have lecture hall or laboratory application for presenting a problem? Are there recreational mathematics games which have this potential as well as familiar physics equipment such as radiometers?

Let's examine what several educators have said about the effect of contradictions, dilemmas and discrepant events:

Piaget

Contradictions met in the environment produce a pattern of disequilibrium. If resolved by an alteration in the individual's pattern of reasoning this is accommodation. The process of accommodating to new and discrepant information was called self-regulation by Piaget.

Bruner

Conjectures and dilemmas give life and direction to a body of knowledge. Both curriculum makers and teachers should provide exercises and occasions to nurture these conjectures and dilemmas.

Suchman

Students attempt to resolve contradictions which are encountered via demonstrations or other visual aids. Inquiry is stimulated if a filmloop shows a discrepant event. Suchman's theory on this is summarized below:

1. People inquire naturally when they are puzzled.
2. They can become conscious of and learn to analyze their thinking strategies.
3. New strategies can be taught directly and added to the students' existing ones.
4. Cooperative inquiry enriches thinking and helps students to learn about the tentative emergent nature of knowledge and to appreciate alternative explanations.

The use of the confrontation concept seems desirable for the following reasons:

It fosters independent thinking and drawing of conclusions. When used by students it indicates that they have learned how to learn.

The idea is independent of the basic teaching method used. Confrontation can be used with lectures, laboratories, field studies, visual aids.

The principle of confrontation gives one criterion by which to judge methodological innovations. It may be a good innovation if it allows confrontation to occur.

In Summary, classroom and laboratory confrontations are encouraged if they stimulate thought and encourage problem solving.

Acknowledgement:

The inspiration for this presentation was provided by Professor Emeritus J. S. Wright who delivered a paper to a STAO conference in the 1970's. Professor Wright's address was titled "Confrontation In The Classroom: Self-Regulation Applied". Books such as "Models of Teaching" 2nd edition by Joyce and Weil published by Prentice Hall in 1980 will give additional expressions of theory by Bruner, Piaget, Suchman and others.

An Inexpensive Expert System Shell for Student-Developed Social Science Instructional Software

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and

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INTRODUCTION

One of the immediate consequences of installing microcomputer laboratories in instructional settings is the creation of a need for appropriate software. Directories describing such software have begun to appear (Stoloff and Couch, 1987) and software reviews are beginning to take their place beside textbook reviews (Butler, 1988). Although software is likely to appear for laboratory courses and for courses such as statistics (SYSTAT, 1986, 1987) it is uncertain if software will be available for a wider range of offerings in the near future. Fortunately, expert system development tools originally developed for business use can be used to develop tutoring software. The characteristics that make this possible include 1) ease of use, 2) high interactivity, and 3) low cost. In the remainder of this report we will describe one such expert system shell, selected on the basis of a series of positive reviews (Aguiar, 1987; Anacker, 1987; Olsen, Pumplin, and Williamson, 1987), and used in the past year to develop tutoring software in a variety of content areas.

CREATING AN EXPERT SYSTEM

The expert system development tool described in the following report became available in 1986 and has been upgraded several times since its release (VP-Expert 1986, 1987, 1988). It is described as a rule-based expert system development tool and contains its own text editor, although external word processing software may be used with it. The software contains a clearly written manual that includes a tutorial.

At the DOS prompt, the program is loaded in response to the typed command VPX which displays the Main Menu shown in Figure 1 (all Figures appear at the end of the paper). The first step in developing an expert system using the program's text editor is to select 2INDUCE from the Main Menu. This selection is made using the arrow keys to move a highlight and striking the enter (RETURN) key or by simply typing the number that appears at the beginning of the selection -- in this case the number 2.

When the Induce Menu appears (Figure 2) 2CREATE is selected and entered. The display then asks for an identifying name for the expert system to be created. It is advisable to keep the name simple, limit yourself to less than eight letters or numbers, and essential <u>not</u> to use a period, colon, or an extension as part of the name. Enter the name selected with the enter (RETURN) key. You are now automatically in the text editor and can create a knowledge table which should be similar to the example called FREUD shown in Figure 3.

The text editing rules are simple and intuitive and are summarized in Figure 4 which is taken from the VP-Expert manual. Information is entered in the table so that each row reads left to right across as an "If - And - Then" statement. For example, in Figure 3, starting under the PSYCHIC-FUNCTIONS heading, the first row of the knowledge table would read: if the function is an ID function, and the level is Strong, then the adjustment is neurotic. The program has certain rules that must be followed while creating a knowledge table. For example, headings and descriptive statements cannot include spaces -- the easiest

solution is to use hyphens as shown in Figure 3. A second rule is that headings and statements for each column are limited to less than twenty-one characters in length and some characters are reserved.

Once the knowledge table is created, save it and exit the text editor using an ALT-F6 key combination (see editing rules, Figure 4); the Induce Menu (see again, Figure 2) appears automatically. Select 4TEXT on this menu and follow the directions in order to generate an expert system based upon your knowledge table. If no mistakes have been made while creating the knowledge table, the expert system will be automatically generated by the inference engine of the program.

To consult the expert system that has been generated, return to the Main Menu and select 4CONSULT. On the screen display that appears, select 2GO. The consultation display for FREUD is presented in Figure 5. In response to the initial query "What is the value of PSYCHIC-FUNCTIONS?" the ID was selected. In response to "What is the value of LEVELS?", the value of strong was selected and the ADJUSTMENT outcome (neurotic) appears in the lower right hand box. The program indicates a confidence (CNF) level of 100 percent since this was the level assumed in the "if" conditions. A second consultation reflecting the choice of EGO function at a Moderate level yields a "So-called-normal" adjustment outcome and is presented in Figure 6.

The box on the lower left of the screen displays each rule of the expert system as it is evaluated during a consultation. The rules scroll past and stop at the rule that applies. If no rule applies, the expert system scrolls to the last rule. In this case, in order to prevent the system from providing an incorrect conclusion, an appropriate "ELSE" rule must be written. A brief description of how this is done is included in the following section.

MODIFYING THE RULES FILE

Thus far the focus has been on creating a knowledge table. However, once the knowledge table has been converted into a rules file by the inference engine of the program, the rules file becomes the focus. The rules file of the knowledge table identified as FREUD is presented in Figure 7. The rules file provides a natural language description of how the expert system works. The ACTIONS section of the file defines the goal of the program which, in this case, is to find the adjustment (neurotic or so-called-normal). The rules reflect the successive If-And-Then statements. Finally, the ASK statements at the end of the rules file provide the consultation queries and, as seen in Figures 5 and 6, the parts within quotation marks and the choices that follow appear during the consultation.

Although the rules file generated by the program is to some extent adequate, some changes are desirable and these can be made directly to the rules file by using the text editor. For example, the consultation question "What is the value of the PSYCHIC-FUNCTIONS?" can be changed to read "What Psychic Function do you wish to explore?" The program allows editorial changes of this kind <u>as long as they appear inside the quotation marks</u>. Comparable changes outside of quotes result in an error message.

Another, more important modification has already been mentioned in the preceding section. It is the nature of the program to move through each rule until a rule is satisfied--that is, until a rule is found that contains the appropriate "if - and" conditions. If this does not happen, the program evaluates all rules stopping only at the last rule. The last rule will be displayed at the conclusion to the consultation and this will be wrong since it appears only because it is the last rule. In the simple example of FREUD this situation will not happen because all possible choices during a consultation can be dealt with by the rules file. However, a more complicated knowledge table, such as the one dealing with brain/behavior relationships in Figure 8, provides possible choices for which no rules exist in the rules file.

For example, using the knowledge table in Figure 8, if during a consultation Limbic-System-1 is selected as the BRAIN-SYSTEM, but the AREA chosen is Prefrontal (from the top row) no rule exists that can lead to a FUNCTION. The easiest way to correct this limitation is to add an ELSE condition to the last rule of the rules file. The complete rules file generated from the brain/behavior knowledge table, with the ELSE statement added to Rule 11, is presented in Figures 9a and 9b.

When this is done, if the program moves through all rules to the last rule without satisfying any rule along the way, the ELSE condition is the only rule that passes. When it passes it displays "Unspecifiable" which is correct--that is, no function can be specified when an AREA of the brain is chosen that is not contained within the appropriate BRAIN-SYSTEM.

This description is only an introduction to the features available in this and other expert system development tools now available for instructional purposes. Many expert system shells, including the one

described here, include the ability to access external data bases, spreadsheets, and graphics packages. One of the most useful characteristics of these shells is that they are not content-specific. That is, they can be used to develop expert systems in unlimited range of topics.

In psychology courses at the University of Windsor, content of prototype expert systems developed to date include artificial intelligence (Weitzenbaum, 1976; McCorduck, 1979, Boden, 1987), statistics (Andrew, Klem, Davidson, O'Malley and Rogers, 1981), clinical diagnosis (DSM-III-R, 1987), psychoanalysis (Freud, 1924, 1975) and brain/behavior relationships (Carlson, 1986; Cooper, Bloom, and Roth, 1986).

CONCLUSION

Inexpensive, highly interactive expert system development tools are now available for use with microcomputers. Students with little prior knowledge of computers can create knowledge tables, generate and modify rules files and carry out consultations with a few hours of supervised lab experience. With practice, selected students can produce their own self-tutoring software.

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Figure 1

VP - EXPERT

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1Help 2Induce 3Edit 4Consult 5Tree 6FileName 7Path 8Quit
1Help 2Create 3Database 4Text 5Worksht 6Quit

Figure 2

VP - EXPERT

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1Help 2Create 3Database 4Text 5Worksht 6Quit
Edit an induction table in a text file

Figure 3

Editing: Old File freud-0.tbl

PSYCHIC-FUNCTIONS	LEVELS	ADJUSTMENT◀
◀		
ID	Strong	Neurotic◀
ID	Moderate	So-called-normal◀
ID	Weak	Neurotic◀
EGO	Strong	Neurotic◀
EGO	Moderate	So-called-normal◀
EGO	Weak	Neurotic◀
SUPEREGO	Strong	Neurotic◀
SUPEREGO	Moderate	So-called-normal◀
SUPEREGO	Weak	Neurotic◀

Insert On   Document Off   Boldface Off Underline Off

1 2 3 [illegible] 4 5 [illegible] 6 7 [illegible] 8 9 [illegible] 10

Figure 4

VP-Expert Editing Commands

RIGHT/LEFT ARROW	Moves cursor right/left one character.
UP/DOWN ARROW	Moves cursor up/down one line.
INSERT	Toggles insert mode. Default is ON.
TAB	Moves cursor to next tab stop.
SHIFT-TAB	Moves cursor back one tab stop.
CTRL-ENTER	Adds a blank line.
DEL (or CTRL G)	Deletes character at cursor position.
BACKSPACE	Deletes character to left of cursor.
CTRL-T	Deletes from cursor to end of word.
CTRL-Y	Deletes line.
ALT F6	Saves file and leaves editor.
ALT F8	Abandons file without saving or changing.
ALT F5	Updates file without leaving editor.

Note: Hard carriage returns are indicated on screen with left triangles (◀).

Figure 5

```
What is the value of PSYCHIC-FUNCTIONS?
ID ◄                    EGO                     SUPEREGO

What is the value of LEVELS?
Strong ◄                Moderate                Weak
```

```
Testing 0

RULE 0 IF
PSYCHIC-FUNCTIONS = ID AND
LEVELS = Strong
THEN
ADJUSTMENT = Neurotic CNF 100

Finding PSYCHIC-FUNCTIONS
Finding LEVELS
```

```
PSYCHIC-FUNCTIONS = ID CNF 100

LEVELS = Strong CNF 100

ADJUSTMENT = Neurotic CNF 100
```

Go

Figure 6

```
What is the value of PSYCHIC-FUNCTIONS?
ID                      EGO ◄                   SUPEREGO

What is the value of LEVELS?
Strong                  Moderate ◄              Weak
```

```
Finding LEVELS
Testing 4

RULE 4 IF
PSYCHIC-FUNCTIONS = EGO AND
LEVELS = Moderate
THEN
ADJUSTMENT = So-called-normal CNF 100
```

```
PSYCHIC-FUNCTIONS = EGO CNF 100

LEVELS = Moderate CNF 100

ADJUSTMENT = So-called-normal CNF 100
```

Go

Figure 7

```
ACTIONS
        FIND ADJUSTMENT;

RULE 0
IF      PSYCHIC-FUNCTIONS=ID AND
        LEVELS=Strong
THEN    ADJUSTMENT=Neurotic;

RULE 1
IF      PSYCHIC-FUNCTIONS=ID AND
        LEVELS=Moderate
THEN    ADJUSTMENT=So-called-normal;

RULE 2
IF      PSYCHIC-FUNCTIONS=ID AND
        LEVELS=Weak
THEN    ADJUSTMENT=Neurotic;

RULE 3
IF      PSYCHIC-FUNCTIONS=EGO AND
        LEVELS=Strong
THEN    ADJUSTMENT=Neurotic;

RULE 4
IF      PSYCHIC-FUNCTIONS=EGO AND
        LEVELS=Moderate
THEN    ADJUSTMENT=So-called-normal;

RULE 5
IF      PSYCHIC-FUNCTIONS=EGO AND
        LEVELS=Weak
THEN    ADJUSTMENT=Neurotic;

RULE 6
IF      PSYCHIC-FUNCTIONS=SUPEREGO AND
        LEVELS=Strong
THEN    ADJUSTMENT=Neurotic;

RULE 7
IF      PSYCHIC-FUNCTIONS=SUPEREGO AND
        LEVELS=Moderate
THEN    ADJUSTMENT=So-called-normal;

RULE 8
IF      PSYCHIC-FUNCTIONS=SUPEREGO AND
        LEVELS=Weak
THEN    ADJUSTMENT=Neurotic;

ASK PSYCHIC-FUNCTIONS: "What is the value of PSYCHIC-FUNCTIONS?";
CHOICES PSYCHIC-FUNCTIONS: ID,EGO,SUPEREGO;

ASK LEVELS: "What is the value of LEVELS?";
CHOICES LEVELS: Strong,Moderate,Weak;
```

Figure 8

BRAIN-SYSTEM	AREA	FUNCTION
Cer-Cortex-1	Prefrontal	Cognition
Cer-Cortex-2	Primary-Sensory	Precise-Sensory
Cer-Cortex-3	Primary-Motor	Precise-Movement
Cer-Cortex-4	Not-yet-known	Memory-Store
Limbic-System-1	Sept-MFB-VTA	Reward
Limbic-System-2	Hyp-St-Amygdala	Attack
Limbic-System-3	Hippocampus	Process-into-Mem
Hypothalamus-1	Dorsal-medial	Sympathetic-ANS
Hypothalamus-2	Ventral-lateral	Parasymp-ANS
Hypothalamus-3	Ventral-Pituitary	Growth-Gend-Diff
Retic-Form-1	Ascer 'ing	Arousal
Retic-Form-2	Descending	Muscle-Coord

Figure 9a

```
ACTIONS
          FIND FUNCTION;


RULE 0
IF        BRAIN-SYSTEM=Cer-Cortex-1 AND
          AREA=Prefrontal
THEN      FUNCTION=Cognition;

RULE 1
IF        BRAIN-SYSTEM=Cer-Cortex-2 AND
          AREA=Primary-Sensory
THEN      FUNCTION=Precise-Sensory;

RULE 2
IF        BRAIN-SYSTEM=Cer-Cortex-3 AND
          AREA=Primary-Motor
THEN      FUNCTION=Precise-Movement;

RULE 3
IF        BRAIN-SYSTEM=Cer-Cortex-4 AND
          AREA=Not-yet-known
THEN      FUNCTION=Memory-Store;

RULE 4
IF        BRAIN-SYSTEM=Limbic-System-1 AND
          AREA=Sept-MFB-VTA
THEN      FUNCTION=Reward;

RULE 5
IF        BRAIN-SYSTEM=Limbic-System-2 AND
          AREA=Hyp-St-Amygdala
THEN      FUNCTION=Attack;

RULE 6
IF        BRAIN-SYSTEM=Limbic-System-3 AND
          AREA=Hippocampus
THEN      FUNCTION=Process-into-Mem;

RULE 7
IF        BRAIN-SYSTEM=Hypothalamus-1 AND
          AREA=Dorsal-medial
THEN      FUNCTION=Sympathetic-ANS;
```

Figure 9b

```
RULE 8
IF      BRAIN-SYSTEM=Hypothalamus-2 AND
        AREA=Ventral-lateral
THEN    FUNCTION=Parasymp-ANS;

RULE 9
IF      BRAIN-SYSTEM=Hypothalamus-3 AND
        AREA=Ventral-Pituitary
THEN    FUNCTION=Growth-Gend-Diff;

RULE 10
IF      BRAIN-SYSTEM=Retic-Form-1 AND
        AREA=Ascending
THEN    FUNCTION=Arousal;

RULE 11
IF      BRAIN-SYSTEM=Retic-Form-2 AND
        AREA=Descending
THEN    FUNCTION=Muscle-Coord
ELSE    FUNCTION=Unspecifiable;

ASK BRAIN-SYSTEM: "What is the value of BRAIN-SYSTEM?";
CHOICES BRAIN-SYSTEM:
Cer-Cortex-1,Cer-Cortex-2,Cer-Cortex-3,Cer-Cortex-4,
Limbic-System-1,Limbic-System-2,Limbic-System-3,
Hypothalamus-1,Hypothalamus-2,Hypothalamus-3,
Retic-Form-1,Retic-Form-2;

ASK AREA: "What is the value of AREA?";
CHOICES AREA:
Prefrontal,Primary-Sensory,Primary-Motor,Not-yet-known,
Sept-MFB-VTA,Hyp-St-Amygdala,Hippocampus,
Dorsal-medial,Ventral-lateral,Ventral-Pituitary,
Ascending,Descending;
```

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An Expert System Development Tool for Intelligent Tutoring in Cognitive Neuroscience

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Department of Psychology
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INTRODUCTION

The availability of expert system development software creates new opportunities for developing instructional software in microcomputer laboratories. Important requirements for such software include 1) interactivity, 2) ease of use, and 3) low cost.

After reading reviews (Aguiar, 1987; Anacker, 1987; Olsen, Pumblin, and Williamson, 1987) and trying several expert system shell "demos" , a PC-compatible product was selected for illustration in this report. Described as a rule-based expert system development tool, the manual claims that it "...allows virtually anyone to build an expert system (VP-Expert, 1986, 1987, 1988). The description is accurate. The non-copy protected program contains its own text editor (but permits the use of external word processing software) and comes with a clearly written manual that includes a tutorial. The software, upgraded in 1987 and again in 1988, is available for less than $100 U.S. through educational discount or from mail order companies. In the remainder of this report we will give a step-by-step example of a prototype expert system developed with this software.

CREATING A KNOWLEDGE TABLE

At the DOS prompt, type the letters VPX which loads the program and displays the Main Menu shown in Figure 1 (all Figures appear at the end of this article). The first step in developing an expert system, using the program's own text editor, is to select 2INDUCE from the Main Menu. This selection is made either by using the arrow keys to move a highlight and then striking the enter (RETURN) key or by simply typing the number of the selection -- in this case the number 2.

When the Induce Menu appears (Figure 2), select 2CREATE. The program then asks for the name of the expert system that you wish to create. After typing the name you have chosen -- the prototype example used here is called BRAIN-01 -- press the enter (RETURN) key. You are now in the text editor and can create a knowledge table such as BRAIN-01 shown in Figure 3.

Information is entered in the table so that each row reads across as an "If-Then" statement. For example, in Figure 3 under the BRAIN-SYSTEM label, the top row of the table reads: If the brain system is the cerebral cortex, then (under the FUNCTION heading) the functions are cognition, sensory, motor, and memory storage (Cogn-Sens-Mot-MemSt). The abbreviations are somewhat awkward at first, but can be minimized as more elaborate knowledge tables are created.

The program has certain requirements that <u>must</u> be met in creating the knowledge table. The two most important are, 1) titles and descriptive statements in the knowledge table cannot include spaces or colons -- use hyphens to separate words as shown in the examples, and 2) titles and statements are limited in length). Notwithstanding these and other limitations, the text editor is easy to learn and intuitive. A summary of the major text editing rules appears in Figure 4.

Once the table is created, save it and exit (the Menu at the bottom of the screen tells how). The Induce Menu (Figure 2) appears automatically. To generate the expert system, select 4TEXT on this menu and

follow the instructions that appear on the screen. If no mistakes have been made in creating the knowledge table, the expert system is generated automatically.

To consult the expert system, return to the Main Menu (by selecting 6QUIT) and select 4CONSULT. On the display that appears, select 2GO . The result for BRAIN-01 is presented in Figure 5. In this particular consultation, the question at the top of the screen (What is the value of the BRAIN-SYSTEM?) was responded to by highlighting the choice "Cerebral-Cortex." The arrow keys are used to make the selection, and then the ENTER and END keys are pressed. The result appears in the lower right box of the display . Thus, FUNCTION = Cogn-Sen-Mot-MemST CNF 100. The CNF 100 refers to confidence (CNF) level that is assumed to be 100% unless lower confidence levels are specifically indicated in the "If" conditions leading to the conclusion displayed. The box on the lower left of the screen displays each rule of the expert system as it is evaluated during a consultation.

The above prototype is the simplest expert system that could be imagined and, except as an instructional example, you would usually not generate such a simple expert system. At the same time, the addition of only a few "If" conditions quickly increases the complexity of the knowledge table, and the resulting expert system begins to show some signs of becoming "expert". For example, Figure 6 shows a knowledge table containing brain systems subdivided into brain areas with each area in a state of either activation or inhibition.

MODIFYING THE RULES FILE

Up to this point, the focus has been on creating knowledge tables (see again, Figures 3 and 6). However, once the knowledge table has provided raw data for generating the expert system, the focus shifts to the rules file. The rules file displays the logic of the expert system in natural language. However, in the form created by the program's inference engine, the rules file is somewhat awkward. To develop a more smooth-running expert system, the rules file usually requires some modification. The rules file generated for BRAIN-01 is presented in Figure 7.

The most important part of the rules file is the ACTIONS BLOCK. In this example, the ACTION specified for BRAIN-01 is simply FIND FUNCTION -- which the expert system does. The other parts of the rules file are RULES and STATEMENTS which in this particular example again are quite limited. The consultation with BRAIN-01 presented in Figure 5 demonstrates some of the reasons why modification of the Rules File is appropriate. For example, to read smoothly, the word "value" at the beginning of the consultation needs to be changed to a more appropriate word such as "name." Other changes that can be made include adding titles, cleaning up the appearance of the consultation screen, and streamlining the consultation process. All of these can be done by directly editing the rules file.

To illustrate the result of this editing, the knowledge table for the more complex expert system BRAIN-ES (see again, Figure 6) has been used to generate a rules file which has then been modified. When consulting this expert system, the first screen that appears is the title displayed in Figure 8. As selections are made in response to successive questions, the displays in Figures 9, 10, 11, and 12 appear.

This brief description touches upon only a few of the features provided by the new generation of inexpensive expert system development tools now available for instruction in cognitive neuroscience. Although the use made of them depends upon the user's instructional approach, the most effective use may be to direct students to specific neuroscience content from readily available sources (Angevine & Cotman, 1981; Carlson, 1986; Shepherd, 1987) so that the students themselves can create knowledge tables and generate their own expert systems for self-tutoring.

CONCLUSION

Inexpensive, expert system development tools are now available for use with microcomputers. One example of a rule-based expert system shell has been described in this paper. Using this or similar development tools, students can create their own knowledge tables, generate and modify rules files, and carry out consultations within a few hours. With practice, students can produce their own interactive software for self-tutoring.

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Figure 1

```
                         V P - E X P E R T

                        Copyright (c) 1987
                           Brian Sawyer
                        All Rights Reserved

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             Published by Paperback Software International

                   Licensed for the exclusive use of
                    Registered Single-User Licensee



1Help    2Induce   3Edit     4Consult  5Tree     6FileName 7Path     8Quit
Help the user
```

Figure 2

```
                         V P - E X P E R T

                        Copyright (c) 1987
                           Brian Sawyer
                        All Rights Reserved

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             Published by Paperback Software International

                   Licensed for the exclusive use of
                    Registered Single-User Licensee



1Help    2Create   3Database 4Text     5Worksht  6Quit
Help the user
```

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Figure 3

BRAIN-SYSTEM	FUNCTION
Cerebral-Cortex	Cogn-Sen-Mot-MemSt
Limbic-System	Rewrd-Attck-MemPr
Hypothalamus-Pit	Symp-Paras-GendDif
Retic-Formation	Arousal-MusclCoord

Figure 4

VP-Expert Editing Commands

RIGHT/LEFT ARROW	Moves cursor right/left one character.
UP/DOWN ARROW	Moves cursor up/down one line.
INSERT	Toggles insert mode. Default is ON.
TAB	Moves cursor to next tab stop.
SHIFT-TAB	Moves cursor back one tab stop.
CTRL-ENTER	Adds a blank line.
DEL (or CTRL G)	Deletes character at cursor position.
BACKSPACE	Deletes character to left of cursor.
CTRL-T	Deletes from cursor to end of word.
CTRL-Y	Deletes line.
ALT F6	Saves file and leaves editor.
ALT F8	Abandons file without saving or changing.
ALT F5	Updates file without leaving editor.

Note: Hard carriage returns are indicated on screen with left triangles (◀).

Figure 5

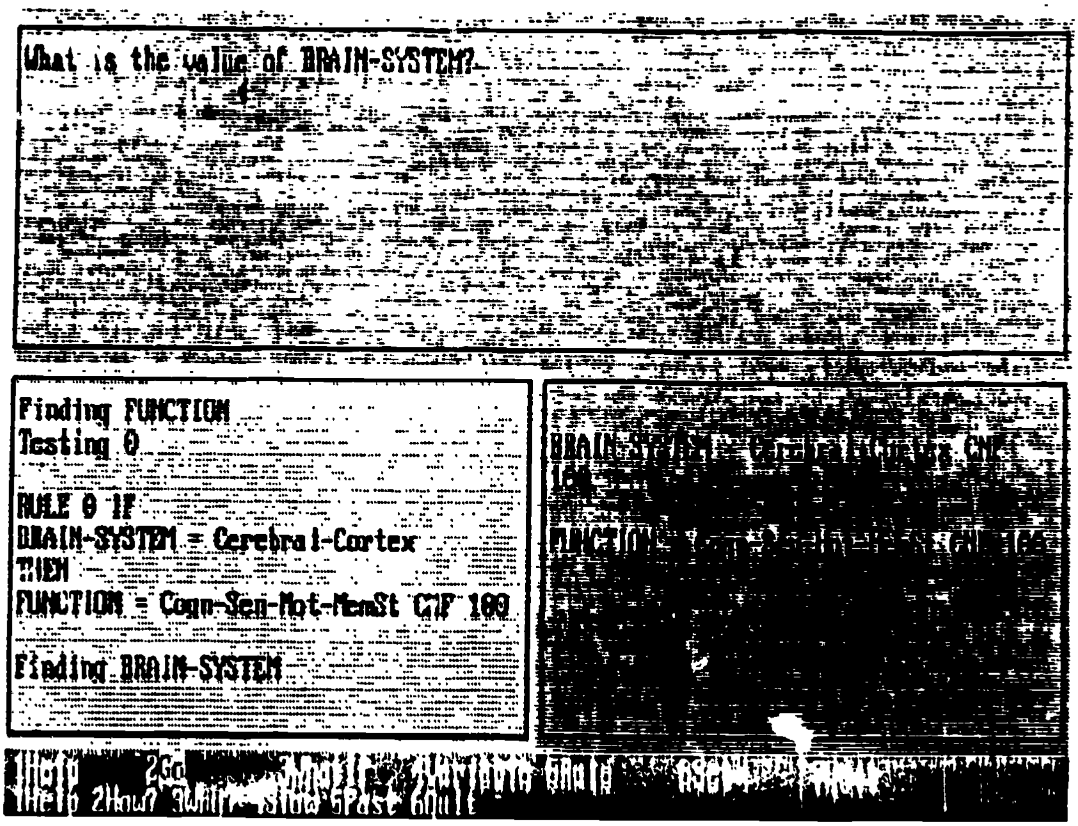
What is the value of BRAIN-SYSTEM?
Finding FUNCTION
Testing 0
RULE 0 IF
BRAIN-SYSTEM = Cerebral-Cortex
THEN
FUNCTION = Cogn-Sen-Mot-MemSt CNF 100
Finding BRAIN-SYSTEM

Figure 6

Brain-System	Area	State	The-Function
Cerebral-Cortex	CC:Prefrontal	Activation	Increased-Cognition
Cerebral-Cortex	CC:Prefrontal	Inhibition	Decreased-Cognition
Cerebral-Cortex	CC:Primary-Motor	Activation	Increased-Movement
Cerebral-Cortex	CC:Primary-Motor	Inhibition	Decreased-Movement
Cerebral-Cortex	CC:Primary-Sens	Activation	Increased-Sensation
Cerebral-Cortex	CC:Primary-Sens	Inhibition	Decreased-Sensation
Cerebral-Cortex	CC:Undetermined	Activation	Incr-Memory-Store
Cerebral-Cortex	CC:Undetermined	Inhibition	Decr-Memory-Store
Limbic-System	L:Sept-MFB-VTA	Activation	Increased-Reward
Limbic-System	L:Sept-MFB-VTA	Inhibition	Decreased-Reward
Limbic-System	L:Hyp-St-Amygdala	Activation	Increased-Attack
Limbic-System	L:Hyp-St-Amygdala	Inhibition	Decreased-Attack
Limbic-System	L:Hippocampus	Activation	Incr-ProcIntoMem
Limbic-System	L:Hippocampus	Inhibition	Decr-ProcIntoMem
Hypothalamus	H:Dorsal-medial	Activation	Incr-Sympathetic-ANS
Hypothalamus	H:Dorsal-medial	Inhibition	Decr-Sympathetic-ANS
Hypothalamus	H:Ventral-lateral	Activation	Incr-Parasymp-ANS
Hypothalamus	H:Ventral-lateral	Inhibition	Decr-Parasymp-ANS
Hypothalamus	H:Vent-Pituitary	Activation	Incr-Grwth-Gend-Diff
Hypothalamus	H:Vent-Pituitary	Inhibition	Decr-Grwth-Gend-diff
Reticular-Form	RF:Ascending	Activation	Increased-Arousal
Reticular-Form	RF:Ascending	Inhibition	Decreased-Arousal
Reticular-Form	RF:Descending	Activation	Incr-Muscle-Coord
Reticular-Form	RF:Descending	Inhibition	Decr-Muscle-Coord

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Figure 7

```
ACTIONS
        FIND FUNCTION;

RULE 0
IF      BRAIN-SYSTEM=Cerebral-Cortex
THEN    FUNCTION=Cogn-Sen-Mot-MemSt;

RULE 1
IF      BRAIN-SYSTEM=Limbic-System
THEN    FUNCTION=Rewrd-Attck-MemPr;

RULE 2
IF      BRAIN-SYSTEM=Hypothalamus-Pit
THEN    FUNCTION=Symp-Paras-GendDif;

RULE 3
IF      BRAIN-SYSTEM=Retic-Formation
THEN    FUNCTION=Arousal-MusclCoord;

ASK BRAIN-SYSTEM: "What is the value of BRAIN-SYSTEM?";
CHOICES BRAIN-SYSTEM: Cerebral-Cortex,Limbic-System,
                      Hypothalamus-Pit,Retic-Formation;
```

Figure 8

Prototype Brain-Behavior Demonstration.

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Press any key to begin.

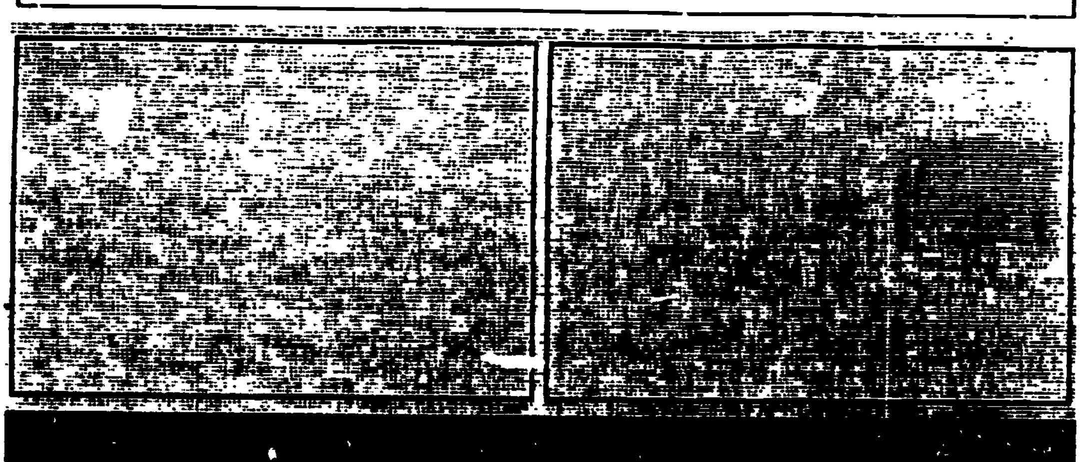

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Figure 9

```
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Department of Psychology
University of Windsor

Press any key to begin.
What is the name of the Brain-System?
Cerebral-Cortex          Limbic-System          Hypothalamus
Reticular-Form
```

```
RULE 0 IF
Brain-System = Cerebral-Cortex AND
Area = CC|Prefrontal AND
State = Activation
THEN
The-Function = Incr-Cognition CNF 100
SLIDE = Brain1 CNF 100

Finding Brain-System
```

```
↑ ↓ →   Enter to select   END to complete   /Q to quit   ? for Unknown
```

Figure 10

```
What is the name of the Brain-System?
Cerebral-Cortex ◄        Limbic-System          Hypothalamus
Reticular-Form

What is the name of the Area?
CC|Prefrontal            CC|Primary-Sens        CC|Primary-Motor
CC|Undetermined          L|Sept-MFB-VTA         L|Hyp-St-Amygdala
L|Hippocampus            H|Dorsal-medial        H|Ventr-lateral
H|Ventr-Pituitary        RF|Ascending           RF|Descending
```

```
RULE 0 IF
Brain-System = Cerebral-Cortex AND
Area = CC|Prefrontal AND
State = Activation
THEN
The-Function = Incr-Cognition CNF 100
SLIDE = Brain1 CNF 100

Finding Brain-System
Finding Area
```

```
Brain-System = Cerebral-Cortex CNF
100
```

```
↑ ↓ →   Enter to select   END to complete   /Q to quit   ? for Unknown
```

Figure 11

What is the name of the Area?

CC!Prefrontal ◄	CC!Primary-Sens	CC!Primary-Motor
CC!Undetermined	L!Sept-MFB-VTA	L!Hipp-St-Amygdala
L!Hippocampus	H!Dorsal-medial	H!Ventr-lateral
H!Ventr-Pituitary	RF!Ascending	RF!Descending

Is the area in a state of activation or inhibition?

Activation   Inhibition

Brain-System = Cerebral-Cortex AND
Area = CC!Prefrontal AND
State = Activation
THEN
The-Function = Incr-Cognition CNF 100
SLIDE = Brain1 CNF 100

Finding Brain-System
Finding Area
Finding State

Brain-System = Cerebral-Cortex CNF 100

Area = CC!Prefrontal CNF 100

↑ ↓ → Enter to select   END to complete   /Q to quit   ? for Unknown

Figure 12

CC!Prefrontal ◄	CC!Primary-Sens	CC!Primary-Motor
CC!Undetermined	L!Sept-MFB-VTA	L!Hipp-St-Amygdala
L!Hippocampus	H!Dorsal-medial	H!Ventr-lateral
H!Ventr-Pituitary	RF!Ascending	RF!Descending

Is the area in a state of activation or inhibition?

Activation ◄   Inhibition

PRESS ANY KEY

Brain-System = Cerebral-Cortex AND
Area = CC!Prefrontal AND
State = Activation
THEN
The-Function = Incr-Cognition CNF 100
SLIDE = Brain1 CNF 100

Finding Brain-System
Finding Area
Finding State

Brain-System = Cerebral-Cortex CNF 100

Area = CC!Prefrontal CNF 100

State = Activation CNF 100

The-Function = Incr-Cognition CNF 100

Interactive Videodisc Instruction (IVI)

Peter Richardson P.Eng.
Tayson Systems Inc.

Interactive Videodisc Instruction (IVI) allows you to extend the limits of conventional computer based learning concepts with the integration of random access video frames or sequences, with associated audio. IVI systems allow you to generate any combination of integrated computer graphic and video images to satisfy your training requirements.

The added dimensions of live picture and sound provide the student explicit feedback resulting from her/his answer. This may illustrate the:

a) simulation of operating a piece of equipment
b) diagnostic procedures within a medical environment
c) events or attractions in the immediate area

IVI provides two audio channels to select from, allowing bilingual delivery of information.

A videodisc can store 54,000 still frames or 30 minutes of motion video on each side of the disc and combined with a personal computer and authoring system, can generate innovative learning modules.

Hundreds of general information Videodiscs are available in the marketplace covering a wide range of educational topics.

An IVI authoring system allows you to use these general information discs:

a) to play the video in the order of your choice
b) overlay your graphics and questions on top of the video image and create training modules.

One such authoring system is VISION.

EASE OF USE, is the "bottom-line" of VISION.

Eliminated is the need to learn an authoring language; VISION emphasizes the design, development and delivery of training modules.

Menus and prompts guide you from initial frame creation through module design and publishing; NO previous technical experience is required.

The flexibility of VISION allows it to run on a variety of hardware configurations.

Included in the complete support for VISION is, initial training, full documentation, tutuorial, reference manual, customer service, maintenance and new releases.

VISION System features

General
- instructors can create full-color animated computer graphic images
- hardware and display independent graphics with text editor

Module Pages can:
- contain any combination of computer graphics, text and/or videodisc frames
- execute third party programs and control external hardware devices
- be randomly generated and check for partially correct answers or spelling errors
- work with a variety of input devices

Completed Modules and Session Files
- session files are created for all student input and reports are available to analyze results
- modules can be published and delivered by diskette, modem or network
- students can be registered to selected modules

Hardware Requirements
- IBM PC/XT/AT, PS/2 or compatible
- 512K memory
- 1 diskette drive and hard drive
- color graphic card and color monitor

Optional: Videodisc, Mouse, Graphic tablet, Light pen, touch screen. Please call us for the latest list of graphic cards, video overlay cards and video display systems that the system runs on.

A Method for Interactive Seminars

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University of Guelph

A widely-held assumption in university is that the seminar is not a suitable teaching strategy for lower-level students. Seminars are generally reserved for more advanced senior students (preferably honors students) or graduate students. Even here, complaints are often heard about the poor quality of oral presentations, the low level of participation in group discussion and lack of preparation. Several university educators have suggested ways in which the seminar might be improved (see Nisbet, 1966; Stanton, 1980?). However, such an improved seminar is still designed specifically for advanced students, so that "already clever students" may now learn "to be wise" (Nisbet, 1966:349). In this article I will propose an alternative seminar suitable for not so advanced students, to promote student development. The aims of such seminars are to get students more involved in the education process and to take more responsibility for their learning. In the process they will hopefully develop better analytical and critical thinking skills, which should also show up in their academic writing.

The seminar format to be outlined below was developed through a process of trial and error over several years of teaching second or third semester students at the University of Guelph. During this process of experimentation I was strongly influenced by the philosophy of learning and the specific workshops techniques developed by Cathy Foy-Schryer who was at that time the English language services coordinator. Her general approach could be summarized as a model of teaching as an ongoing dialogue between teacher and students and among students themselves. I started applying this approach in order to overcome a number of problems I had earlier encountered in the classroom.

In the past, only a student assigned to do a particular seminar presentation would do the required reading and he or she would then read aloud what usually turned to be a report that was too long. Apart from the occasional presence of already highly articulate group leaders, it was usually difficult to stimulate class discussion and other students would not ask questions. Most students felt that they "didn't know enough about the topic" or were unwilling to admit that they had not done the readings or would want to talk about completely different topics not related to the course. Even the student doing the seminar presentation would rarely express their own opinions or develop their own insights or criticism of the readings assigned for discussion. In the end, I usually ended up monopolizing or dominating the conversation or worse, slip back into a lecture mode. The seminars I run today look quite different.

A Sample Seminar

Most of my new seminar courses (or their seminar component) are based on a set of readings, consisting of anywhere from ten to fifteen articles taken from academic journals or chapters from readers. These are usually arranged in a logical or chronological order. The total number of students enrolled in such seminar courses ranges from ten to thirty (at most) and all students are expected to read all the material (like before). The format of the seminar meetings (1 1/2 or 3 hours), and the necessary preparation and follow-up work as follows:

I Prior to the actual class meeting

1. A student or group of students (no more than 4) are responsible for designing several questions related to the readings assigned for the next class. These questions are meant to stimulate discussion about what the article is about (its main theme), underlying assumptions and how the article related to other readings or topics covered in the course.

a. The questions are brought to class (to be handed out or written on the blackboard). The questions should ideally contain a blend of more specific and more general questions; of questions which are directly related to the article under discussion and others which go beyond the article.

b. The students are free to design their own questions but I offer to look at their questions beforehand (for clarification and assistance) and, if necessary (usually at the beginning of the course) I can also give them some suggestions or questions of my own.

II In the classroom (round-table style)

1. The class is divided up into smaller groups (or no more than five). Each group discusses one of the questions (or alternatively, one specific and one more general question).

a. The student(s) who designed the questions should ideally join each of the discussion groups. They are not required to act as group leaders, although they may need to clarify the intent of the questions if necessary.

b. The instructor leaves the room for about twenty minutes. The purpose of this is to give an opportunity for the students to freely express their ideas, ask questions and develop their ideas without worrying about being evaluated on the quality of their oral performance.

c. Any technical terms which no one can explain can be put on a place in the blackboard for later explanation, if necessary.

d. When the instructor returns to the classroom (everyone is usually talking), s/he may then circulate from group to group to join the discussion, answer questions or simply observe the group interaction.

e. An attendance sheet is passed around during the discussion (see later section of evaluation) and an honour system (plus peer pressure) is used to ensure that all the students have done their readings. It is expected that students usually bring a copy of the article in question to class (with pencil notes in the margins) or a piece of paper with notes or comments (for their own use).

2. About three quarters of the way through the seminar (or after a break), a spokesperson for each group presents a short 5 minute summary of their discussion (usually in the form of an answer to the question that was discussed) to the rest of the class.

a. The instructor acts as moderator or chairperson.

b. The answer does not have to be unanimous; some groups may want to report on differences of opinion or disagreements.

c. Ideally (depending on time constraints) the answer or summary should be put in writing. Alternatively, one of the people who originally designed the questions for discussion could take notes.

d. There is some flexibility in who makes the brief oral report on behalf of the group; it could be one of the people who designed the original questions or each group could appoint a different spokesperson for every week. Ideally everyone should have a turn doing this sometime during the course.

3. Again, depending on the nature of the group dynamics, scheduling and time constraints, some time might have to be set aside at the beginning or the end of the class to allow the 3 or 4 students who designed the original questions to get together to coordinate or consolidate their efforts.

III After the seminar meeting

1. The original group of students who designed the questions for group

discussion are responsible for preparing a two or three page report or outline, summarizing the article and also going beyond the article (criticism, analysis or relating the article to the broader literature)

a. This must be group effort; the students may work individually and then amalgamate their individual reports, they may want to divide up the work (each do a section) or even write a majority and a minority report.

b. The format is flexible. I usually recommend the use of headings and sub-headings and will allow point-form sentences as long as the introduction and conclusion (or final critical comments) are done in proper paragraph format. Sections of the report may also be written in the form of a dialogue between two or more real or hypothetical persons.

c. The content is flexible as well. The students are free to either incorporate or ignore the insights provided by the class discussion (they are not expected to prepare a set of minutes) and are encouraged to be creative in the manner in which they write their report <u>as long as</u> they include a concise summary of the article and also go <u>beyond</u> the article in some fashion.

2. A type-written copy of the seminar/article report must be ready within a week (or ten days) for distribution to the rest of the class. This report is the outcome of a group project (if 2 or more students work together), but, in a sense, it is also a group product since the entire class contributed to this report through their input and discussion.

a. A rough copy of this report must be handed in to the instructor first, who then provides feedback, including editorial comments. I do this on a word processor and I usually prepare anywhere from

one paragraph to a full page of comments. Each of my comments corresponds to or refers to a number I put in pencil in the margin of the report. My role is thus one of editor who has to be critical but at the same time respect the written work handed in.

b. I am willing to give feedback on the first draft of either a single group report or on individual reports (with suggestions as to how they should be amalgamated).

c. The student(s) then go back to the drawing board and produce a polished final version, suitable for distribution to the rest of the class.

This whole cycle of question preparation, group discussion and final report writing is repeated every week until the end of the course (or a segment of a course). At the end of the course, each student will not only have read and learned the material in each article but they will also have a set of reports which they can use for future reference or to help them prepare for a final individual assignment, which could take the form of a take-home exam.

Method of Evaluation

Students are not formally evaluated (graded) for designing their questions, for the quality of group discussion or for the first draft of their report. In each instance, however, I give lots of feedback in terms of critical comments and suggestions for improvement. The final group report (done by one or more students) is then given a mark (let's say out of twenty). In addition, every student automatically gets a mark based on the attendance sheets handed out during each seminar. However, I make it quite clear that this is a participation mark (including preparatory reading), not a mark for just showing up. Students are told they should not attend class if they have not done the necessary

reading, because they are expected to come prepared to discuss the article and ask for further clarification. This does not mean that the student is expected to fully comprehend each article (this comprehension is one of the purposes of the seminar discussions). An individual student grade is also given for a separate, final assignment (a final exam or paper).

The philosophical principle underlying this method of evaluation (as well as the entire seminar format) is that students should be encouraged to learn to think through practice and group interaction. I believe that students should not be penalized for expressing initial doubts or for "making mistakes" in the process of learning how to think for themselves and to write in an academic setting. For this reason I prefer to use the distinction between evaluation (feedback) and inspection (final grading) made by Paulo Freire (1972), a Brazilian educator. This distinction is similar to that between formative and summative evaluation used by many educators in North America. The task of the teacher (even at the level of university) is to help the weaker or less advanced students to fulfil their potential. This is why I do not assign numerical grades for first copies of the final report or the quality of group discussion. Even the grade for the final draft of the seminar report is subject to upward revision if the student's performance shows noticeable improvement by the end of the course. At that time only, do I decide whether a student is worth an A, a B or a C (or less).

Summary and overview

The seminar I have outlined was the outcome of a lot of experimentation which involved false starts and many errors. For example, initially I did not provide enough structure for the seminar discussions nor sufficient feedback to ensure a good quality seminar report. Some of the techniques I use (for example, having students design their own initial questions) came from sugges-

tions made by students themselves. No doubt there is room for further innovation; for example, I might try to get the students to take over some of the responsibility of editing each other's work. The special needs of each class and the nature of the subject matter might also require a slightly different approach. I recognize that the method proposed in this paper might work better with more mature students or students who are already committed to the subject of the course. If fact, my most successful run was a course I gave at Atkinson college (York University) for a group of students in continuing education. However, I have found that even students who did not take my seminar courses out of choice appreciated the opportunity to take a more active role in the process of learning.

Other instructors may have to operationalize the general principle of active learning and interaction (between instructor and students and among students) in other ways. My model seminar is only an example, not a ready-made recipe that could be applied to every situation. I certainly cannot guarantee that any method using the general principles I have enunciated will be less time-consuming or enabled one to teach bigger classes more efficiently. However, I found that my teaching became personally more rewarding, even though it often took more time in planning, organization and providing feedback. I especially advocate my approach for those interested in student development. The more advanced students can easily learn on their own and don't need constant feedback and encouragement. They don't really require good teachers -- only a knowledgeable resource person and an efficient library.

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Chess in the Teaching of Critical Thinking

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An important component of critical thinking is the capacity to perceive logical relationships. Can this capacity be schooled or is it entirely a function of native intelligence? The present paper is predicated upon the assumption that schooling is possible based upon either of two methods: 1. the application of mechanical techniques such as Venn Diagrams, truth-tables, etc.; 2. puzzle-solving. The first method must be used wisely else it might cripple the ability to discover logical connections without mechanical crutches. The second method counteracts reliance upon rote procedures, since a good puzzle invariably calls forth a certain degree of "creativity" on the part of the solver.

The present paper is concerned with the aesthetics of puzzles, an important matter from the pedagogic viewpoint. It is most important that students should not equate the idea of a puzzle with the idea of a difficulty surmountable only by superior intelligence. To be sure, difficulty in some measure is the sine qua non of a puzzle. But a puzzle is also a thing to be enjoyed; and this enjoyment, if stressed in the right way, can be a powerful motivator in the teaching situation. From the standpoint of enjoyment, chess puzzles ("problems" is the term preferred by afficianados) have particular advantages and, when introduced innovatively in my course, Critical Thinking (Philosophy 74-210), met with enthusiastic student response.

I believe there are two main kinds of aesthetic "payoff" from solving puzzles. The one kind I call, following Martin Gardner (1) the "Aha!". The other, and perhaps more significant one, I call "intellectual beauty".

Most puzzles reward the solver with an "Aha!" - a moment of thrilling and sudden revelation. For an illustration consider the chestnut, "Brothers and sisters have I none, but that man's father is my father's son. Who am I?" It is an "Aha!" to realize that since the speaker in the puzzle has no brothers he must himself be his father's son. I.e., from the speaker's standpoint, my father's son = me. (It is clear at once from this "Aha!" that the speaker can be identified more specifically as the father of "that man".)

In a chess problem, the "Aha!", while certainly present, plays a subordinate role. The main aesthetic value embodied in a chess problem is intellectual beauty. Intellectual beauty is based upon tasteful exploitation of theme and variations. It is similar to the beauty found in certain art forms except that the medium of expression is pure thought. There is a complex network of logical relationships, but the complex is held together by one or more motivic ideas. For instance, there may be several distinct variations (a variation, in the context of a chess problem, is a sequence of moves resulting from a particular Black defense to White's initial or key move) all of which exemplify the theme of Grimshaw interference - the mutual interference of rook and bishop. I daresay the pleasure in apprehending this sort of unity-in-variety is something like the pleasure of listening to good jazz or perhaps a Bach fugue. Students, after a modicum of training, are quite capable of appreciating a fine chess problem and feel enriched for doing so. The intense activity called forth by solving gives one the feeling of recreating the same exquisite pattern created by the composer, and this can be an intensely absorbing experience. It is an experience which counteracts intellectual passivity in the strongest possible way.

One excellent way to present chess problems in the classroom situation is by means of a demonstration board. Such a board measures about 68 x 81 cms. and is clearly visible even in a large classroom. A board, complete with pieces, costs about $20 and is obtainable from the Chess Federation of Canada.

(1) Martin Gardner, Aha! Insight (New York City: W.H. Freeman and Company, 1978).

Applying a Computer Based Spatial Analysis System in a Studio Teaching Format

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INTRODUCTION

New computer technologies have been developed to assist in thelandscape planning process. Increases in the power and theaffordablity of microcomputers, coupled with new sophisticatedsoftware has improved the accessibility of the new technology for research, education and practical application purposes. In the School of Landscape Architecture new computer-assisted planning technology has been acquired with the past year for research applications. The purpose of this study was to explore the ways and means to move the technology from the research laboratory to the teaching studio in landscape planning.

THE TECHNOLOGY

The School of Landscape Architecture at the University of Guelph was fortunate in 1987 to receive a grant to purchase a state-of-the-art Geographical Information System (GIS). A computer based GIS provides the tools for collecting, storing, retrieving, transforming, displaying and manipulating spatial data from the physical and social environment for a variety of purposes. Following an evaluation period, a microcomputer based system called Spatial Analysis System (SPANS) developed by Tydac Technologies Inc., Ottawa, Ontario, was selected.

SPANS relatively user friendly command menu allows access to powerful analytical functions, including multiple map overlays, proximity analysis and spatial modeling. The system can integrate data from many sources and will interface to most major GIS's. Satellite imagery can also be incorporated for use with other data bases. SPANS operates on the AT/386 DOS-based microcomputer family. SPANS utilizes a quadtree data structure which allows for the computational abilities associated with raster format systems while allowing for a resolution approaching vector based systems that will run effectively on a microcomputer.

APPLICATION IN EDUCATION

In Landscape Architecture, much of teaching process in planning and design takes place in a studio environment. Students have the opportunity to apply theory, methods and technology in solving real planning problems. In Winter Semester, 1988, it was decided to integrate the SPANS GIS into a graduate level course, Regional Landscape Planning Studio. In addition to the normal requirements of the course, the students were to learn and apply the new GIS technology to the planning process.

The output of the student work has been published, Eramosa Township Study, and includes regional analysis in determining:

1) Rural residential development potential
2) Natural area conservation
3) Cultural landscape values
4) Small-scale intensive farming potential

The analysis work was done by building a computer-based series of biophysical maps that were manipulated through map overlay processes involving suitablity and conflict models. The students conducted their analysis within the context of retaining the existing prime agricultural land. (The models and map outputwere illustrated at the "Show" portion of the conference.)

Jo-Anne Bennett, a graduate student in Landscape Architecture, used the class as a subject for her Integrative Project, The Development of an Educational Approach and User Guide Notes for the Spatial Analysis System. Her study examined the methods for learning and applying SPANS and make observations on the student progress.

EVALUATION

Bennett's study and the teaching evaluations revealed a number of benefits of integrating the new GIS technology into a planning studio teaching mode. The students appreciated the exposure to state-of-the-art technology that is rapidly gaining acceptance in professional practice. The powerful analytical capabilities of the system allowed the students to extend their analysis beyond the normal limits imposed by a course of this time period. The GIS model building process forced the students to apply rational, defensible thinking to problem solving. As well, SPANS provides a hardcopy of the mapped results in color which is suitable for inclusion into a final report, thus eliminating the need for conventional drafting.

The disadvantages include the effort required to learn the GIS technology which displaces the time available for analysis and planning. This can be further complicated by the fact that students may not be experienced in using the disk operating system, editing programs or data management packages. As well, a digitized data base is required before computerized modelling can be undertaken. Due to the extensive amount of material to be adsorbed in a thirteen week period, a higher level of instructional support is required to insure that all students keep up with the class schedule.

Based on the experience in the classroom and Jo-Anne Bennett's study, the following recommendations have been made for conduct of future courses:

1) Computer literacy- a minimum level of computer literacy in MSDOS, word processing and knowledge of the principles of data management are necessary before students attempt using GIS.

2) Support- adequate teaching support is required in a high technology course of this type. This would include a GTA or technologist familiar with SPANS to assist the students.

3) Computer work stations- Adequate SPANS work stations are required during studio instructional periods. One station per four students would be the maximum.

4) Teaching modules- The vendors user manuals are not adequate for instruction. Teaching notes to supplement the technical manuals and sample and/or demonstration data bases are necessary to assist in the initial instruction on the system.

An Experimental Approach to the Study of Policy: Selected Issues

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For the last dozen years or so, faculties of education in North America have offered doctoral courses in policy for schools -- initially with attention to the standard (and to some extent, misleading) stages of the public policy process -- formation, implementation, and evaluation. Lately, if the literature of this field is any indication of what is actually being discussed in classes, interest also exists in policy analysis, in the meaning of "public interests", in justice and rights while making policy choices, and more. In a sense, all these courses are experimental in that this policy field is young enough that no agreed-upon or traditional way of proceeding exists.

At my institution, I have introduced such a course, but not without facing four issues that I would like to share with you today. My concerns include 1) the course's congruence with other required courses with a Department, 2) the specificity of the course's objectives, 3) the amount of readings, and 4) the learning modes. These issues are hardly innovational -- surely everyone here has dealt with them in their own teaching. So, my hope is that our experiences are common enough along these lines that, different as our work contexts may be, we might profitably share resolutions to these matters.

Issue 1: How should a course relate to other courses in a program within a presumably unified Department?

If synergy is a prime goal -- and texbook-writers sometimes claim it is for policies and for departments like mine (of Educational Administration) -- one prescription is that plans at any one level ought to relate to plans at other levels. Thus, a policy course should work in tandem with, or supplement, other doctoral courses in a Department and, at even a higher level, with courses elsewhere in an institution. In my case, I have gifted professorial colleagues who work energetically, resourcefully, even brillantly to help students understand the philosophy of science, the ideological contexts, and the modes of research on school organization -- and organization is the key theme, as that focus almost has become our Department's raison d'etre. Courses with other orientations exist in my unit, but they do not flourish as much as those about organizing schools.

Simply put, my approach towards tieing-in with other courses in my small Department is simply to treat the politics and organizations of educational policy delivery. Although my students and I do explore the environment in which organizations operate, the prime focus is on educational policies and the organizations through which they are delivered.

I'm not sure that this connection is enough, however. Perhaps greater coherence might be achieved if I were to assign the same readings as my colleagues, thereafter working over those core materials with a special policy/political perspective. Our doctoral students, who complain of having to read 500 pages per week per course, certainly would appreciate that approach, and the jointness of our lessons could be truly impressive.

A seasoned coordinator of our program has discouraged me, however, from doing that. Faculty are expected, he says, to have different specialities, texts are expected to reflect those differences, and most importantly, professors relish the autonomy to assign whatever readings they want, without benefit of coordinating committees. The integration between courses goes on, this colleague tells me, "in each student's head" and as each of these students answer questions on our annual comprehensives. So much do I regret that this exam is the only formal experience at synthesis our students have across all their courses that I almost wish I had the energy and skill to persuade my colleagues to work together on some sort of teaching-learning venture (perhaps a workshop over a term? perhaps a fortnight-long blitz activity in April?) whereby students and faculty come together to publicly draw upon all our assorted teachings and learnings.

(1) This paper was prepared as the "tell" part of a "tell and show" entry for the Second Higher Education "Innovations in Teaching" conference at Guelph University, April 20, 1988.

What we do have, though, is an informal synthesis -- some of those other professors' ideas are so compelling and so dynamically taught that students bring them into discussions during my classes and, to a lesser degree, into papers for my course. Still more term-paper writers would exploit additional other-course ideas, I suspect, if we professors explicity were to welcome such inter-textuality. The rub, I submit, is that the usual student knows that chauvinism for our own domain prompts most academics to value term papers which preeminently work-over our own materials. On the assumption that boundaries between specialities can be paralysing for someone who would understand situations and try to help solve them, is there anything we teachers can do about this?

Issue 2: What sort of understandings should be cultivated?

To answer that question in my own milieu, I asked myself, "why policy?" Part of the current popularity of policy courses, I believe, stems from their being seen as possibly helping educators meet the increasing demand for accountability, for coping with situations in ways that realize the goals that elected boards have adapted for accessible education of high quality.

One approach then would have been for my class to study at some length the accountablity movement. Yet I chose simply to offer an early mini-lecture on that theme. More importantly, I tried to capture that timely emphasis by using a hallmark of the accountability movement, the learning objective.

I can recognize an admirable openness in the objective that is stated quite generally -- in a sense, students can be "romanced" as they imagine their own version of what is to be learned. Nonetheless, I hold that a policy course would lack fidelity to the accountability thrust if it offered objectives that were fuzzy as these two (which I have seen in policy syllabi of professors at other universities):

1. To familiarize students with the major conceptual bases and research trends in educational policy
2. To promote the application of a policy perspective as a way of understanding decisions in educational organizations.

So, rather than going with such catch-all objectives, I set down some sought-for "competence expectations." These reflect objectives that I have long valued for learning about policy generation, the forementioned policy cycle, and argumentation:(2)

A. Generating Policy Alternatives To Improve Education:
1. Understand and be able to evaluate policy documents for their judiciousness and impact for organizations.
2. Be able to conceptualize, acquire information, forecast, objective-set, present options to clients, and design strategies for easing future policy succession and termination within and beyond organizations.

B. The policy cycle and educational organizations
1. Understand the educational policy cycle and the need for policy analysis within school systems.
2. Understand the reasons for competing values in educational policy and the importance of "value-critical" policy analysis.
3. Understand the reciprocal relationship between educational policy, the policy cycle, and educational organizations.

C. Argumentation and Communication within Organizations & The Environment
1. Be able to sort out propositions that are "interesting" and non-interesting.
2. Be able to make sophisticated policy arguments in a variety of modes.
3. Be able to critique lazy or ineffective writing and to write with clarity.

I have also taken advantage of syllabi of colleagues whom I suspect (from their writings and from my observation of them at paper presentations) to be role-models in their own teaching of the accountablity thrust. Put another way, to supplement my objectives, I adapted certain ideas of two fellow-academics, one in Pennsylvania, the other in California, whose writings I have very much respected. (My hunch is that much borrowing of this sort goes on in teaching "innovations.") The result was the inclusion of two more rather specific expectations as objectives:

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(2) Frankly, you will see here - I might as well face up to it - a certain touch of social engineering, even of technocracy, which I take to be a part (but definitely not all) of the character of policy studies for planners and managers. Foc the sake of balance and synergy in our program, this is a knowing contrast to the orientation of my more philosophical and issue-oriented colleagues who teach doctoral courses in my Department.

D. Alternative models of policy inquiry and policy models

1. Be knowledgeable about the characteristics, strengths, weaknesses, and uses of alternative models of (and approaches to) policy inquiry and analysis.
2. Be knowledgeable about the characteristics, strengths, weaknesses, and uses of alternative models, approaches, and ways to deal with issues.
3. Be able to use Elmore's concept of backward mapping in developing policy proposals based on research.

E. Governance

1. Understand the policy interactions between top-level administrators and elected officials at thelocal and provincial levels.
2. Be able to explain and contrast alternative theories of innovation and implementation in school districts.
3. Be able to discuss impediments to organizational reform and possible ways of overcoming them.

Responsiveness may be one of the best qualities about a lesson's dynamics, and so consistently I have to wonder: by opting for a specific focus with 5 major competencies that encapsulate 14 particular components, have I frozen out a certain amount of over-the-course flexibility? How have some of you provided sufficient leeway for your classes to look at other topics besides the ones you want to concentrate on?

Issue 3: What is the appropriate amount of required reading?

Generations ago, one of my professors, the humanist Lewis Mumford, used to claim that long reading lists were not essential. He valued term papers that had just one bibliographical reference, if the student had carefully and insightfully pondered that single source and if the student had himself or herself tracked down that article or book. Somehow today, however, I sense that things have changed -- students, expecting to be exposed to the important works in "the field," seem to expect us academics to choose the bulk of the readings. In my policy specialization, though, the literature is so extensive that even if students were to read during a term until their eyeballs fell out, they would only begin to scratch the surface of the available good readings.

My accommodation has been to give them, for future reference, a heavy bibliography and during the course itself to emphasize a) two texts (one looking at policy research and the other rather pragmatically considering components of the policy process), b) about a dozen or so dissertations on educational policy, and c) about 8 other articles. I think this bill of fare introduces policy learners to various dimensions of the (to say the least) eclectic literature while speaking to the assorted "competency expectations" above. I also think this background prepares each of them to present in class (for a written/oral assignment) a perspective on one substantive policy area.

As it usually turns out, about 400 pages are required to be discussed for each session. Roughly, I calculate that this total is commensurate with the sometime graduate-school norm that one has three hours of reading for every hour of class. But even for our full-time students, is this allocation too much? not enough? My colleagues at other universities in this general domain require an average of one text and 18 other articles. (3) Generally, that sum is for master's rather than doctoral courses, but the thought lingers: I may be expecting too much time to be spent over the books -- especially since my students typically are not indefatigable youngsters but sabbaticalling administrators in their 30s and 40s (or, occasionally, their 50s), with families and other routines or pulls away from the university. What to do?

Issue 4: To what degree do the learning "modes" facilitate the sought-after competencies?

Besides lectures, paper-writings, tests, and discussions, probably most of our courses involve various other modes of learning and idea-exchange. I would like to mention here three such "other" formats for promoting inquiry. (4) One is more or less original while the other two build upon the innovations of others.

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(3) See Richard M. Englert, "Portrait of the Politics of Education Field: What Is Written." for an analysis of syllabi for courses, paper presented at the 1987 annual meeting of the American Educational Research Association.

(4) In another place, I have written about a fourth mode for this policy course, and so will not repeat here the end-of-term procedures for trying to motivate students to apply all the course's learnings to a practical problem that they define (with starting points provided by me). See "One Way To Train For the Problems of Administrators." ERIC file number ED 208 473. For a discussion of issues with this approach, see Tom Roby, "Cultivating Habits of Deliberation." in Journal of Curriculum Studies, 1985 or ERIC file number EJ 319 056.

The sub-issue that I identify with each of these modes may be similar to concerns that you have faced in matching pedagogical or androgogical techniques with your bodies of knowledge.

Sub-issue 1, involving The Dissertation Defense

Even my "original" mode borrows from another occasion -- the oral defense of a recent dissertation. To learn about policy while being pseudo-socialized to that ultimate assignment of the program, I ask each student to project themselves as the author of one dissertation (which, for the sake of breadth, I usually select). In part, my instructions go like this:

> Consider that you are covering and defending the dissertation before a group of faculty examiners. Be positive about "your" best points and highlights. Say in your own words how they fit into what's generally known about the field.
>
> Then be prepared to be asked harrowing questions about "your" investigation by a random number of the rest of us, posing as faculty examiners. Having also read the dissertation, each of the other class participants should be prepared to raise at least one discerning question with you (our questions are to be different from week to week). We'll have an intellectual justification for our questions too, and we should be prepared to relate the dissertation at hand to the themes on policy research in our text by Paris & Reynolds, Logic of Policy Inquiry. Finally, after this "bear-pit" experience, you -- this time as yourself -- can offer your own pleasures and reservations about the dissertation and its interestingness. Start to walk out of the room if we dawdle for more than 35 minutes on any one of these.
>
> At our second session, I'll role-play the part of Graham Orpwood defending his dissertation on the deliberation of curriculum policy.
>
> As you review these dissertations, observe how the authors introduce their problem, what they coordinate and subordinate, how their methodologies are congruent with their questions, how they write their last chapters (something of an arduous task), and -- not least, since (for one assignment) you'll be writing one yourself for this course -- how they critically review their literature.

Pros and cons of this particular approach should be mentioned On the plus side, I believe that this process can increase the student's sense of what dissertations, not just on policy, are about. I also believe that this process is reflective of the deliberation process, whereby different interests question each other about the diverse goods and services that are to be served by a policy. On the negative side, the student examiners can ask too-easy questions of student-defenders, anticipating a time when (in exchange) their former interrogators ask them "snap" questions too. An even bigger drawback or strength to this mode is that the task is something that students have not done before, and it requires a little risk-taking.

An issue with any activity is how much time to give it? I sometimes worry that I may trying to squeeze too much into a course, not allowing sufficient "soak in" time for students. But instead of asserting that concern as my sub-issue for this mode -- pacing could be a sub-issue for any mode -- let me refer to a particular consequence of the Dissertation Defense role-play. Taking that risk of format has been an issue for only 3 out of about 65 students. In different years, those 3 individuals chose to simply present a conventional seminar on the dissertation they had been assigned. Instead of putting searching questions to one student "candidate," class-members followed those 3 presentations with observations about the research. Those seminar-like discussions were fair (not outstanding) in quality, but years later, when they finally completed defenses of their own dissertations, these same 3 students still did not fully connect with their real examiners' questions. My sub-issue then is: should I have had such an "escape hatch" for the 3 recalcitrants, or should I have leaned heavily on them to develop some familiarity with a process that was new and therefore stretching for them? Might I have done more to habituate them to the give-and-take of deliberation, dissertation-evolution, and policy? The broad question is, even though one tries to provide a climate of supportiveness for the assumption of new roles, how far can a teacher nudge students to do what they have not done before?

Sub-issue 2, involving The Writing Lab (5)

As indicated in the list of competencies above, improved writing has been an intrinsic goal of this course - I hope this investment eases students' progress in writing policy reports in their professional life and through that difficult dissertation challenge, writing. So, in short essays, students take stands on policy articles. This approach is a greatly abbreviated and directed version of an approach developed by Cadwallader and Scaboro. Through the syllabus, I take a more directive role for in-class actions:

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(5) See M. Cadwallader and C. Scaboro, "Teaching Writing Within a Sociology Course: A Case Study of Writing Across the Curriculum," Teaching Sociology, 9 (4), July, 1982

1. For our second class meeting, everyone should read a short section (on cultivating interest) from a book by Karl Weick. It will seem a bit far-out, and you may sharply disagree with it, but from time to time the instructor will return to its themes. A 130-word think-piece, in comprehensive academic language, should be written in reaction to this excerpt. Later in the course and on various assigned days, each should write a 1-page (about 225 words or so) reaction for 3 of the 7 remaining pieces on educational policy. Thus, while reading 8 pieces for this part of the course, each student should write a total of 4 reactions, the one on Weick being a half-page long and the other two being a page long. (Please, do not prepare more than a solitary 1-pager for the same day of class.)

How to proceed? For the Weick essay and three of the 7 other Lab sections, the student should first indulge in freewriting, i.e., unedited, unoutlined, unthreaded reactions to the material. Somewhere in the several pages of this rough freewriting, a generative sentence or phrase will pop up. It should be a pushy and powerful thought, and the writer should organize her/his reaction to the assignment around that generative notion. Extensive rewriting will be necessary -- we're not interested in seeing your first drafts. So, with Strunk & White's style guide (or another style book) in hand, the student should prepare a reaction to the assignment (typed please). Using the Department's xerox facilities, the student should give a copy of this reaction to every member of our class (the instructor included) by 1 p.m. of the Tuesday before our Wednesday class when that article will be reviewed. (Please adhere to the dates on our calendar, attached, i.e., don't "do" a paper that we've already covered or distributed to each other at other classes.) These reactions of yours can be put in our individual Department mailboxes or distributed to each other at other classes.

2. Each of us should read, and jot notes on, all the one-pagers prior to our meeting. Because some preparation time for this is required for sense-making, circulating papers after 1 p.m. on Tuesday is too late. (I regret having to enforce this ground-rule.)

3. At the inception of each writing lab, the instructor will appoint a chair. At that person's bidding, all will read their paper, or a portion of it, aloud. As this process can be a bit like taking one's clothes off in public, the chair not only needs to keep proceedings moving (while discouraging repetition), but to empathize with the naked writer in each of us. If the proceedings are not moving along briskly enough, the instructor ruthlessly will have to step in. The chair should not let people waste our class time by "me too" speeches, as a reader repeats reactions that the writer has already heard.

4. After each reading, the chair will call upon the rest of us to take 1 minute to tell the author, straight on, the impact of his/her paper. As a reader/hearer, offer MUSINGS on the following points:

a. The highs and lows. Say what were the loud words or phrases that jumped out, that stick in your mind. What struck you as soft or weak? Did you feel peaks and valleys? Were there sinks and sources of energy, cold and hot spots? Was the writing flat or bumpy? What "got through" to sustain your attention? Frankly, what didn't?

b. The internal churnings. Give the writer a stream-of-consciousness account of what went on inside you mind during the reading. If you were thinking about something else tell about it. If the writing made your mind wander, the writer needs to know. Consider that a kind of movie is going on in your head connected in some mysterious way to the reading. Inform the writer about that film. Is the movie in your head also the writer's movie?

c. Putting words in the writer's mouth. Simply describe what you think their essay is trying to accomplish. Do not say that the writer succeeded or failed; instead, say what you think he or she tried to do. Then succinctly retell the story in your own words.

d. Stylistic violations of Strunk & White (or of other guides) can be mentioned, but let's not dwell on these.

5. If, after all others have had their say, each author wishes to comment on comments of our group, he or she can respond. This is voluntary and because of time constraints, we probably will be relieved if the writer usually passes the chance by. In any event, we are not interested in elongated defenses from the writer -- at the most, a crisp 45-second reaction to the reactions can carry the day.

Usually as we conduct the initial Writing Lab, the atmosphere is a little tense. But, before long, students seem to "take" to this initiative, the first time in years (some say) they have received close, sensitive criticism of their writing. While the process seems to work without such a complete involvement of the instructor, sometimes I complete the essay-writing assignment too, and welcome musings (which have been helpful) about my communicating too.

An issue involves scheduling of this feature. For a small class of about a dozen, we find ourselves spending 30 to 45 minutes over four or five weeks so musing about the various policy essays. Cadwallader and

Scaboro, the inventers of this approach to feedback on writing, urge that Labs be conducted outside the classroom at various students' apartments, at night, with attendance not required. I have never tried that scheduling, out of fear that students would resist the extra meeting time -- a few commute home every night 75 kilometers or so -- but perhaps such a mutual-aid technique in off-hours would attract the most committed? How far can the instructor go in urging students to get together outside of class so that one person's iron sharpens another?

Sub-issue 3, involving The Majority Vote Quiz (MVQ)

Four unique tests are given, but the "marks" are known only to the test-takers themselves. Here again I am adapting, this time Bertil Hansen's suggestions for developing students' abilities at persuassion, (6) which I see as important for success in the policy process. Hansen proposes that the instructor develop each of a certain kind of test, but I only develop the first of this series, leaving it to teams of students to develop the rest from chapters in one of our texts. I believe that the quizmasters learn as much (maybe more) from the exercises as the test-takers.

All the tests are multiple-choice, xerox copies of which are distributed by the responsible team. Test-designers are to take great pains to make sure that their answers are all equally plausible and justifiable. Test-takers identify answers that they believe the most correct.

The quizmasters then lead our class through their questions, one by one. These quizmasters ask for "the" answers and if our responses are ones to which no one objects, they will be pronounced correct without further ado. But if two or more answers are put forward for the same question -- and they almost always are -- quizmasters call for reasons warranting those selections,. As test-takers supply their reasons for preferring one reply over another, quizmasters listen attentively; they taken note of advocacies that are especially compelling. Once all reasons for different answers have been advanced, quizmasters permit a class vote; the choice with the most votes is counted as "correct." Typically, votes shift -- I know my own vote as a participant does -- test-takers often are moved by the logic of their colleagues.

Quizmasters also can award "martyr points" to those test-takers who muster thoughtful answers that are out-voted. Quizmasters are not to award these points just because they regard the out-voted answer as correct, as that would remove an incentive for earning martyr points. Rather, these points are the quiz-masters' means of mitigating injustices done by the majority in overall contexts of in-class dialogue. Further, martyr points are to create incentives for some students to speak up who might otherwise be intimidated by the apparently overwhelming disapproval of their classmates. These points are parcelled out stingily, just as one would apportion any scarce commodity.

For the final two tests, I supplement Hansen and complicate the process, drawing upon a chapter from William Dunn that details "Modes of Advocacy."(7) I assign students to include, as they justify their test answers, a mode of advocacy that they have seemed to under-use in previous sessions. Thus, a student who has been strong in arguing from authority (the "expert" text says so) or value (with an ethical claim about rightness or wrongness of matters)) will be expected to argue pragmatically (from a parallel case or analogical similiarites among relations), or explanatoryily (with a cause-effect relationship), or intuitively from an inner mental state of "tacit knowledge, or analycentrically (arguing from the validity of methods or rules), and so forth. I hand out these assignments the week before so that students have a chance to re-familiarize themselves with aspects of these modes, as described by Dunn. (Elsewhere in the course, they also use these formulations of Dunn.)

By having the students design the tests, the instructor can see what they regard as important and, if appropriate, offer counter-statements or edifications. This process seems to spark involvements with the assigned texts, and discussion often is lively. One slice of evidence, already alluded to, that this approach "works", at least in part, is that this Dunn framework occasionally helps to structure papers that my students turn in to other professors. But there is something of an issue here too: I'm not sure that Dunn's analysis is accepted as true scholarship by a few of those colleagues, however -- a suspicion exists that advocacy is something bereft of a deep (and becoming) theoretical framework. In higher education, how much craft is apt?

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(6)See B. Hansen, "Adventures with the MVQ," Teaching Political Science, 5 (1), October, 1977.

(7) Chapter 4, Public Policy Analysis, Englewood Cliffs: Prentice Hall, 1981.

A RECAPITULATION

Four questions have been raised about one professor's teaching. In effect, I have asked

1. How should a course relate to other professors' teachings in a program within a presumably unified Department?
2. How specific should we be about the sorts of understandings we set out to cultivated?
3. How much reading is appropriate in courses of different levels?
4. To what degree do our learning "modes" actually facilitate the objectives that we have?

I tried to illustrate elements of that last question by describing three modes that I employ, which themselves can be associated with sub-issues such as these: How far can a teacher go in nudging students to do what they have not done before? How can an instructor go in urging students to get together outside of class so that one of these person's iron can sharpen another? and, In higher education, how much craft or emphasis on tehcnique is apt? While my illustrations have been of a particular policy course within one Department of Educational Administration in a certain professional school, in our conversations I hope that persons outside that milieu might be willing to raise questions as well as share insights and experiences that address those concerns.

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PREFACE

The following is a quotation from page three in the 3rd edition of "Measurement And Evaluation In Teaching," written by Norman E. Gronlund, who is a Professor of Educational Psychology at the University of Illinois. The book was published by Macmillan Publishing Co. Inc., New York.

"Evaluation includes a number of techniques that are indispensable to the teacher...However, evaluation is not merely a collection of techniques - evaluation is a process - it is a continuous process which underlies all good teaching and learning."

WHAT CAN THE COMPUTER DO?

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The word processor/computer can produce multiple choice tests and studyguides based on a number of resources that may be:

a) Directly related to a specific book, chapter and unit of study, as required.

b) Based on booklets, as for example, the Ontario government publication "Marriage As An Equal Partnership" - A Guide To The Family Law Act..

c) Based on employer's manuals for in-service training.

d) Based on case-studies, charts, diagrams or financial state-ments.

You may prescribe scales of taxonomy both in the construction of the questions and in the construction of the statements that make up the questions. The gradations of taxonomy approach infinity.

You may specify the percentage of statements to be taken from any unit of study and thereby "weight" the tests or study-guides.

A copy of the test or study-guide may be printed showing the questions, the answers, and the source of each of the state-ments which form part of the questions. This copy will identify the book, chapter, unit of study, and statement number.

A second copy of the test will be printed showing the questions without answers or sources.

By using permutations and combinations the potential number of questions and tests approaches infinity.

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ADVANTAGES, DISADVANTAGES AND CAVEATS RESPECTING COMPUTER TESTING

1) Valid testing is the sine qua non of effective teaching and it is therefore important to assess the validity of multiple choice tests created by word processors/computers.

   Professor Gronlund compares the multiple-choice form with other objective-type test items, and generally prefers the former. He also confirms the validity of the multiple-choice form as a measurement and evaluation tool. Comparisons made between the results of essay-type tests and assignments and the multiple-choice form show that students who scored well on the former, scored equally well on the latter, and vice versa.

   We should also recognize that not all skills or achievements can be effectively measured by using either or both methods exclusively because clinical observation and evaluation may also be required.

2) Computerized testing and learning resources should not be adopted to the exclusion of other methods of testing or of other pedagogy generally. There is a real danger that the economies which this type of automation will provide, may be used by some administra-tors to reduce costs at the risk of reducing quality. By the same token, some teachers may choose to reduce their workload at the risk of reducing quality.