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Effective Use of Computer Graphics in CAI: A Review of the Literature

Gina Siliauskas

Abstract: Computer graphics technology offering great potential for designing new types of instructional interactions is fast becoming available to the CAI designer. This paper first describes various new graphic display capabilities, then reviews relevant literature that could assist in determining how they could effectively be used in CAI applications. The ability to animate both graphics and text and the ability to directly manipulate graphic elements on screen displays represent revolutionary features. Little research, however, is currently available which could help provide guidelines for the development of instructional applications-for computer g r a p h i c s .

It has been said that CAI's greatest potential lies in its capability to individualize instruction using interactive techniques (Moore, Nawrocki, & Simutis, 1979). With increased computing power, systems for manipulating data, including programs, text, graphics, video, voice, sound and touch, are rapidly improving, providing us with powerful new tools for interaction. As these systems become increasingly accessible to the CAI designer, there will be a growing need for clarification with regard to instructional applications.

Restrictions in hardware have limited the use of images in CAI programs, and to date more emphasis has been placed on the presentation of text in an interactive mode than on the use of graphics. As a result, CAI programs have been largely dominated by word-oriented dialogues. Current significant advances in computer graphics technology, however, are now resulting in an increasing shift in emphasis from textual to graphic presentations (Bork, 1981; O'Shea & Self, 1983). Our task here will be to examine the emerging capabilities of computer graphics as they apply to CAI and to review relevant research that may assist us in determining their effective use.

WHAT DO WE MEAN BY COMPUTER GRAPHICS?

Images of objects can now be created, stored, and/or manipulated by the computer - this is the *essence* of computer graphics (Lewell, 1985). Marcus (1977) provides us with a

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general but useful definition of computer graphics: "any kind of imagery mediated or generated by computer control and most appropriately, but not exclusively, displayed on cathode ray tube screens" (p. 6). Graphics capabilities in computer systems range from the printing of simple characters to sophisticated picture drawing and image manipulation commands. Computer graphic displays have been used to fulfill a variety of functions such as in the automation of manufacturing processes and the production of engineering drawings, architectural plans, and commercial art layouts.

Examples of computer graphic output include: low resolution paper output; high quality black/white or color pictures of real or imaginary objects for slides, films, or video; and images produced on video displays and characterized by user intervention (Foley & Van Dam, 1982). From a CAI design standpoint our focus is the output generated on a video display screen. Great differences can exist with regard to the type of screen image produced, its quality, and the extent to which it can be dynamically controlled by the viewer. This last factor of viewer control can be used as the criterion for categorizing computer graphic applications as either passive or interactive, a distinction we shall see as having significant implications for CAI design.

Current developments in microprocessor technology are resulting in the design of computer systems with a vast range of graphics capabilities. Special graphics processor chips now under development will make text-based computing systems obsolete (Lu, 1986). In addition to enabling us to create more sophisticated images on the screen, including animated programs, graphics-based systems will allow easier integration with text. New microcomputer systems with such revolutionary video capabilities will become the vehicle for the most common instructional applications of computer graphics.

CATEGORIES OF COMPUTER SCREEN DISPLAYS

It is helpful for our purposes to present a scheme for categorizing computer screen displays to use as a descriptive framework for discussing computer graphics applications in CAI. The widely accepted distinction between text and graphics in relation to print can also be applied to static text and static graphics in screen displays. In addition, the ability we now have to animate content to make it dynamic allows us to further distinguish between screen displays.

Text Displays: Static

Jonassen (1982, p. ix) describes text as "written discourse (aggregates of words) in printed form" that can either be displayed on paper or a CRT. Insofar as text presentation techniques on a screen have a visual element, variables such as screen resolution, size, color, and style of characters play a critical role in communicating messages (Heines, 1984; Merrill, 1982). The alphanumeric symbols that comprise text are usually presented in a linear fashion, and have been typically displayed in a static mode in most CAI applications, with the exception of certain limited dynamic features such as scrolling (moving windows of information) and flashing, as if displayed on a printed page.

Graphic Displays: Static

In reviewing the literature on graphic displays, Moore and Nawrocki (1978) suggest "pictorial," "schematic," and "symbolic" as the terms best representative of the categories used to differentiate among them. As we shall see, these classifications can be generalized to computer screen displays as well.

A pictorial display refers to a "representation of objects or events, to include their relationships, but with the representation having some degree of fidelity to the physical characteristics of these objects or events" (Moore & Nawrocki, 1978, p. 33). Examples would include photographs, drawings and other realistic renderings of real-life objects.

The category of schematic displays describes "two-dimensional line drawings showing spatial or temporal relationships" (Moore & Nawrocki, 1978, p. 33), such as blueprints, circuit diagrams, and maps.

Symbolic displays function as "character sets in which each character has a predesignated, but nonlinguistic, referent to a specified object or concept" (Moore & Nawrocki, 1978, p. 33). The use of symbols is part of the field of iconic communication, which focuses on communicating meaning through visual forms. The word "iconic" implies the use of basic visual imagery dependent on "the ability of people to perceive natural form, shape and motion" (Huggins & Entwisle, 1974). This is in contrast to the use of alphanumeric representations which require linear, linguistic interpretations. The elements of iconic messages can be organized non-linearly in multidimensional space allowing numerous interrelations.

This classification of graphic displays is an arbitrary one, and a closer examination of the literature reveals certain definitional problems. Twyman (1979), for example, finds it difficult to distinguish between pictorial and schematic categorizations. Merrill and Bunderson (1979), on the other hand, find the Moore and Nawrocki classification scheme to be restrictive, and suggest adding a fourth category to the three outlined above (i.e., figural displays to represent the illustration of relationships between abstract ideas). Although other categorization schemes for graphic displays exist based on other criteria, we find this one provides us with a useful starting point for discussing screen displays.

Pictorial, schematic, and symbolic graphic displays can now be electronically represented on a CRT screen. Perhaps even more importantly, however, computer graphics technology now allows us to generate entirely new forms of displays. For example, systems are now able to scan various types of information into the computer. Two-dimensional information such as maps or three-dimensional information in the form of descriptions of solid objects can be drawn into the computer to produce graphic displays, vastly extending our capabilities to graphically represent information. In view of such capabilities, Greenberg (1982), has expanded the definition of computer graphics to include "the communication of graphic (non-alphanumeric) data *to or from* the machine " (p. 7).

Foley and Van Dam (1982) refer to computer graphics technology as "the most important mechanized means of producing and reproducing pictures since the invention of photography and television; it also has the added advantage that with the computer we can make pictures of abstract, synthetic objects" (p. 5). In addition to enabling us to portray real objects and to represent abstractions, the new technology allows us to superimpose abstract and realistic representations, creating yet another new form of graphic display (Brooks, 1977).

Text Displays: Dynamic

With the advancing revolution in computer/video display technology, we will be able to manipulate text in a more creative and dynamic way. The movement of text on the screen promises to become a powerful tool. Heines (1984) offers the following as examples of this potential of text: "...it can be displayed at various speeds, using pauses to add emphasis to key words. In addition, words and short phrases can often be effectively animated across the screen to denote a flow of information and/or materials" (p. 110).

Graphic Displays: Dynamic

All of the graphic displays described previously as being static now have the potential to be dynamic. The ability to add movement to static images represents a powerful tool for communication and information purposes. In addition, the fact that computer/video systems are now capable of creating, storing, retrieving, and manipulating new forms of dynamic images in real time (at a rate which reflects the perceived outside world) or, if desired, at a rate not consistent with real time (slower or faster), has significant implications for CAI applications. A general description of various new forms of dynamic displays follows.

Dynamic models. Dynamic models have properties built into the model description which enable them to change their characteristics within the limits determined by the designer (Glassner, 1984). The use of dynamic graphics is important in the animation of models. For example, a static model of our solar system can only be moved about on the screen, or presented in different perspectives or scales. Changing this model into a dynamic representation, however, permits the movement of planets within the solar system. This ability to move or change the shape of internal elements is what distinguishes static from dynamic models.

Techniques for what are termed "update dynamics" (Foley & Van Dam, 1982) refer to changes in the physical properties of the objects being viewed (e.g., shape, color, and size). There are a large number of modes to encode information with respect to time variation in shape and color of objects. Computer graphics systems allow us to define pictures that involve a variety of transformations, including two-dimensional into three-dimensional and perspective transformations. For example, engineers use computer graphics in structural analysis to build finite-element models to determine the distribution of stress in physical structures (Lewell, 1985). Computer graphics enable us to represent dynamically varying images which portray phenomena, either real or abstract, which vary with time and position. Dynamic sequences can, therefore, be used to convey different types of metamorphosis.

Simulations. The capability of computer graphics systems to rapidly display and efficiently move visual elements in a three-dimensional field is of particular significance for simulation and testing purposes. Lewell (1985) suggests that: "Whenever an image can replace a real object, for the purposes of interaction, a graphic simulation could conceivably be devised" (p. 22). In visual flight simulation, for example, a projected display is used to portray a geographical area, with topological and geometric structure of objects and surfaces being dynamically represented (Schachter, 1983).

Dynamic icons. The use of dynamic computer graphics allows us to generate movement in iconic communication as well. In a study on iconic communication, Huggins and Entwisle (1974) proposed that "the moving iconic symbol" is a new medium with special strengths having great applicability to instruction and requiring much additional research. They note that iconic representations characterized by motion and spatial perspective should be especially created to suit the electronic medium.

Dynamic diagrams. Most diagrams have been developed for use on the printed page, and therefore are static and closely related to the accompanying text. Marcus (1977) maintains that an increasingly important use of diagrams will be to organize vast amounts of information into a practical and readable format. He extends the meaning of the word "diagram" to encompass an array of symbols that utilizes not only two-dimensional but three-dimensional space as well. The array of symbols includes alphanumerics, points, lines, and planes, which may be characterized by texture and color.

In defining the parameters which would accommodate a more dynamic and visual approach to structuring diagrams, Marcus (1977) includes the following: "movement of symbols across and into the visual field, layering of information in actual or implied depth

/literal or phenomenal transparency or translucency, color, multiple entry and exit, and figure-field relationships" (p. 6).

By facilitating the use of these visual elements in the design of diagrams, dynamic computer graphics will provide us with the means of extending our capability to convey vast bodies of information.

PASSIVE VERSUS INTERACTIVE APPLICATIONS

In examining the implications of emerging computer graphics capabilities on CAI design, we need to make a critical distinction. Computer graphics applications can be categorized as either passive or interactive, depending on the involvement of the end-user of the application. Passive applications are those in which the viewer does not interact with the display, while interactive applications require an active involvement with the screen image. Sutherland (1970) provides examples of two types of interactive applications which may have instructional consequences. One application involves solving pictorial problems (e.g., topographical mapping and design), the other involves obtaining additional understanding of complex natural phenomena through the use of simulations.

Computer graphic applications which allow the viewer to dynamically control the image on a display surface with regard to content, format, size, and color are referred to as interactive. Control can be exerted by means of various interaction devices such as keyboard, lever, or joystick, each of which signals the user's intention to the computer. Interactive applications allow the system to respond to user input and therefore require two-way communication.

Interactivity thus implies a dialogue between the user and the computer. The computer responds to the signals from the input device by modifying the display. The user perceives this change in display as the response to his or her commands. Martin (1973) differentiates between four types of dialogue:

(1) Dialogue in which precomposed images can be selected by the user, but not otherwise modified in any way;
(2) Dialogue in which images can be modified, but only by alphanumeric means;
(3) Dialogue in which the user can draw or manipulate pictures of objects. The input devices used and the speed of the computer in changing the image give the user the impression of drawing directly on the screen.
(4) Dialogue in which the user is able to create and manipulate symbolic graphic images.

Interaction is achieved through a technology which allows the viewer to adjust certain aspects of the dynamic screen display - speed, for example, the amount of detail shown, or the portion of the image displayed. Techniques for motion dynamics allow the user to employ two perspectives: 1) one in which he is stationary, and 2) one in which he is mobile. In the first case, objects in the display can be moved with respect to the viewer. In the second case, the viewer is able to move around the stationary objects displayed on the screen. The latter technique is best exemplified in its flight simulation application, where the viewer moves in and around various elements of the defined environment.

Techniques for motion dynamics which allow the viewer to be mobile can also be used within the context of a non-realistic screen environment. Viewers can move in and around molecules, two-, three-, or four dimensional mathematical functions or scatter diagrams of data points in two- or three- dimensional space (Foley and Van Dam, 1982). Marcus (1977)

describes such a simulated space, "Cybernetic Landscape 1," in which the viewer is able to explore a language space composed of abstract visual forms and conventional textual elements. "No longer bound to the incised, written, or printed sheet," the reader "travels through the text as context" (p. 10).

Sutherland (1965) who regards the display screen on an interactive graphics system as "a window onto a virtual conceptual 3-D universe," elaborates on this application of computer graphics technology: "I think of a computer display as a window on Alice's Wonderland in which a programmer can depict either objects that obey well-known natural laws or purely imaginary objects that follow laws to be written into the program." (1970, p. 57).

Foley and Van Dam (1982) summarize the implications of the capabilities of this new technology:

> Interactive computer graphics allows us to achieve much higher bandwidth man-machine communication using a judicious combination of text with static and dynamic pictures than is possible with text alone. This higher bandwidth makes a significant difference in our ability to understand data, perceive trends, and visualize real or imaginary objects (p. 6).

Opportunities for instructional applications abound as we are now free to experience in a new dynamic medium concepts that have been traditionally confined to textual expression (e.g., mathematical formulas and linear print) (Adams & Fuchs, 1985).

Direct Manipulation

A key feature of interactive graphics displays is the ability to represent objects and to provide a means for manipulating them. Schneiderman (1984) reports that interactive systems exhibiting the following features seem to receive the most enthusiastic user support: visibility of the object of interest; rapid, reversible, incremental actions; and replacement of complex command language by direct manipulation of the object of interest. The best known example of direct manipulation is the video game. The commands are physical actions, including joystick motions, button presses, and knob rotations. The results of actions are obvious and easily reversed.

Schneiderman refers to such interactive systems as "direct manipulation" systems. Users are said to report positive feelings in terms of: mastery of the system, competence in task performance, ease in learning the system, and confidence in their capacity to retain mastery over time.

Spatial data management systems provide another example of direct manipulation systems. Spatial data management is a technique for accessing data through their graphical representations, or "icons," which are arranged in two-dimensional information spaces known as "Ispaces". These systems are comprised of a color, raster-scan display, a touch-sensitive screen, and a joystick. The user is able to travel within an Ispace and zoom in on specific icons for additional detail (Friedell, Barnett, & Kramlich, 1982). Schneiderman (1983) proposes that the success of such systems is dependent on the designer's skill in choosing icons and developing layouts that are natural and easily understood.

RELEVANT RESEARCH

Instructional Graphics

Graphics in general have been assumed to contribute to the effectiveness of communi-

cation, including communication for instructional purposes (e.g., Bork, 1981). In a comprehensive review of the literature on the effects of instructional graphics, Moore and Nawrocki (1978) identified six different "theoretic predispositions" (p. 4) underlying the basic assumption that graphics serve to increase the effectiveness of instruction. Graphics are thought to be: 1) perceived more efficiently than other forms of verbal or auditory displays, 2) realistic, 3) preferred by learners, 4) capable of relieving overloaded perceptual channels by adding sensory input; 5) important because perceptual research has shown individual differences in visual ability to be a significant variable, and 6) only part of a whole instructional system. Moore and Nawrocki (1978) found, however, that the assumption that graphics increased instructional effectiveness to be unsubstantiated by empirical research findings, although some studies were found showing positive effects.

Although each medium has its own unique characteristics, the presentation of static images on computer displays can be compared to some extent to the presentation of pictures in a text. Static graphic displays are most often visual representations displayed in support of a textual component. In this context it is useful to refer to the research relating to the instructional effectiveness of text illustrations.

In discussing how the use of pictures can improve the effectiveness of instructional textbooks, Brody (1982) notes the various functions a picture can serve: to reinforce the information presented verbally, to provide additional information, to help ensure retention of information, and to serve as an organizer. Despite the considerable amount of research conducted involving the use of pictures, an understanding of which pictorial elements affect learning from instructional texts is still lacking (Brody, 1982).

Levie and Lentz (1982) note seven different functions of text illustrations categorized as attentional, affective, cognitive, or compensatory. Although they conclude that illustrations can facilitate learning from text, the researchers observe that how they do so is not clear. In terms of the implications for future research, Levie and Lentz (1982) focus on the need to categorize the functions pictures can perform and the need to prescribe how to design for these functions. Wisely and Streeter (1985) in fact present a scheme outlining seventeen functions of static visuals in relation to supporting text. The proposed scheme, however, is based only on intuition and a literature review, and thus requires validation.

Insofar as computer graphics technology extends our ability to represent graphic information, as described earlier, the CAI designer must be prepared to call upon this resource in making design decisions. Until definitive research in this area is available, continuing research should help us identify the conditions in which graphics are a significant adjunct to the instructional process.

Computer Graphics Applications in CAI

Specific research addressing the effectiveness of computer graphics in CAI applications is scarce. A study conducted in 1979 by Moore, Nawrocki and Simutis compared the effectiveness of three types of graphics displays in a CAI lesson, namely low level graphics (schematic representations and boxed alphanumerics), medium level (line drawings), and high level (animation plus line drawings). The type of graphics display was found to have no significant effect on test scores. The researchers, however, noted that the experimental design of the study may have resulted in a masking of any potential effects of graphics during learning. They recommend as a better approach an exploration of the role of graphics in learning in terms of "When, where, how, and with whom are graphics to be used? (p. 13).

By contrast, Rigney and Lutz (1976) had found that animated graphics inserted into one version of a CAI science unit produced higher posttest scores and more positive attitude.s toward the instruction than a non-illustrated control condition. Bernard and Pineault (1984)

found a similar overall effect in favor of static illustrations designed to support a computer-based instructional unit on visual anatomy. They also found that simultaneous presentation of text and illustration (i.e., both in view at the same time) promoted better memory of the verbal text, while sequential presentation of text and illustration (i.e., text presented first followed by supporting graphic) tended to produce better memory for the elements protrayed in illustrations. While these results suggest that graphics included within a computer-based instructional environment may be expected to increase learning, the literature regarding such applications has not advanced to the point that specific design guidelines may be derived. For the moment, designers of CAI materials must derive guidance from studies performed on static and/or non-interactive media.

Human Factors Research

This area of research, which combines information from the fields of psychology and engineering, is concerned with how to visually display information on computer screens and is of great potential interest to the CAI designer. Currently, however, the variables regarding dialogue design which have been researched focus more on textual than graphic aspects (Reilly & Roach, 1986).

Interactivity I Direct Manipulation

More sophisticated techniques are required to study the role of computer graphics in the learning process, and interactive applications require separate exploratory study. An early study conducted by Oliver (1969) to investigate the effectiveness of interactive computer graphics to teach selected methods in numerical analysis was reported by Brooks (1977). A non-randomized, pretest-posttest design was used in the study, in which the use of interactive computer graphics was found to significantly improve performance. In terms of qualitative observations, individual manipulation of the mathematical objects was found to improve perception and understanding of the objects represented. In addition it was noted that students using the interactive graphics system showed greater class participation and showed initiative in using the system in unanticipated ways.

The role of direct manipulation in learning requires further investigation, as we have little by way of research to explain its effectiveness. Nelson (1980) has proposed a "principle of virtuality," which refers to a representation of reality that can be manipulated, to describe the phenomena. Similarly, Rutkowski (1982) refers to a principle of "transparency," describing the ability of the user to apply intellect directly to the task with the tool seeming to disappear.

Research in the area of problem-solving may assist us in understanding the effectiveness of direct manipulation. Polya (1957), for example, proposes that drawing represents a means of suitably representing mathematical problems. Bruner (1966) also uses the idea of physical representation to convey mathematical principles. Researchers Carroll, Thomas, and Malhotra (1980) discovered that subjects given a problem with spatial representation were able to solve problems more quickly and successfully than subjects who were given an isomorphic problem with temporal representation. Schneiderman (1983) maintains that physical, spatial, or visual representations are easier to retain and manipulate than others, citing the success of LOGO in teaching children mathematical concepts.

The phenomena of direct manipulation involves a high level, active response from the user to the system. Within a CAI context, this implies an active involvement of the student with the learning situation, increasing the likelihood that the student will learn. Bork (1981) maintains that the quality of interaction in the design of the program ultimately determines the quality of the instructional program. The capability of direct manipulation made possi-

ble through computer graphics technology will greatly enhance current levels of interaction. A great deal of research in this area will be required, however, before we will be able to maximize the effectiveness of such interactions.

CONCLUSION

We have examined some of the emerging capabilities of computer graphics technology within the context of potential CAI applications. As well, we have reviewed the research in key relevant areas in an attempt to determine their applicability to these new graphic tools. It is a fact that we will have increasing access to presentation and response capabilities that have never before been possible. Guidelines for the use of these capabilities are not yet available, and on the basis of the current state of research in the field, we can predict that such assistance will take time in arriving. The CAI designer, however, needs to be aware of this impending shift from text-dominated lessons to graphics-oriented presentations where it will be necessary to design new and different interactions.

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Facts About Unlicensed Use of 1/2" Videocassette Productions in the Classroom

Donna M. Lavoie

Abstract: The purpose of this article is to inform educators about Canadian Copyright Law as it applies to the use of 1/2" home video movies in the classroom. It has become an issue because numerous schools now possess 1/2" videocassette recorders. Many teachers are not aware of a copyright problem with using home video in the classroom and video distributors are often no better informed.

The fact is, and producers stand firm on this, that a public performance license must be obtained from a designated distributor to show *any* 1/2" video home movie in the classroom.

With copyright law needing major revisions over the next few years, the article also raises questions about fair prices to schools for the use of 1/2" video home movies in the classroom. It is certain that the schools cannot be considered as part of the "home use" market, so what special considerations, if any, should schools receive from producers?

The purpose of this report is to give information on a copyright issue concerning the use of theatrical film productions in the classroom. The problem stems from the fact that many schools now have 1/2" videocassette recorders and teachers are anxious to use materials in this convenient format. This paper outlines the steps we undertook to study the issue and some conclusions that can be drawn. Whenever possible, related sections of the existing Canadian Copyright Act are cited to clarify the arguments.

The catalyst in this study was an advertisement originating from a video distributor in Thornhill, Ontario. This company was selling 1/2" format videocassettes of well known film classics at attractive prices and implying they were ideal for use in the schools. Film titles were subdivided under the headings "videotapes suitable for secondary and post-secondary levels" and "videotapes suitable for elementary level." The legality of this was questioned because 1/2" videocassettes of this type have traditionally been designated "For Home Use Only." A call to the company to see if they had clearance from the producers enabling them to sell these to schools elicited a vague no, with the explanation that as long as no admission was being charged they saw no legal problems. In the process of making similar inquiries to the same company, the Nova Scotia Department of Education, received another interesting reply. They were told by the distributor that although the major produc-

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tion companies that owned the films were not interested in "granting any kind of licensing or duplication rights," and that although duplication of the tapes would be prohibited, it would be possible for the schools to buy multiple copies. Purchase of videotapes from this company ranged from $53 to $147 per cassette.

Not satisfied with these answers, our next step was to contact local video distributors for the addresses of the major production companies for their point of view. In the process of doing this, it was surprising to find that all four of the local distributors contacted were now renting to schools and saw no problems, once again, as long as no admission was being charged. From conversations with these people it became obvious that the Canadian Copyright Act as it now stands is open to broad interpretations.

A call to Canadian Consumer and Corporate Affairs did little to shed light on the situation. I was told what I would hear repeated many times; that the Act is currently under revision and reports on the recommendations are available. For the moment, it would appear that the only way to prove the law is to establish legal precedent.

The possibility of various interpretations becomes obvious when one reads the Canadian Copyright Act and tries to apply it to present-day situations. Enacted in 1924, the present Act has had amendments over the years, but requires an entire revision to include guidelines for technologies that have since come into existence. Equipment did not have the duplicating capabilities it has now, and a home market for VCR systems was not envisaged.

The underlying philosophy of copyright law is to foster and protect authors' creative works captured and preserved on any medium so that their ideas will be of benefit to society. The flip side is that authors will make their works available to society, and this they are usually more than willing to do for a price. In section 3 (1) of the Copyright Act (Statutes of Canada, 1970), being the author of a work means having the sole right to produce or reproduce the work in any form desired, along with the sole right to adapt it or perform it in public. In the current Act, performance is defined as: "Any acoustic representation of a work or any visual representation of any dramatic action in a work, including a representation made by means of any mechanical instrument or by radio communication. " (p. 1278) The medium of television is conspicuous by its absence here until one recalls that in 1924 television was not yet in existence. Copyright protection is accorded *whether or not* the work is officially registered and the term of protection generally extends to 50 years after the demise of the author.

In relating this part of the law to our inquiry regarding the use of theatrical film productions in the classroom, there is certainly a strong case for the production houses to which these films belong. Although the Copyright Act does not specifically cover home-video, it emphasizes control of the owner to reproduce the work within the format desired. When production companies license 1/2" format videocassette copies for the home market they specify so by labelling their films "For Home Use Only". Section 17 (1) of the Copyright Act states: "Copyright in a work shall be deemed to be infringed by any person who, without the consent of the owner of the copyright, does anything that, by this Act, only the owner of the copyright has the right to do ." (p. 1290) Current philosophy is that any action which prejudicially affects the owner is considered a violation of copyright and usually, this means damage in the monetary sense. In relating this to the issue of home-licensed video being used in the classroom, it can be argued that such distribution in the schools takes away from a potential market quite different from the home market for which the material was intended. The production houses contacted feel that a fairly priced, wide selection of their materials is available under alternative options. Several Canadian companies now issue public performance licenses to cover the use of popular films on 1/2" videocassette format for non-theatrical uses. Education falls into this category of use along with

clubs, summer camps, taverns, lounges, institutions, libraries, churches, and private business. The terms and conditions of this type of use are clearly outlined. Figure 1 is a warning copied from the final page of one film catalogue we received. It emphasizes the distributor's attitude about school use of videocassettes without a license to do so.

Figure 1.
A Public Warning Regarding the Unlicensed Use of 1/2" Format Videocassette Films.

WARNING
"FOR HOME USE ONLY" MEANS JUST THAT!!"

The pre-recorded video cassettes and videodiscs available in stores are **FOR HOME USE ONLY.**

Sales of pre-recorded video cassettes and videodiscs do not confer any public performance right upon the purchases. A performance which is not given in a private nome, may be considered a public performance. Showing in hotels, bars, clubs, lodges, factories, summer camps, and schools are public performances, subject tp copyright control.

S.3 of the Copyright Act R.S.C. I970 c.55 grants the copyright owner the exclusive right to perform the work in public. Accordingly, without a separate licence from the copyright owner, **IT IS ILLEGAL** to exhibit pre-recorded video cassettes and videodiscs in a public place, **regardless** of whether or not admission is charged. Ownership of a pre-recorded video cassette or videodisc does **not** constitute ownership of a copyright.

Companies, organizations and individuals who wish to properly exhibit copyrighted motion pictures and audio-visual works **must** secure licences to do 59. The purchase of pre-recorded video cassettes and videodiscs **does not** effect this legal obligation.

If **your** legal rights were violated, **you** would insist upon seeking appropriate redress. So will the undersigned companies who are members of the:

CANADIAN MOTION PICTURE DISTRIBUTORS ASSOCIATION
Astral Films Limited
Columbia Pictures of Canada
MGM-UA TV Canada Limited
Paramount Pictures Corporation (Canada) Limited
Twentieth Century-Fox Film Corporation
United Artists Film Corporation
Universal Films (Canada)
Warner Bros. Distributing (Canada) Limited

HOME VIDEO BOARD - CANADA
Columbia Pictures Home Entertainment
MGM/CBS Video Enterprises
Paramount Home Video
James K. Rayburn Inc. - (representing Walt Disney Productions)
Twentieth Century-Fox Video (Canada) Limited
Universal Films (Canada)
WEA Music of Canada Limited

Suite 1703, 22 St. Clair Avenue East,
Toronto, Ontario, M4T 2S4, Canada.

Note: This is a facsimile of the back cover of Astral Bellevue Classics 1983/84 Non - Theatrical Catalogue. Used with permission.

The prices companies charge schools for short term rental and long term lease of public performance rights to use video in the classroom have fluctuated over the past two years. One company has lowered its prices enough to make schools consider lease or rental of properly licensed video as a feasible alternative to the use of video licensed for home use. This company offers weekly rentals of $8 per tape, as well as long term lease at $100 per year, per video. On the other end of the scale, another company offers its rentals at approximately $55 per video, with long term lease possible at $150 to $250 per video for the life of the cassette or 5 years, whichever comes first.

At one point in this study, it was suggested that perhaps education would be able to justify use of home-video under the "fair dealing" section of the Act, an exemption which allows use of all works for purposes of private study, research, criticism, review or news-

paper summary. It would be presumptuous indeed to categorize viewing in a classroom of thirty students as private study or research and this has been established in Canadian Case Law.

Responses from the two major production houses contacted produced an emphatic *no* to the unlicensed use of 1/2" videotapes in the classroom. Walt Disney Telecommunications and Non-Theatrical Company (B. Tenn, personal communication, June 14,1984) replied: "...It is our position and the position of other motion picture distributors that videocassettes licensed and sold for private home use, may not be used in a classroom or school situation." The representative of CBS/FOX Video (Canada) Ltd. stated, "I have to advise that the use of videotape movies in the classroom is definitely a violation of Canadian copyright laws" (J. Bowerbank, personal communications, May 28,1984).

Through Disney we were encouraged to contact the Home Video Board of Canada for their comments. One should note that this board is entirely comprised of major production houses and video distributors across Canada and the U.S., and that it is affiliated with the Canadian Motion Picture Distributor's Association. In their correspondence to us, the Home Video Board included the copy of a letter to Gordon Jarrell of the Scarborough Board of Education written by their lawyer Bernard Mayer Q.C., summarizing the legal basis for the stand taken by the Canadian Motion Picture Distributor's Association (H. B. Mayer, personal communication, March 15,1984). One of the important points drawn out in Mayer's letter is as follows: "The Copyright Act does not contain any definition of the term performance in public.' It is, however, in the opinion of the Canadian Motion Picture Distributor's Association clear that a performance in the course of face-to-face instruction in a school is a public performance."

Mayer goes on to say: "In determining what is a performance in public, the courts have drawn a distinction between a public and a domestic or quasi-domestic performance. No performance has ever been held to be for a domestic or quasi-domestic purpose where the principal members of the audience did not reside under one roof." He then adds, "The fact that no profit is derived from any performance does not mean that it is not a public performance." It is interesting to note that many of the people the author questioned about copyright insisted that as long as no admission was being charged there was no infringement.

Regarding public performance, it should be noted here that the revised copyright acts of the United States and United Kingdom both contain limited specific exemptions from the exclusive right of public performance for educational purposes in classroom instruction. Present Canadian copyright law does not contain such a provision for education, but it has been recommended in the previous Liberal government's white paper on copyright (Government of Canada, 1984) and the recent Report of the Sub-Committee on the Revision of Copyright (Government of Canada, 1985).

The Home Video Board (M. Roth, personal communication, June 29,1984) included in its letter to us, a copy of a memo that the Ontario Scarborough Board of Education circulated to its principals, warning about the misuse of video film features in the classroom.

In April, 1984, the P.E.I. Department of Education issued a memo warning against showing "For Home Use Only" videotapes in the classroom. Most principals and teachers were not aware of copyright infringement, especially in cases where the video distributors were willingly renting to them.

CONCLUSIONS

Given the inadequacies of the present Copyright Act and the fact that it may be some

time before we have a more comprehensive one, it is necessary that educators be well informed on copyright issues if they are to have any say on the laws that will be affecting all sectors of the educational system. After having waded through numerous intangible reports and proposals for revision just to get information on one issue, the author realizes how complex this task can be. Copyright is so broad a topic that the majority of the general public, including educators, find it very difficult to interpret properly.

What do proposed revisions hold in store for educators? In the most recent Report of the Sub-Committee on the Revision of Copyright, entitled *A Charter of Rights for Creators* (Government of Canada, 1985), it is proposed that the Copyright Act not be changed substantially where education is concerned. It does recommend an exemption in the course of teaching activities to "perform a work in public," and to "transmit and retransmit a work within the confines of a single educational institution." The terms "public performance" and "perform" are liable to cause considerable confusion for educators unless they are more clearly defined under a new Act. This author's interpretation of the exemption suggested for education in the white paper and the Report of the Sub-Committee on the Revision of Copyright, is that this would permit teachers and students to legally perform a copyright play in the classroom, to videotape it and to transmit it within the confines of the school. However, it is unclear whether the exemption would cover the classroom showing of a "For Home Use Only" film on video.

It is obvious that the production houses have consolidated to take a firm stand on the issues, and they are being heard. The question is, in the preparation stages of a new Copyright Act, are the views of educators also being taken into consideration? Who is our common voice? What role should AMTEC play? For the moment, a large number of films are available to us through public performance licensing for "non-theatrical" uses, but should we stand in the same price category as clubs, taverns, lounges, summer camps, institutions, churches, and private business? Is access easy enough and are the pricing formulas fair? These are questions which come to mind when one thinks of how convenient and economical it is to see any number of these films in the comfort of our own homes for just a few dollars.

One must not forget, however, the right of producers to a fair price for their materials. The costs and risks involved in any production are great and if we as educators want to foster the development of a good educational market we must be willing to give reasonable compensation. Otherwise, we will be completely overlooked as a market of any influence.

The president of one production company (Fisher, personal communication, July 25, 1984) summed up his point of view on copyright and education in the following way:

> Unfortunately most educational authorities have until recently disregarded the rights of producers and creators on this issue, and left both teachers and producers to fend for themselves...! have long believed that the educational community will act in a responsible manner once informed of the facts, and providing the producers are reason able in making the materials accessible and at reasonable prices.

It has become apparent to this author that schools are willing to use properly licensed materials as long as they can get good service, variety and reasonable prices.

In conclusion, the author believes that one of the more positive side effects of all the hoopla concerning copyright is that producers and educators are finally talking to one another and working out a common ground for negotiation.

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Extracting Training Implications from Multi-Component Needs Assessments: Extension of the R-C-D Model

Richard A. Schwier

ABSTRACT: A common data source in training needs assessments is the target audience. The interpretation of these data can augment other front-end analyses to make decisions about the design of training events. This article examines the Relevance-Competence-Desire (RCD) model of training needs assessment to speculate about the instructional design implications of interactions among these components. How can different types of instruction be designed to capitalize on various configurations of perceived relevance, competence and desire exhibited by potential learners?

INTRODUCTION

Models and definitions of needs assessment abound (Witkin, 1984); however, the instructional developer often faces difficulty applying these useful concepts in a training setting. As heartwarming as it may be to developers that the selective focus of our discipline seems to be shifting from "what we teach" to determining "what we *should* teach," we are faced with the problem of using needs data to help guide decisions about the nature or "look" of training intervention.

Needs assessments are typically used to identify gaps (or discrepancies) in results. Kaufman, Stakenas, Wagner and Mayer (1981) usefully distinguished between actual needs (discrepancies in results) and quasi-needs, which are discrepancies in inputs or processes. Within the context of Kaufman's Organizational Elements Model (Kaufman and Stone, 1983), actual needs may include discrepancies in internal organizational results (products and outputs) or external outcomes. Training, on the other hand, is seen as one of several potential processes or inputs available to reduce discrepancies in results.

Once actual needs are identified, decisions are made concerning how to reduce discrepancies. Within the context of formal models of instructional design, training decisions are usually based upon data collected during other front-end analysis and design stages. Since many models of needs assessment include potential trainees, needs assessment data may provide information which goes beyond identifying discrepancies in results. What information can be extracted from needs assessment data to determine whether training is appropriate and, if training is implemented, to influence the design of training intervention?

This article examines the training design implications of needs assessment data within

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the context of one model of needs assessment. Can an instructional designer extract clues from needs data which influence how training should be conducted?

THE R-C-D MODEL

Misanchuk (1984) proposed a model of needs assessment which includes three components: the relevance of an identified task or skill to the performance of an individual's job role; the competence of an individual to perform that task or skill; and the desire of an individual to undertake training in that task or skill. A needs assessment is performed in order to determine whether or not training should be conducted in specific skill areas, and what priority different training needs can be assigned.

It should be noted that this type of needs assessment is conducted within the context of organizational objectives and standard instructional system design approaches. The needs assessment is preceded by a thorough task analysis and, regardless of the outcome of the assessment, the organizational objectives do not change. For example, a uranium mining operation may be interested in determining the perceived relevance, competence and desire for training of employees toward training in emergency radiation treatment procedures, but the objectives of the organization will continue to include the safety of employees, regardless of the outcome of the assessment.

This article will extend the relevance-competence-desire (R-C-D) model of needs beyond the questions of the mechanics of data collection and whether remediation should occur in various skill areas. The collective consideration of needs data derived from an assessment will determine the need for training or other intervention, and procedures for conducting this type of needs assessment are dealt with elsewhere (Misanchuk, 1984). This extension of the R-C-D model will concentrate on the interactions among R-C-D components, given the organizational decision to impose training. As individuals within the organization exhibit different configurations of the R-C-D components, what types of training intervention can reasonably be invoked?

Who Decides?

The R-C-D needs identification model represents an employee-centered approach. One assumption of the model is that individuals being assessed are able to identify which tasks are most relevant to the performance of their job roles, and the organization sponsoring (paying for) training programs values the opinions of respondents.' Certainly, this is a reasonable expectation in most cases, as organizations routinely depend upon individuals to define tasks within a more general job description. The process of natural selection in the working environment (Misanchuk, 1982) also serves to ensure that individuals who understand and perform within organizational expectations are hired and survive, while those who do not are either not hired or do not survive in the organization.

Nevertheless, situations occur in which there is disparity between the organization's perception of "what should be" and the employee's perception of "what should be." For example, upper-level management may anticipate the introduction of word processing in offices on a large scale, and expect division supervisors to be familiar with the operation of the equipment. Supervisors, on the other hand, may realize that word processing is coming,

Typically, respondent anonymity is preserved in needs analyses to encourage objectivity and introduce reliability in the process. Of course, anonymity can limit the application of needs data to the differential assignment of individuals to training events.

but view related skills as secretarial, rather than supervisory, concerns. Resultant needs analysis data would probably imply low job-relevance in an environment where relevance is being defined externally. Should training be imposed?

In many, if not most, training contexts the decision to fund training will be in the hands of upper management. Needs assessment data will be helpful in assigning priorities to areas, but will certainly not completely displace the intuition and priorities of those ultimately responsible for financing training. In any event, once training priorities are assigned, target audiences will not be homogenous. Individuals within the target group will exhibit varying R-C-D configurations. ID personnel applying needs assessments consider aggregate information to assign priorities, but may overlook potential design implications for individuals who will undertake training.

The proposed model of needs assessment can be usefully extended into the realm of learner analysis in an industrial training context. It is possible that complete assessments can provide information about potential learners which will shape decisions about the types of training interventions which will enhance learning and performance.

To extend the model requires a fresh examination of the components of the R-C-D model in light of the implications for designing training intervention. It is not a natural marriage. For the purpose of measuring needs, Misanchuk (1982, 1984) suggests possible response scales which range from "absent" to "high" levels on each dimension. 2 For the purpose of learner analysis, it is conceptually useful to introduce "negative" values on the scales, as trainees can possess aptitudes and attitudes which run contrary to the goals of training.

Relevance

TABLE 1
Perceived Competence Scale and Training Implications

Level of Relevance		Training Implications
Relevance	Abstract Experiences	Independent Study and Classroom Training
Irrelevance	Vicarious Experiences	Model Experiences and Simulations
Interference	Concrete Experiences	On-Site Practice and Demonstrations

Conceptually, the perceived relevance scale can include points which range from positive (high relevance to successful performance) to negative (interference with successful performance). If the task analysis was competently performed, most skills will be judged relevant to successful job performance by individuals with similar job roles. But significant

These labels are the author's. Misanchuk's scales ranged from "not required" to "essential" (Relevance), "certain not to take it" to "certain to take it" (Desire), and "no skill" to "a great deal of skill" (Competence) in assessment tools.

exceptions may appear. For example, line supervisors in an auto parts factory might be asked to judge the relevance of interpersonal communication with workers to their performance. Some may feel that such training is "touch-touchy-feely," and that they need to be hard-nosed with their employees to ensure high production. Therefore, training in interpersonal communication might be viewed as counter-productive to their performance and judged negatively. Management, on the other hand, might believe these individuals could benefit the most from training.

The organizational relevance of training is not always task-related. Even in cases where low-relevance consensus is achieved, training may be imposed because of the political context of training. In many contexts, training programs serve an intra-organizational public relations function. Organizations sometimes provide opportunities for employee growth, even occasionally irrelevant growth, because training can foster a sense of participation in, and commitment to the organization. For example, many industries are recommending employee participation in physical fitness programs, not because of job-relevance, but because of indirect, affective benefits which may result. In some cases, training may be introduced because training divisions need to look busy - training for the sake of training. There is considerable pressure on training divisions to be productive, and sometimes this may result in a mentality whereby training becomes the prescribed solution for every performance problem.

How might individuals at different points on the relevance scale be best accommodated in a training event, assuming that a task really is relevant and training is appropriate? As perceived relevance diminishes, it is reasonable to speculate that training experiences should become more directly tied to the working environment, so that relevance can be demonstrated. Low to negative ratings indicate a need to move directly into the working environment and provide experience with the skill in the job context. On-site training and direct demonstrations can be used not only to teach the skill or task, but also to illustrate the relevance of the training to successful performance.

As relevance increases, vicarious experiences can be substituted for direct experiences. Models, exercises and simulations can be introduced, although care should continue to be taken to make specific, logical references to the job role.

In cases where relevance is evident or assumed, training can become more abstract. This is not to suggest training *must* be abstract to be effective. In many cases, the task may require concrete treatment, or a highly concrete treatment may be preferred. Still, high relevance offers the opportunity to treat content more abstractly if appropriate. A classroom setting may be adequate for group training events, and it is possible that independent study approaches can be successfully introduced. The main point is that as perceived relevance fluctuates, training contexts may change beneficially from experience-grounded to relatively abstract in nature. This will, however, be mediated by the nature of the task.

Competence (See Table 2 on next page)

Similarly, the dimension of competence can range conceptually from positive (high degree of perceived competence on the skill or task) to negative (perceived lack of aptitudes necessary to learn the task or skill). An individual who professes competence may feel that additional training is not necessary to perform his/her job role adequately. If this, in fact, is the case, and continued skill development is not valued by the institution, it would merely be necessary to measure actual competence to verify the accuracy of the individual's perception, and ignore further training.

Sometimes, on the other hand, a competent individual could benefit from additional training. For instance, a public relations official may be a competent public speaker, but the

TABLE 2
Perceived Competence Scale and Training Implications

Level of Competence	Training Implications		
Competence	Challenging Experiences	Lengthy Frames or Segments	Intrinsic Reinforcement
Benign Incompetence	Low Difficulty Experiences	Brief Frames or Segments	Periodic External Reinforcement
Perceived Lack of Aptitude	Guaranteed Success Orientation	Brief Frames or Segments	Continuous External Reinforcement

organization and the individual may benefit if the person participates in additional skill development. Many skills which are not amenable to criterion referenced evaluation (e.g., public speaking, research skills, counselling skills) can never be judged "good enough." In this case the training intervention must demonstrate rewards for excellence or growth. Individuals who consider themselves competent can be challenged by training to pursue excellence, or they may become bored.

When low to negative competence ratings are evident, the trainer must first determine if the negative aptitude actually prevents the acquisition of skills for that individual. If it is determined, however, that an individual is "trainable," then attitudinal issues must be addressed.

When low to negative competence ratings are evident, then training events should adopt a success orientation. Training should incorporate heavy doses of knowledge-of-results and positive reinforcement in order to encourage the trainee to continue and to build self-confidence. Training should not be so challenging as to be discouraging, but neither should it be frivolous. Shorter segments could be used to allow opportunities for periodic feedback.

Desire (See Table 3 on next page)

Desire represents an important consideration in the design of training events. Positive (high desire), zero (apathy) and negative (subversion) values of desire may be exhibited by individuals entering training. Negative (subversion) perceptions may be held by resentful employees who not only do not care to participate in training, but who may subtly or overtly attempt to sabotage training. At the very least, these individuals will be uncooperative, and if possible, should be excluded from the training event. If a decision is made to exclude a participant, the learner must be given full information regarding the consequences of failing to cooperate *a priori*. Problems in identifying these individuals are obvious, and certainly no written assessment is likely to indicate which individuals might be obstructive. But interviews, intuition and cues during training will help isolate "pockets of discontent," and the trainer must determine whether the inclusion of disenchanted individuals will undermine training for others, and take appropriate action.

The higher the desire of individuals to participate in a particular training event, the lower the profile necessary on the part of the sponsoring agency to legitimize the training.

TABLE 3
Desire Scale and Training Implications

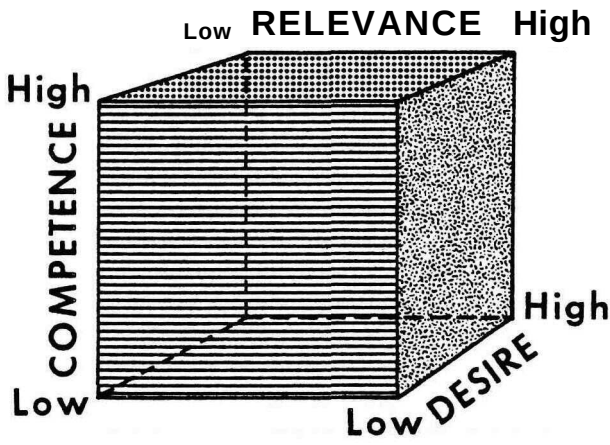
Level of Desire	Training Implications		
Desire	Supportive/Permissive Organizational Posture	Intrinsic-Intangible Rewards	Informal-Facilitative Source (Guided Instruction or Independent Study)
Apathy	Coercive Organizational Sanctions	External-Tangible Reward System	Formal-Directive Training Source (Instructor)
Subversion	Exclude from Training		

In cases of high desire, subtle intervention may be sufficient, giving trainees the opportunity to pursue instruction on their own. Independent study, with the organization providing release time and resources, may be all that is required, and intrinsic rewards may be sufficient.

As desire diminishes, corporate influence must increase. Formal training events sanctioned by the sponsoring agency will be promoted, and perhaps required. Intervention will become more prescriptive, yet include a motivational orientation. It may be necessary to "sell" participants on the worth of the training. External reward systems, including such things as salary incentives and promotion, may be needed to motivate participants.

APPLYING NEEDS TO DESIGN

Figure 1.
The Relevance - Competence - Desire Model of Needs.



Interpreting the R-C-D model in terms of learner information provided by the needs assessment, it is possible to speculate about specific types of training events which might be appropriate for different groups of individuals with varying needs configurations.

For the purpose of the following discussion, each component of the model will be assigned values of "high" and "low," acknowledging that subtlety is being sacrificed for the sake of clarity.3 The result is a delineation of system states within which the model can be interpreted. Interactions among the three components suggest a variety of training designs necessary to successfully conduct training.

Low Desire - Low Competence - Low Relevance

Figure 2.
Low Desire - Low Competence - Low Relevance.

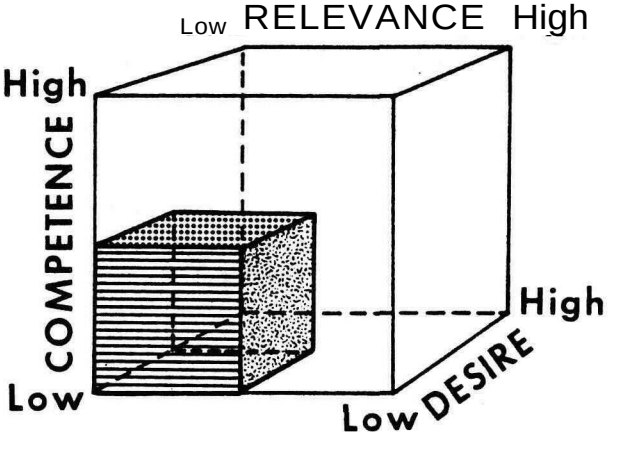


Figure 2 illustrates individuals who exhibit low desire, little competence, and who see little or no relevance to the job role. Seldom would training be provided if the needs analysis reveals this configuration, but if training is imposed, what should the training event be like?

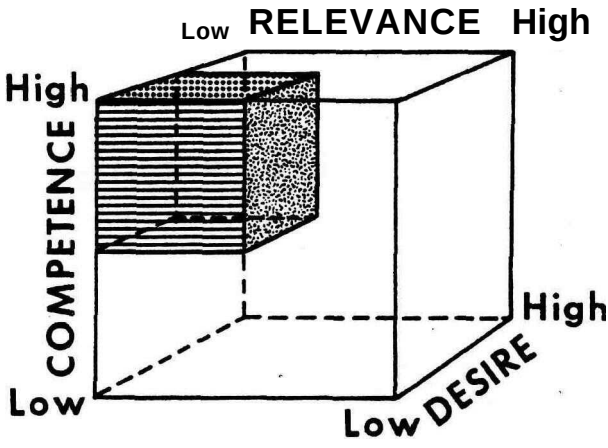
It would probably be necessary to coerce these individuals to participate. Formal, structured events will dominate, with an emphasis on motivational, concrete activities which build confidence in the trainee's ability to perform. Where possible, an actual or simulated job site should be used for training, and instructors should encourage participant involvement and provide frequent positive reinforcement for successes. It is important that abstract lecturing/telling sessions be kept to a minimum, because a reticent group can become subversive if they are not given ownership of the activities. Participant ownership and reinforcement will build desire, active participation and a success-orientation will improve perceived competence, and the job environment and concrete activities will enhance relevance.

Negative to zero values are included in the label "Low," while "High" includes the range of positive values for each component. All values are conceptual, and are not intended to represent interval data points.

Larger skill areas should be broken into brief exercises exploiting frequent opportunities to provide reinforcement. An external reward system including such things as certificates, job ranking or salary incentives may be considered by the sponsoring organization to encourage successful participation.

Low Desire - High Competence - Low Relevance

Figures.
Low *Desire - High Competence - Low Relevance.*



Training which attempts to increase perceived relevance and motivation with competent individuals presents interesting instructional design challenges. Usually training would be avoided if these perceptions were deemed accurate. But if .training is mandated, the content should be moderately difficult to challenging so that interest is maintained.

To increase relevance, training should be conducted on an actual or simulated job site, and activities should stress application of skills in the job role through actual or simulated performance. Perhaps the most influential source of training information would be a peer who can demonstrate the application of skills.

Increasing desire is another problem. Within the organizational context, sanctions for participation may need to be coercive, or heavily encouraged, and external, tangible rewards must be clearly evident. The information source should be highly motivating and fairly dominant, especially during the early stages of training.

High Desire - Low Competence - Low Relevance (See Figure 4 on next page).

In this situation, the trainee wants to learn, but feels inadequate and is not aware of benefits to job performance. In order to compensate for deficient components, highly structured instruction, broken into brief segments which exhibit low difficulty and provide an opportunity for frequent positive reinforcement, can be provided on-site. For example, training in heavy equipment repair could be provided by a fellow worker, taking the trainee step-by-step through the training by first demonstrating a minor operation, then allowing the trainee to perform it. This type of instruction may be more expensive than conventional

Figure 4.
High Desire - High Competence - Low Relevance.
(Discussion on previous page)

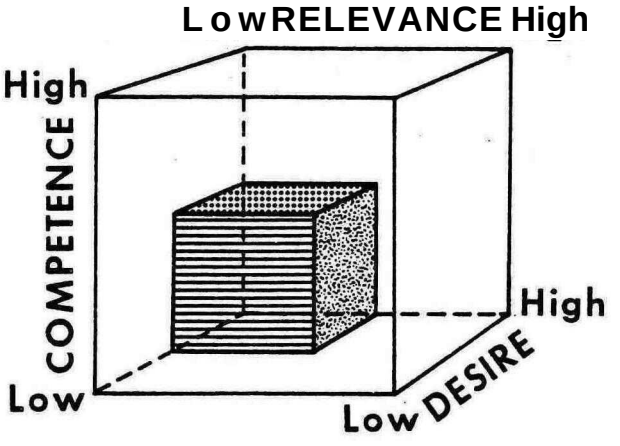
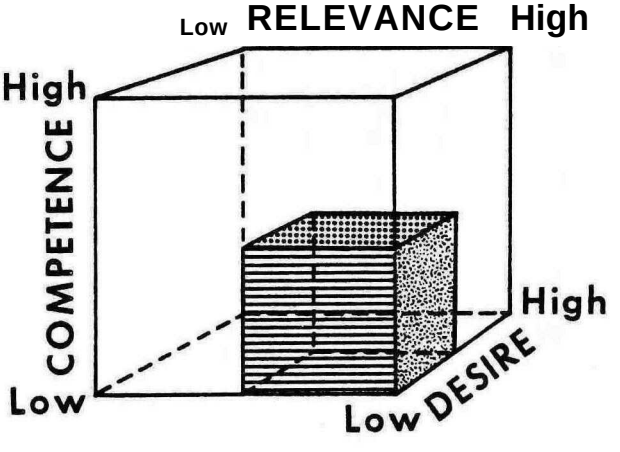


Figure 5.
Low Desire - Low Competence - High Relevance.
(Discussion on next page)



training modes, but it couples immediate relevance with methodical competence development. On-site coaching, which adopts many of the characteristics of paper and pencil programmed instruction, requires no transfer of learning.

As the trainee is motivated to learn, the organization can adopt a more supportive and permissive posture toward training, rather than coercive. The instruction need not be flashy or overtly motivating, as the participant is more likely to be intrinsically motivated to perform. It should be noted that although rewards for participation will also be intrinsic for someone who desires instruction, external rewards should not be denied if they are provided for less-motivated individuals. Denial of extrinsic rewards may serve as a punishment, and thereby diminish the desire to participate.

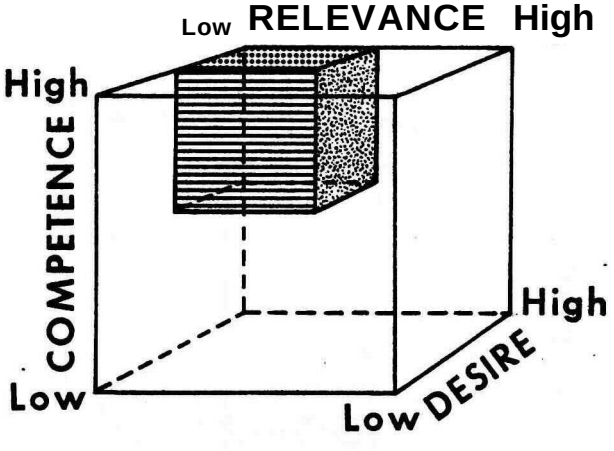
Low Desire - Low Competence - High Relevance (See Figure 5 on previous page)

This configuration may describe an individual who realizes the importance of a particular skill or task, but who does not want to participate in training despite a perceived need to improve the skill. This may be the result of negative affect. The task or skill may be a particularly unpalatable part of the job role. Because relevance is evident, instruction can be provided in most any location, and can include topics which range from the concrete to the abstract — again, depending upon the nature of the task.

Organizational sanctions can be imposed to encourage participation, and tangible incentives should be offered. Instruction, whether provided by instructors or materials, should be motivational, provide a high probability for success, and utilize frequent positive reinforcement and knowledge of results so that participants realize their improvement.

High Desire - High Competence - Low Relevance

Figure 6.
High Desire - High Competence - Low Relevance.



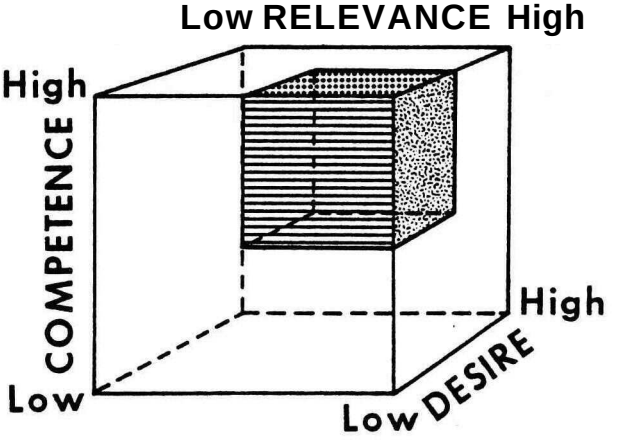
Strictly speaking, this is not a training problem. The employee is already competent, and if further skill development is not useful to the organization, then training is unneces-

sary. It may merely be necessary to measure actual competence in order to confirm the employee's perceptions.

If the organization decides to provide events which will increase perceived relevance, then brief awareness-raising sessions can be imposed to demonstrate relevance. Sessions on the job site can demonstrate the direct application of competencies and can illustrate benefits to the employee for successful performance of skills. Brief intervention, carried out periodically, rather than an extensive single event will be useful to reinforce relevance.

Low Desire - High Competence - High Relevance

Figure 7.
Low Desire - High Competence - High Relevance.



If perceived competence is accurate, then this configuration does not represent a training need. This could be labelled the "know-it-all syndrome." Introducing external, tangible incentives may build enthusiasm for further improving the skill. If the individual is able, it may be useful to use this employee to train others, and provide salary incentives for participation as a trainer. This may also result in increased status, and motivate the individual to refine skills.

High Desire - Low Competence - High Relevance (See Figure 8 on next page)

This configuration represents the instructional developer's dream. The trainee realizes the importance of the skill or task, is highly motivated to participate in training, and perceives a need for improvement. This person will probably be a "quick study." Most any delivery approach (assuming that content is related to objectives, relevant job tasks, audience characteristics, etc.), in any reasonable setting, is appropriate and the organization can adopt a causal, supportive posture. Instruction can take a facilitative orientation, and rewards for participation need not be tangible incentives. The caution about reward systems expressed earlier should be reemphasized, however. If other individuals who are less motivated receive tangible rewards for participation in training, then these should also be pro-

Figures.
High Desire - High Competence - High Relevance.
(Discussion on previous page).

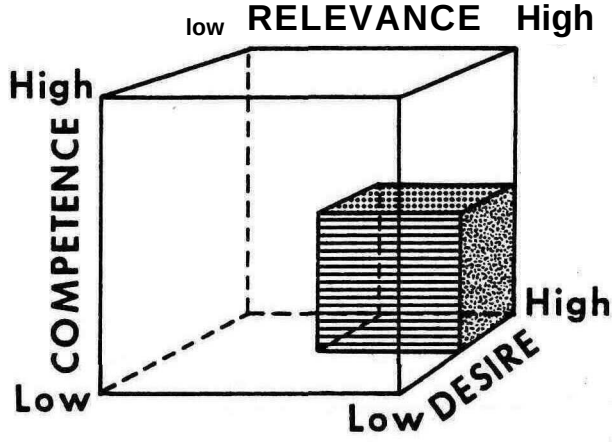
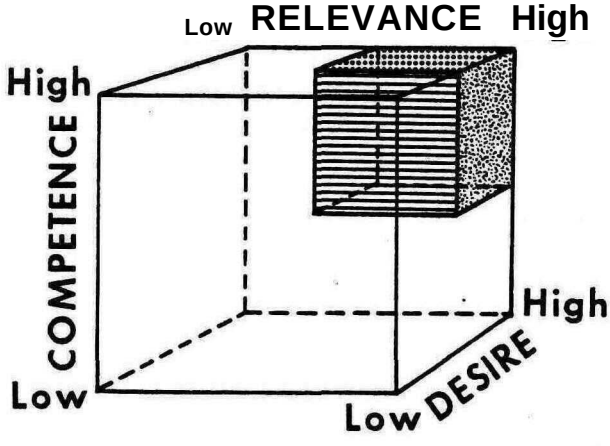


Figure 9.
High Desire - High Competence - High Relevance.
(Discussion on next page).



vided for more motivated individuals. Withholding such rewards may result in lower desire, as the trainee may feel exploited by the organization.

Instruction should be highly structured and employ a success orientation, not only to compensate for low perceived competence, but also to maintain existing desire to participate. Self-instructional materials may be used profitably in this context, if appropriate to the task. They provide a format which will offer necessary structure, and which will make the development of competency apparent to the trainee through continuous feedback. Regardless of the instructional method employed, it is important that the organization make resources and time available to the employee to pursue training.

High Desire - High Competence - High Relevance (See Figure 9 on previous page)

Again, if this person is already sufficiently competent, then training is unnecessary. But if further development of skills is deemed important by the sponsoring organization, then intervention need only be minimal and informal. It may only be necessary to make resources available and get out of the learner's way. Thus, institutional gains can be realized with a minimal investment, such as stocking a resource centre with appropriate materials. This type of individual may be an excellent prospect for participation as a peer trainer, delivering instruction to other employees.

It should be noted that developing excellence in competent individuals can backfire. The organization may find itself in the position of financing the development of individuals who will leave the organization to accept greater responsibility elsewhere. For example, if a computer programmer, as a result of in-house training, learns three new languages and develops a marketable artificial intelligence system, the likelihood of his or her leaving the organization to start a new company increases.

LIMITATIONS

There has been no attempt in this paper to describe a prescriptive framework for making design decisions for training. Rather, the intention was to re-examine the components of this model of needs analysis, and speculate about the nature of training events which would complement different component configurations. If you subscribe to a definition of needs which emphasizes one or two of the components (Misanchuk, 1982) then it will be necessary to attend only to the design implications for those components, ignoring irrelevant components.

Other considerations also intervene. Full exploitation of the model would require parallel development of training modes to capitalize on the needs of individuals. This has serious budgetary implications, as the costs associated with training development will certainly be inflated. This would only be feasible in cases where there are sufficiently large subgroups of individuals to warrant parallel development. This must be accompanied by a high level of confidence that different training modes will be cost-effective — that matching learner needs and compensatory training modes will produce significant performance differences. Research is needed to examine the speculations offered in this article.

SUMMARY

This article extended the R-C-D model of needs assessment into the realm of learner analysis. It examined the instructional implications of each of the model's components, and

how varying configurations of R-C-D components could influence the differential design of instruction to complement learner perceptions of relevance, competence and desire.

The perceived relevance scale was examined in terms of its influence on the level of abstraction possible in instruction and the location of training. It was speculated that perceived competence could influence the level of difficulty, structure, segment length and type of reinforcement appropriate in training. Desire was reconsidered in terms of organizational posture, reward systems and formality of source.

The major hypothesis in this article is that a needs assessment provides information about potential learners which carries design implications. Considering potential interactions among R-C-D components may lead training designers toward reasonable development decisions, and provide fodder for research into the design of training.

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The Development of VITAL: A Microcomputer-Based Videotex Teaching and Learning System for Education

George A. B. Moore

Abstract: Recently, considerable interest was aroused about the potential of Videotex for educational purposes. In Canada this was Telidon which in 1983 was upgraded to the NAPLPS standard. This study explored the use of Telidon for instructional purposes. Limitations in existing Telidon system software for instruction and the high costs of the conventional Telidon approach led the project team to develop and test a micro-computer based course authoring and presentation system called VITAL.

Findings from the study with eight instructors revealed a high degree of student acceptance for the colour graphic materials, especially in visual science disciplines. It was also found that time required to produce instructional materials, while considerable, is substantially less than that reported in the general literature.

Using Computers and Telidon in Higher Education

While computers have been used in university education for the past 2-1/2 decades (Alpert & Bitzer, 1970), high costs, lack of experience, unfamiliarity and a high.degree of social inertia have resulted in a relatively slow adoption outside a few selected disciplines (Digital, 1985). This has changed in the past 5 or so years and today the elusive potential of computing is coming closer to our grasp. As powerful and appealing as are the new developments in low cost computing, the essential factors in good educational applications are not the machines themselves but the instructional purposes to which they are placed. The most critical areas for attention are the development of instructional design capabilities among instructors and some attention to the context in which the instructor is engaged with this newer medium.

The emergence of the lower cost personal computer and the growing availability of good quality software packages for word processing, spreadsheet analysis and file management have opened up the use of the microcomputer as a valuable tool for both faculty and

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students. This use, however, is distinct from the use of the computer in instruction (Pylyshyn, 1984).

During the early 1980s considerable interest was aroused in Canada about the potential of Telidon for educational purposes. TVOntario embarked on a Telidon field trial, the University of Victoria pioneered an Apple II based Telidon page creation system, the University of Waterloo developed a CPM based storage and delivery system, Athabasca University developed database software for Telidon to operate on Unix host computers, and the Ontario Educational Micro computer specifications, which led to the ICON, required such machines be capable of handling Telidon code.

In the initial stage of Telidon the system consisted usually of a reasonably sized mini computer as a host for the database, a special purpose hardware decoder terminal and telecommunications between the two. More recent developments have reduced the size and cost of systems using Telidon code which in 1983 was replaced by an expanded standard, the North American Presentation Level Protocol Syntax (NAPLPS). One of these systems is a development at the University of Guelph called VITAL (Videotex Integrated Teaching and Learning). A more significant development is the migration of Telidon/NAPLPS from single purpose hardware to microcomputers through the use of software decoders.

While NAPLPS has replaced Telidon as the North American standard for this unique form of colour graphic and textual display, both belong to a generic family identified here as Videotex.

A Pilot Study in Using Computer-Based Videotex Instructional Materials

In 1982 the University of Guelph received an equipment award of $76,000, on a matching funds basis, from the Industrial Investment Stimulation Program (IISP) of the Canadian Department of Communication for the study of Telidon applications. This award specified three areas of study and application: an agricultural information service, an on-campus electronic information service for staff and students and the use of Telidon in teaching (Moore, 1985a).

The first area of study, agricultural information, was undertaken in 1983 as a joint venture with Infomart, the owners and operators of the Grassroots service for farmers based in Winnipeg, Manitoba. This service began in April, 1981, and at the time of the Guelph study was limited geographically to the western Prairie provinces. In April, 1983, it began operating in Ontario through the University of Guelph's trial and in July, 1984, the service expanded into the eastern USA as Grassroots America.

The joint project gave the University immediate access to the considerable computing resources and to the expertise of the Infomart staff which were in place to support several commercially operating Telidon services. It was possible for the University's instructional applications project to be mounted *piggy-back* on the agricultural service. The computer equipment available comprised a VAX750 and a VAX780 with Infomart Telidon System Software located in Winnipeg. These computers and software carried the database and provided the system's traffic control.

A dedicated dataroute line was purchased between Guelph and Winnipeg and equipped with a 16 channel concentrator. Two of these channels were used by the University's page creation staff to upload material into the database, 4 were used for the instructional project and 10 for the agricultural service.

University owned equipment included two Norpak EPS microcomputer systems for creating the Telidon pages and 50 user terminals of which 6 were allocated to the pilot study and connected to Winnipeg via the University's computer network and the dedicated dataroute. In operation, a student using the system was connected to the Winnipeg database as if

it were an on-campus facility.

By the summer of 1983 computer applications to instruction were limited to several simulations running on the mainframe and two VAX dedicated to courses in computer science. No generally accessible instructional computing facility was available to members of the University community. The microcomputer pools and networks in the Colleges of Physical Sciences and Agriculture were in the first stages of planning but were not operational. Thus, in August, 1983, a pilot project was undertaken to enable four professors to test the available Telidon/NAPLPS facility for instruction.

The initial instructional materials created for the pilot study comprised interactive testing modules for courses in Extension Education, Neuroanatomy, Ornithology, Psychology and Zoology. These courses were selected because of their high visual content and the fact that high quality, low-cost colour graphics are one of the principal characteristics which differentiate Telidon/NAPLPS from other computer systems.

A three-step process was used to create the instructional materials. First, the instructors participating in the project selected segments of the course for treatment in consultation with an instructional designer. The material was then arranged into "frames" on paper as it would be viewed by students. Second, a staff graphic designer coded this information into Telidon/NAPLPS "pages" using the Norpak Telidon frame creation equipment. This step required frequent consultation with the instructor to ensure the accuracy of the final Telidon/NAPLPS "page." Step three required the programming of the "pages" to achieve the instructional intent.

Telidon databases at the time were basically tree-structured with users working through the material from a series of progressively specific menus. This was deemed too restrictive for interactive instructional uses and special purpose action task sub-routines were created by Infomart to handle this requirement.

Two instructional approaches were used in the pilot study. The first was to complement courses with a need for frequent student testing and feedback. The courses here were in extension education, neuroanatomy, ornithology and psychology. A second application was undertaken in Introductory Zoology where 600 students made heavy demands on the instructor to "see again" after class his colorful overhead transparency illustrations. In this case the materials for the course, Animal Kingdom, were prepared as a reference database accessible in the library. Figures 1 and 2 (See next page) show examples of the materials prepared for courses.

In all cases the use of the Telidon/NAPLPS system represented an adaptation to an existing instructional approach. This resulted in a very fast turn-around of approximately 4 weeks from the initial decision to use the system until the course materials were available to students.

The Role of the Instructors and the Pilot Study

A key consideration in any innovation is the willingness and readiness of participants. In this project this included both the faculty and their students. Rogers (1983) lists five key factors in the adoption of innovations in a social system. These are perceived relative advantage, compatibility with existing practices, complexity of the innovation, trialability or the extent to which the innovation can be explored without making a major initial commitment to adopt, and observability or the degree to which the innovation can be seen by others.

While the pilot study was undertaken to assess the feasibility of Telidon/NAPLPS as an instructional medium, several of the participating instructors viewed it as an innovation in their teaching. The motives and reasons for taking part in pilot projects are tied more closely to one's primary responsibilities and concerns than they are to the researchers' need

FIGURE 1.
Frame from Reference Material in Zoology.

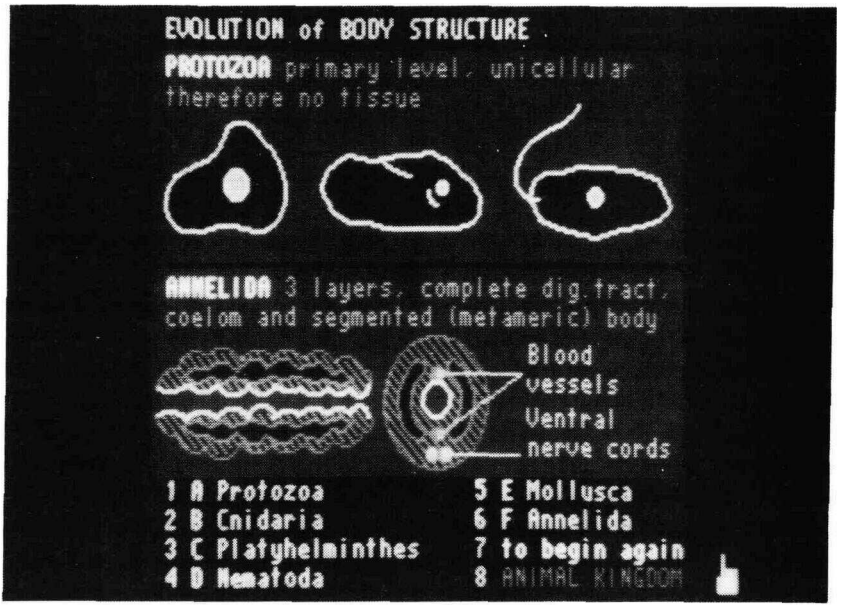


FIGURE 2.
Frame from a Test Package in Ornithology.

to know. Thus it was found in this project that serious attention had to be given to the participating instructor's needs as distinct from those of the investigators.

In keeping with Rogers' principles an attempt was made in the Guelph Study to select courses with instructors who had perceived instructional needs which might be served by the project, and those whose existing instructional organization was compatible to and could

accommodate this computerized application without major reorganization. Three of the courses were using a Personalized System of Instruction (PSI) or Keller Plan type instructional format so the Telidon/NAPLPS materials were adapted to provide student testing and feedback. The other courses used the system to present biological graphics and schemata. In keeping with Rogers' principle of trialability, only portions of these courses were treated in the pilot study.

One of the four instructors involved in the pilot study had previous experience with using the computer for instructional purposes, while for the other three this was a novel undertaking in which the complexity of the procedures was an important consideration. This was handled by using staff in the Telidon page creation centre to work with the faculty members in designing, producing and programming the materials. The role of the instructor was as content authority in determining the material to be presented to achieve the instructional intent and to monitor the work of the design staff to ensure resulting computer material conformed to the objectives.

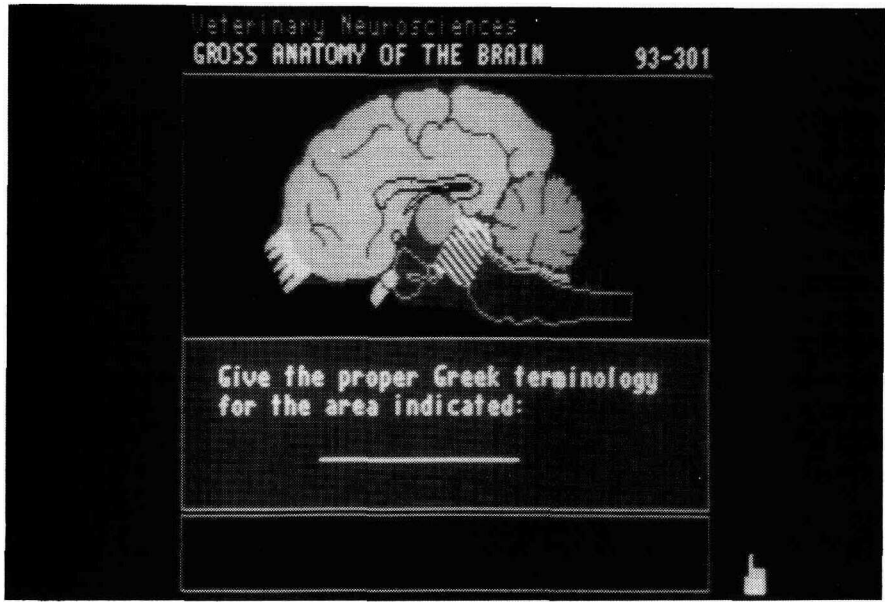
Information and demonstration sessions for other instructors were held at various points in the project where the pilot participants described their experience and demonstrated their material. Materials were developed for four more instructors as a direct outcome of reports from the pilot project.

FIGURES.
Frame from Course in Geology Showing Student Workstation.

Student reaction was measured by surveys taken in the Winter and Fall semesters of 1984. They reported the system as easy to use, the colour graphics of value and expressed an interest in continuing its use (Moore, 1985a). The opportunity for self-pacing, immediate feedback, individual and group study, the quality and variety of questions, the stimulation of recall and the emphasis on student learning were listed by the students as advantages of this approach

Leppmann and Herrmann (1982) have been using the Keller Plan (PSI) as both a

FIGURE 4.
Frame from Course in Neuroanatomy.



means of teaching introductory psychology and as a field for research. They have found that students perform consistently one letter grade higher on common departmental examinations than students in lecture/discussion sections. However, students also report a much higher workload in a PSI type course (Hermann, 1984). In their existing PSI applications Leppmann and Herrmann had used trained student facilitators to conduct the quiz sessions and provide for feedback. The number of quiz sessions began to present budgetary difficulties which in turn led to a search for computer-based alternatives. In a separate trial project, Herrmann began the development of a computer testing system GATES (Guelph Automated Testing and Educational System) operating on the Department of Computing and Information Science's VAX. This was made available on a concessionary basis for the research but was normally restricted to Computer Science courses and unavailable to other teachers.

In a comparative study between Telidon/NAPLPS and ASCII displays for instructional material, Herrmann (1984) found a strong preference for the Telidon/NAPLPS type of graphic display. This study involved students in a third year psychology course and compared student perception of workload with achievement on final examinations in each of three instructional modes. A control group received instruction in the traditional lecture/discussion format. The two treatment groups received instruction in the PSI format with the mastery quizzes and associated feedback provided by computer-based delivery. Treatment Group I received test items presented by standard ASCII monochrome display. Treatment Group II received the same items formatted and displayed using Telidon/NAPLPS. In both treatment groups the test items were text without visual illustration, however, the Telidon/NAPLPS materials were constructed to take advantage of graphic design characteristics of layout, colour, text size and spacing inherent in Telidon/NAPLPS. Apart from these graphic design aspects of the display, the content of the test items for Treatment Groups I and II was identical.

In the control group students' expectations of final grade and perception of workload

were reported to be similar to other courses in which they were enrolled. In Treatment Group I, computer tests using ASCII displayed text, students reported a heavier workload than in other courses and the anticipation of a correspondingly higher grade. Students in Treatment Group II, computer tests using Telidon/NAPLPS display, reported the expectation of higher grades but the perceived workload was reported to be similar to that in other courses. Objective measures of number of test attempts and machine time for both treatment groups indicated Treatment Group II did not differ in workload from Treatment Group I. Herrmann concluded that the nature of the computer display in this study did make a difference in student attitude toward the workload in the course. He has suggested that the Telidon/NAPLPS format may contain some intrinsic motivational value in that as students worked with the material they were not directly conscious of the passage of time. This raises interesting areas for research in the design of computer messages. The differences between ASCII display and NAPLPS may be analogous to the differences in printed text between typeset material and word processor output of a dot-matrix printer.

In other survey in the four courses included in the pilot study, students reported on the sometimes slow response time to their inputs and the inflexibility of the system to interpret their responses which were correct in concept but misspelled. They also complained that some test items appeared before they had studied the material in class. There was some frustration that wrong answers or unacceptable responses were judged but not corrected.

Some of these difficulties were related to the limitations of the long distance communication lines operating at 1200 baud or the fluctuating demand on the host computer by the major Grassroots users resulting in variable response time. Other more serious limitations related to the instructional decisions incorporated by the instructor such as the sequence of test items and the handling of incorrect responses.

The pilot project indicated that while the system offered promise, there was a need to improve the technical aspects, especially the slow response time. It also revealed the need to concentrate on instructional design factors. The major conclusion was that a Telidon/NAPLPS system could be used effectively as an instructional vehicle but that a lower cost microcomputer based system should be investigated and that an instructionally oriented authoring system was needed to overcome the limitations of available Telidon/NAPLPS data base software. In conjunction with Tayson Information Technology Inc. of Toronto, the project team began, in spring 1984, the task of designing and writing software to operate on the IBM-PC system or on compatible work-a-like equipment. The goal was to create a versatile interactive teaching and learning system (VITAL) on a microcomputer.

The objectives adopted in designing VITAL were as follows:

(a) To implement Telidon/NAPLPS with its high quality computer colour graphics and text on a microcomputer;
(b) To create a system which could be used by teaching and support staff who were not computer programmers;
(c) To combine the essential elements of content creation, instructional programming, content presentation and record keeping into one integrated software package;
(d) To provide a system which would be open to a number of variations in the way material could be handled for courses of different levels and with different instructional design parameters;
(e) To provide a system with a low entry cost in terms of equipment but which could also grow in capacity to support 20 or more simultaneous users on a local network (Moore, 1985b).

VITAL: AN EMERGING TELIDON/NAPLPS MICROCOMPUTER-BASED LEARNING SYSTEM

VITAL exists now as an integrated videotex course authoring system which enables instructors, teaching assistants and media personnel with little, if any, computer programming skills to produce colorful text and graphic learning materials on low-cost microcomputer equipment. The system uses the IBM-PC as the basic equipment building block to which a hard disk, network capability and a variety of student terminals may be added. Initial Telidon equipment was costly and purpose specific. Subsequent developments by Norpak, Microstar, Microtaure, FBN software and IBM have resulted in increased capability for the microcomputer through the use of colour graphic cards and software decoders. With these additions the micro can function as a NAPLPS terminal or study station.

The instructional application called VITAL bears little resemblance to the Telidon of the early 1980s. Careful observers of that day recognized that Telidon was not a specific type of equipment or application but essentially a new and efficient way of encoding graphic material for storage and display in a computer. If one accepts that as the essence of Telidon and its more recent manifestation in NAPLPS, then VITAL is a form of Telidon/NAPLPS. However, since Telidon in the popular mind is equated with large databases and remote access over telecommunication lines, it may be more helpful to acknowledge the Telidon ancestry but see VITAL as a distinctly different application.

VITAL, like its earlier Telidon antecedents and other application software packages uses a menu approach to provide straightforward prompts to instructors in creating and programming materials as well as to students in using them. The functions of VITAL are accessed from a main menu which routes the user to one of four functional menus (Tayson, 1985).

Program Menus

The first menu is the *System Administration Menu.* The functions activated from this menu provide for the assigning of user access ID numbers and passwords.

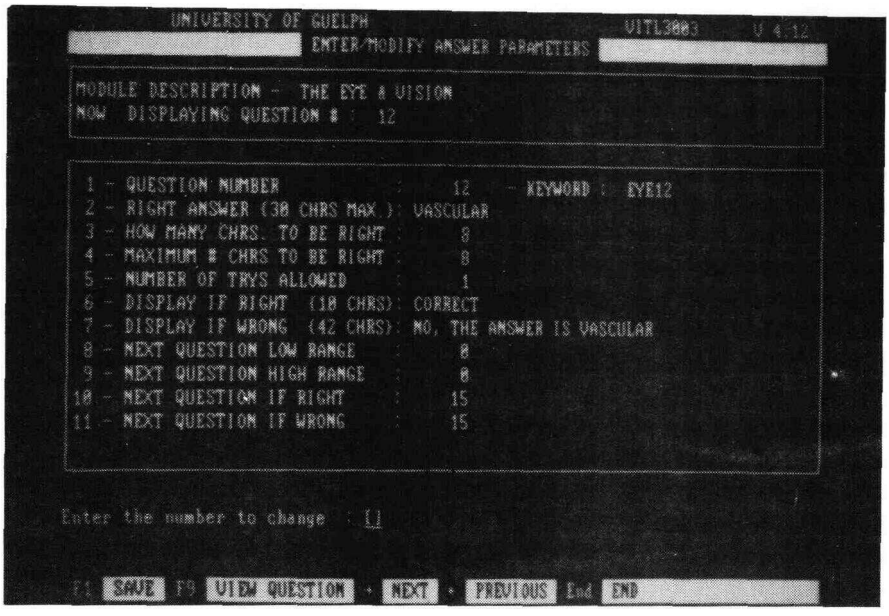
The *Instructor's Menu* establishes the instructional modules and sets the parameters for each module. It is also from this menu that the instructor programs the material by entering the appropriate information to the eleven parameters shown in Figure 5 (See next page).

Items 2, 3, 4 and 5 contain all the information required to register the correct response and to judge student inputs. Items 6 and 7 provide the initial feedback information to follow the judging feature. Items 8 and 9 specify whether the forward sequence will be linear or random. This feature allows for either a random selection within the entire pool of items or a block random selection within a designated area of the item bank. Finally, items 10 and 11 provide for either linear or branching paths. Each frame in the data base is assigned a reference (question) number, item 1, and each frame is programmed by using the "Enter/ Modify Answer Parameters" function. While the commands are simple to execute, the eleven items combine to give considerable programming power.

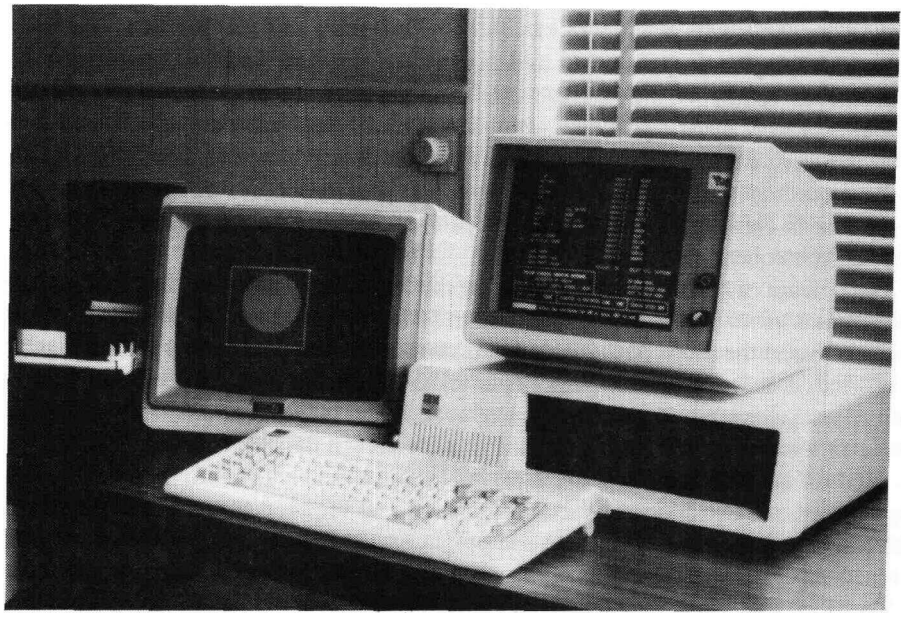
The Instructor's Menu allows the instructor to check the accuracy of the programming through the "Run the Module" function which emulates the student terminal display. This Menu also contains the commands to provide reports of individual student performance or summary reports of the class activity.

The third menu is *Module Administration* and it is here the individual instructional frames are created. This is achieved by using the Frame Creator function. The instructor's work station shown in Figure 6 is an IBM-PC equipped with a Norpak PCD6 card, a monochrome monitor and an analog RGB colour monitor.

FIGURES.
Menu for Providing the Instructional Program Sequences in the VITAL Modules.



FIGURES.
VITAL Workstation for Creating and Programming Instructional Materials.



The monochrome monitor displays the graphic, text and colour choice menus. It allows the operator to track and alter the status of the currently active functions. The colour monitor provides an immediate display of the visual elements as they are being assembled.

Editing of text is achieved through a Text Editor.

The fourth and final menu is the *Presentation System Menu.* This sets up the software to allow students to access the modules and activates the session level record keeping of all student transactions.

At the current state of development VITAL does not contain algorithms to generate problems or to effect simulations. It is limited to handling material which can be specified in a predetermined manner.

Implications for Instructors and Other Outcomes

Prior to the pilot study very little direct evidence was available at Guelph of the impact on faculty workload in creating course materials for such a system. What was available was information from other studies on the need for highly skilled computer programming specialists (Jones, 1984; Sparkes, 1984) and estimates of the time required to create 1 hour of instruction ranging from 100 to 500 hours of preparation time. Hofstetter (1983) placed a cost estimate on this activity of $2,500 per hour for uncomplicated tutorial material without judging features to $8,000 per hour for simulation material. Hofstetter reported that the time commitment at the University of Delaware to create 1 hour of instruction of PLATO required 76 hours of designer (instructor) effort plus 120 hours of programming time. Bates (1984) suggested that this time cost could be reduced by "more sophisticated authoring languages making it easier for teachers to write material for CAL." At Guelph, apart from the pilot study, unless an instructor was accomplished in programming or had access to computer programmers, the use of computers for instruction was an elusive dream.

The reality for most faculty members is that their teaching load is a recurring activity with very few opportunities to invest the heavy "front end load" required to create, test and evaluate alternate resource based learning approaches. This includes the necessary time to acquire enhanced instructional design skills. While equipment acquisition is relatively easy, the essential requirement to acquire instructional design skills, time and support, generally is in short supply.

The Guelph pilot project sought to determine the extent to which a user friendly system such as Telidon/NAPLPS could ease the entry of faculty members into an exploration of alternatives. Since everyone, faculty and support staff, was learning the procedures for the first time, a relatively steep learning curve prevailed. Materials were produced in modules requiring 10-20 minutes of student contact per module. It was found that the investment of time in creating the first module drops to about one-third by the completion of the fourth and subsequent modules.

The amount of preparation time spent by the four faculty members in the pilot study ranged from 8 hours per hour of student use to 54 hours with a median of 30 hours. Four instructors joined the project after its initial phase and have reported time investments ranging from 4 hours per student study hour to 30 hours. In five cases the faculty had teaching assistants whose time commitment, in addition, range from 8 hours to 104 hours per hour of instruction. Centrally provided support staff in the Telidon Page Creation Centre accounted for an additional 10 hours to 90 hours per student study hour with the median being 50 hours. In two courses no external support was required apart from initial training of the teaching assistants who created and programmed all the instructional materials. The combined experience of the eight instructors to use the system to date suggests a reasonable estimate of 22 hours instructor time spent in planning, preparation and evaluation of the materials for each hour of student study once familiarity with the system is achieved. In addition, 50-60 hours of support staff time are required for each hour of student study time. Individual cases, however, range from a low of 4 hours instructor/8 hours support staff to a

high of 54 hours instructor/194 hours support staff. In the latter case this was the first course undertaken with an exceptionally high learning curve. While these findings confirm that considerable time and effort are required to create computer based learning materials, this time investment is about one-third that reported in the literature on preparing computer based learning materials (Hofstetter, 1983).

Interviews with seven faculty members in the fall of 1985 revealed that all but one considered the project to be advantageous. They reported such things as "it satisfied my curiosity," "it appealed to students," "it forced me to update the course and improve its quality" or "raised the value of the faculty/student contact time in class." In other developmental projects at Guelph, faculty similarly report the primary value not to be the specific materials produced nor media used but the enhanced grasp gained of the learning process itself. Since few faculty members are trained as teachers this is an important outcome. In the search for improved teaching and learning practices the use of a system such as VITAL provides an opportunity for in-service training in instructional principles.

Recently an institutional cooperation agreement between the University of Guelph and Sukhothai Thammathirat OPEN University, Thailand has selected VITAL for a pilot study as an additional delivery vehicle in the latter's distance education system to 400,000 adult students. A training session in December, 1985, for 16 academic staff and 8 technical staff demonstrated the speed with which basic VITAL courseware skills can be acquired by those unfamiliar with computing equipment. At the conclusion of an eight day training workshop four course teams comprising four faculty and two support staff had each created an interactive, highly visual, tutorial package of 10 minutes duration. The disciplines selected were mathematics, basic science (two courses) and economics.

CONCLUSION

The University of Guelph's pilot study of videotex as a viable educational medium has provided promising findings of student acceptance in terms of both its use and the quality of instructional materials carried on it. It has found growing acceptance among instructors for the quality of teaching materials which they can create without previous computer language or programming skills. The experience of the pilot study with a large minicomputer and network communications led the project staff to design and implement a microcomputer based versatile interactive teaching and learning system using Telidon/NAPLPS.

VITAL exists as one more tool in the kit of teachers and instructional designers. It offers an integrated computer based learning system capable of producing highly visual instructional material. These can be used in tutorial packages which allow for self-paced independent study and which can give students frequent practice and feedback.

No one medium is a panacea. A number of years ago a Canadian scholar, Ted Sheffield (1974), studied the practices of outstanding teachers. He was led to the conclusion that there is no one way to teach. There are a number of ways, some better than others, but essentially it is a matter of good instructional design and the application of good learning theory.

The intent has been to make VITAL plastic and flexible so that it can support good instructional design. The answer to improved effectiveness and efficiency of our teaching efforts does not lie in the tools we create but in the purposes to which we apply those tools. VITAL is one such tool but the creative and effective applications will come from teachers and instructional designers with a commitment to helping people learn. It is this concern for the outcomes of instruction which is urgently needed in an environment which is largely technology driven. Balcovich, Lerman, and Parmelee (1985) have observed that "universities

have often simply accepted the specific technologies of current hardware and software before asking how they might use them."

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Alternative Approaches and Guidelines for Conducting Needs Assessments

Hanna Mayer

Abstract: Needs Assessment is a mandated first step in identifying and solving human performance problems in education as well as in business and industry (Guba & Lincoln, 1982; Kaufman, 1982, Rossett, 1982; Witkin, 1984). In education, learner needs are the basis for curriculum decisions (Witkin, 1979). In business/industry, deficiencies in employees' skills, knowledge and attitudes are the basis for training and development interventions (Oppenheimer, 1982). But while the process of needs assessment is basic to the success of that which follows, it is also characterized by great diversity in scope, data collection and analysis techniques, and cost effectiveness.

This paper focuses on a description of three basic approaches to needs assessment, with particular attention given to their usefulness and applicability. Techniques which can be used to collect needs assessment data are described. The approaches outlined in this paper are assessed in terms of their potential utility to users in business and educational settings as measured by their estimated time requirement, accuracy and cost.

WHAT IS NEEDS ASSESSMENT?

Needs Assessment is a process of determining gaps between *current* and *required* (or desired) organizational and/or individual performance (Kaufman & Stone, 1983). In essence, needs assessment attempts to answer two basic questions:

- *Where* are we going? (or what are we to accomplish?); and
- *Why* are we going there? (—and, how far is it from where we are now?)

By answering the first question correctly, we identify our goals and objectives. These goals and objectives, stated in measurable terms, define a target destination at which we aim. The second question, "why are we going there," makes us ascertain our goals and objectives. It assures that there is a valid reason for working toward achieving the specified goals.

ALTERNATIVE NEEDS ASSESSMENT APPROACHES: PURPOSE AND SCOPE

The ultimate purpose of needs- assessment is to ensure that our efforts, time and money

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are spent on programs and interventions which are useful, in that they contribute to improving performance. The scope of needs assessments varies from complete full-fledged approaches to quick-fix status surveys. In full-fledged approaches, we focus on the assessment of present and projected goals, objectives and related performance specifications and accomplishments. In quick-fix status surveys we merely distinguish between *current* expert performers and poor performers; we do not assess performance in relation to future requirements when we conduct a status survey.

Mayer and Kaufman (1985) describe the following three major alternative approaches to needs assessment..

Alternative I: Problem Identification

This approach looks at "what is" versus "what should be" and investigates the variables which may indicate the existence of a performance problem in or for an organization. The problem identification approach is comprehensive and rigorous. It starts with no assumptions, looks at the situation as a whole and goes as far as questioning organizational goals and objectives to identify problems (i.e., gaps between these objectives as stated, and their attainment).

For example, within an industrial setting, the problem identification approach can be used to assess the current versus desired safety record of cars manufactured by "Rapidcar Auto Corporation" (RAC). RAC measures its safety records by the survival rate of car accident victims in which cars from RAC are involved. An analysis of the possible causes for identified gaps between current and required survival rates from car accidents may result in changes to Rapidcar Auto Corporation's goals and objectives (regarding safety records), operational procedures to insure attainment of the goals and objectives, etc.

An example of the Problem Identification alternative to needs assessment in an educational setting would be the identification of the current versus desired number of school graduates who can get and keep jobs. The graduates in question have received their education at "Vocational Education Center ABC." An analysis of the possible causes for the identified gap which impacts graduates of "Vocational Education Center ABC" may result in changes to the Vocational Education Center's goals, objectives, teaching/learning methodologies, etc.

Alternative II: Problem Analysis

This alternative to conducting needs assessment examines mainly the "what should be" aspect and usually involves little questioning of the details of the current situation. The emphasis in this approach is on searching for the causes of a *pre-specifled* problem. Problem analysis is often the second phase of the problem identification approach described earlier as alternative I. Problem analysis is a stand-alone approach to needs assessment which is appropriate when there is no information about the existing situation, (i.e., the required performance is currently non-existent) or when such information is irrelevant to the problem under consideration. A typical example is the introduction of a new computer system for use in an organization, when there is an *assumption* of a performance problem associated with the use of the new computer system. The causes for the performance problem could be, for instance, skill/knowledge related, or attitude related.

In analysing performance problems a procedure familiar to educational technologists is *front-end analysis.* This procedure is conducted to determine the nature of, and the causes or remedies for performance problems. The remedies, or solutions may require educational or training interventions, redesigning the environment, or altering the incentive and feedback system in and for an individual or an organization (Harless, 1970).

In a business or industrial setting, we often do *&job-task analysis* as part of the front-end analysis process. The job analysis procedure is used to determine the required ("what should be") tasks to be performed in a given job. A proper job analysis provides an inventory of tasks listed or charted so as to indicate the correct sequence for performing these tasks as well as any interdependencies among them. An instructional analysis is conducted in business and industry *after* the job analysis is completed (if instruction is the appropriate solution for the identified performance gap) to ensure a close relationship between the requirements of one's job and the instructional process.

In educational settings we usually assume that instruction is the correct method for solving performance problems. Furthermore, we treat performance and learning requirements as one and the same. Therefore, in education we usually do not conduct job analyses; after establishing an instructional goal, we proceed directly to conducting an instructional analysis which outlines the subskills required to achieve the instructional goal.

Alternative III: Problem Verification

The third alternative for conducting needs assessment is the *problem verification* alternative, or the "status survey" approach. This approach is often used both in business/industry and in education. In both settings the first step in the assessment procedure is to establish a "standard" or identify a "master performer." The second step is to assess all students' or all employees' performance level and identify the gap between the various current performance levels and the established current "standard" or level of performance of the "master performer." The final step in the assessment process is to establish methods and means to close the identified gaps in performance.

An example of the "status survey" approach in a business setting would be the assessment of needs of insurance claims processing clerks. Jerry, the "master" (or expert) insurance claims clerk correctly processes 50 insurance claims per day. All the other insurance claims clerks process 25-35 claims per day. Methods and means for closing the gap between Jerry and all the other insurance claims clerks must be examined and implemented as necessary. The assumption here is that 50 insurance claims processed per day is the established performance standard. Of course, by the time all clerks can process 50 insurance claims correctly per day, the standard may change to 60 insurance claims and methods/means for meeting the new standard may have to be employed.

In an educational setting, Grade 3 level reading is a standard of reading for all grade 3 students. All students in grade 3 must work on their level of reading to reach the grade 3 standard. If the standard of grade 3 reading changes at some point in the future, then students (and teachers) will have to work at closing this new performance gap.

Thus, the problem verification approach does not get into identifying or analyzing problems but rather focuses on the "what is" aspect of a situation. This approach identifies an acceptable standard of the *current* level of performance as the target (i.e., desired) one and aims all interventions at achieving this current standard. The great pitfall of such an approach is that by the time an intervention is implemented, the identified current standard for performance may be outdated. The advantage, however, is that status surveys do provide a relatively inexpensive way (no fancy analysis techniques are required) to successively approximate an improved level of performance.

DATA COLLECTION RESOURCES AND TECHNIQUES

The completeness of a Needs Assessment approach is a function of comprehensive

investigation of all variables related to identifying, analysing and verifying the problem at hand. To conduct a comprehensive investigation, one may use a variety of data collection resources and techniques. Each of these resources and techniques can be used by itself or as one of several techniques to apply in the needs assessment process. Note that some techniques are more time consuming than others (e.g., individual interviews); some are more costly than others. The data collected could be classified *as soft* or perception data, or as *hard* factual data. The accuracy of obtained information is a function of the type of data collected *(e.g., facts* about company profits and projected, calculated profits or losses tend to be more accurate than individual's *perceptions* of the same). The following are some of the needs assessment data collection techniques one can use, classified as soft or hard data resources.

Soft Data

Literature review. An analysis of related literature in the needs assessment field would include an examination of models, kits and procedures that are relevant to the intended needs assessment study (e.g., Kaufman & Mayer, 1981), as well as materials related to the topic at hand. For example, if a management needs assessment is to be conducted, then literature related to needs assessment as well as literature related to management should be reviewed. It is important to conduct literature reviews to keep up with new developments in the relevant fields.

Lessons from other organizations. This is basically an investigation of similar needs assessments that have been carried out in organizations other than your own. There is no point in reinventing a procedure that another organization has already carried out, and it is important to find out what approaches, methods and procedures have or have not worked for other organizations. Beware, however, of importing a model or method which does not fit your organization and its realities.

Archival review of internal documents. This encompasses a review of all the relevant documentation in your organization that may be related to your needs assessment effort. Data on the results obtained currently as well as the goals and objectives of the organization in terms of the expected results provide valuable information when conducting a needs assessment. Information about the performance appraisal system, job descriptions, budgeting, data on current and forecasted resources as well as results of any organizational climate or attitude surveys are valuable for determining the causes and potential remedies for identified problems. Make certain, however, that these symptoms really relate to documented organizational problems.

Human resources or personnel analysis. This could be part of the archival review of internal documents but may also rely on interviews with staffing and Human Resource personnel to identify the number and type of personnel currently available as well as human resources projections for the future.

Individual interviews. Selective interviewing in the organization is another technique for collecting needs assessment data. Usually it is recommended to interview a representative number of performers, supervisors and peers within the organization or department who are in contact with the group being investigated. Sometimes the interviewing procedure focuses only at the top level of the organization in order to get a view from the top executives, rather than from the performers themselves. Interviews can be used to set the stage for an overall survey to be conducted in an organization or as a follow-up to survey results with the intention of focusing on identifying specifics which survey questionnaires cannot sufficiently identify.

Focus groups. Focus groups are used in structured brain-storming sessions to clarify

results of surveys and to obtain additional information about items which the surveys didn't cover. Participants in focus groups are usually representative of the target audience that responded to the surveys. Sometimes focus groups are the only data collection method used. When that is the case, it is important to make sure that members of the focus groups represent the target audience in the organization accurately.

Surveys. The purpose of a survey is to obtain information from a representative group of performers, clients, peers and supervisors about the current and required levels and aspects of job performance or organizational contributions. Surveys are usually used to collect data from a large number of people and have a relatively short demand on people's time (about 10-30 minutes).

Hard Data

Hard data comes from actual controlled observations of reality. They differ from "soft" data in that actual performance or results are obtained and used to determine gaps between "what is" and "what should be."

Observations. Observing the work done at the actual job site is a technique for generating an accurate task inventory. A potential difficulty with this method is finding an observer skilled enough to accurately describe and explain the observed tasks and their interrelationships, and problems associated with assuming that an existing task is really an important one and that which is being observed is an accurate representation of the actual job.

Performance assessment. Actual work samples are taken, such as production rates and quality control data to determine what is being produced, and the quality of that production. Particularly useful for this is the comparison of measurable objectives with the actual results, such as the number of radios produced and the number of those which passes inspection.

Another type of performance assessment is a test which a learner is given after a course or experience to determine the amount which has been mastered. Still another indicator of performance would be the corporate profit and loss sheet. Performance assessments may be made at every level of organizational activity, from a particular task to the survival of an organization, from production of fenders to the safety of automobiles, from supervisory skills to corporate profit.

SELECTING THE APPROPRIATE NEEDS ASSESSMENT APPROACH

Each of the Needs Assessment alternatives described in this paper has strengths and weaknesses which can be described in terms of three basic variables.

(1) *Accuracy and Validity:* This variable relates to the quality of results accomplished as measured by the relative adequacy of the collected needs assessment data. Put another way, it is important to question the extent to which we are confident that the collected data accurately describe the real "needs."

(2) *Time:* This refers to the duration it takes to conduct the needs assessment. Some approaches are very time consuming and therefore very costly. Other approaches are quick, but may still be very costly if the results are not valid.

(3) *Cost:* The amount of money it would take to complete the needs assessment process as itrelates to the value of the obtained information is an important considera-

tion. The estimation of high versus low cost is often a function of the attributed importance or criticality of the assessed needs.

Ideally, the nature of the problem should determine the appropriate needs assessment to use. In reality, however, both in business/industry and in educational settings, compromises have to be made because of varying organizational priorities, limited resources, urgency, budgetary constraints, etc. The selected approach to conducting needs assessment therefore tends to be that which would provide the *most accurate* (and valid) needs assessment information at a *minimal cost* and in the *shortest time* period. Using the accuracy, time and cost criteria, the three alternatives to conducting needs assessments can be compared as follows.

Problem identification. This tends to be the most accurate approach to assessing needs. It is complete, comprehensive and rigorous. If done right, the problem identification approach would provide data about resources, procedures, results and consequences. Accuracy will increase if several data collection techniques (e.g., literature review, archival review, interviews, survey, etc.) are used. The assessment process will vary in time and cost requirement, depending on the nature and scope of the problem at hand. Problems of a large scope usually take longer to solve and are more costly. Time and cost can sometimes be reduced by using only one or two data collection techniques rather than a combination of several.

Problem analysis. This approach tends to be less accurate than the problem identification approach because problem analysis focuses on analysing pre-determined problems without necessarily questioning the *validity* of these problems. In all other respects the problem analysis approach is similar to the problem identification approach. Here too, shortcuts can be taken by limiting the type and number of data collection techniques utilized and thus reducing the time and cost of the process. Such shortcuts, however, may affect the accuracy and validity of the results of the needs assessment process. Decisions regarding the needs assessment action plan and methodology should therefore be carefully examined in light of the relative importance of expected results.

Problem verification (status survey). When a decision is made to select the status survey approach, it is implied that a "quick fix" to a problem is required. This approach tends to be the least accurate of the three needs assessment alternatives and is usually based on individuals' perceptions of a current situation without a careful identification and analysis of future ("what should be") requirements. The time and cost of a status survey vary according to the data collection methods used (e.g., surveys are usually less expensive and less time consuming than one-on-one interviews).

The final decision regarding which needs assessment approach best fits one's requirements is thus a function of a number of factors. Shortcuts and compromises may be taken in using each one of the three alternative needs assessment approaches presented in this paper. One should always consider the scope and relative importance (or criticality) of the problem at hand and ensure that any shortcuts in the methodology which are intended to save time and money do not result in an intolerable compromise in the accuracy and quality of the needs assessment results.

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CONFERENCE

YORK UNIVERSITY, JUNE 14 and 15,1986

The Canadian Association for Distance Education will hold its first face-to-face conference on June 14 and 15,1986, at York University. The dates have been chosen to co-ordinate with the AMTEC conference scheduled in Toronto, June 15-18 and the GAUGE annual meeting and conference scheduled for Ottawa, June 17-19.

The format of the conference will be such as to maximize the participation of registrants in interactive sessions involving discussions and workshops on a variety of topics. **Topics may include:**

- **copy writing**
- **relations with traditional educators**
- **course design**
- **analysis and evaluation of pedagogical systems**
- **administrative support and systems**
- **the distance education learner**
- **new interactive technologies**
- **market analysis**

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Media Managers

Al LeBlanc, Editor

Media Personnel Identity Crisis

Al LeBlanc

One of the greatest stress points for media personnel is the problem of role perception by fellow employees within an institution and from outside the field. To compound the problem is a lack of clear definition of duties and functions from the general to the specific. Very often the question, "What do you do for a living?" generates a puzzled expression as we try to put into layperson's terms what it is that we dp (so well).

In the media field we are often confused by a wide variety of labels attached to the role from place to place. Usually, following the label Media or A/V we tag on such qualifiers as Supervisor, Coordinator, Consultant, Teacher, Manager, Director, Superintendent, etc. In order to provide some reference points for a "re-think" of this dilemma, I have included two actual definitions currently in use by an Ontario School Board. One is for a Coordinator and one is for a Consultant.

Definitions

Coordinators. Coordinators are individuals appointed by a Board to coordinate a department which functions across the total school system. The Coordinator organizes and operates the department subject to the authority of a supervisory officer. The Coordinator works with professional staff in the department and across the school system.

Consultants. Consultants are individuals who are appointed by the Board in various specialty areas because of their expertise in these areas. Consultants are not responsible for other professional personnel. Consultants work with teachers to assist in improving the quality of the teaching/learning process in the school. In some larger departments, consultants are responsible to department coordinators.

Duties of a Coordinator

Following is an actual sample of the duties of a Media Coordinator as implemented by a school board:

DUTIES OF COORDINATOR
MEDIA RESOURCE CENTRE

A. Related to correlation of resources with the needs of principals, teachers and students.

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Development of programmes in media utilization.

Provision of the following areas of service:

- Selection of materials;
- Cataloguing and processing;
- Reference Service;
- Production of graphic and photographic materials;
- Production and electronic distribution of radio and television materials;
- Circulation of loan materials.

Promotion of cooperation in matters relating to media with other school systems, with libraries, museums, etc. in the community, and with provincial and national institutions and agencies of government.

- Collaboration with supervisory staff developing curricula, to ensure that materials are purchased and/or produced that are appropriate to these curricula, and to assist teachers to become familiar with these materials and with associated equipment.

Development of programmes to promote and facilitate the use by teachers of materials in different and complementary media.

Arrangements for the professional development sessions by activities within and beyond the school district.

- Provision for the exchange of information and ideas between school learning resource teachers and their staff.

Implementation of procedures for previewing, evaluating, acquiring, cataloguing and processing of materials in cooperation with classroom teachers, curriculum specialists, and others.

- Provision of a complete reference service and a multi-media professional library.

B. Related to Administration, Director, Superintendents and Board.

- General supervision of the programme of the district learning resource centre.

Maintenance of statistics and records as required by the Board.

- Maintenance of information files concerning publishers, producers, and other sources of materials available for acquisition by purchase, lease, etc.

Arrangements for evaluating media equipment, including field testing, and advising, concerning their suitability for purchase or lease.

Preparation of the budget for the Media Resource Centre.

Arrangements for acquired materials to be received and prepared for circulation.

Maintenance of inventory of replacement parts (for repairs) and of consumable supplies (for local production of materials).

- Operation of efficient distribution and circulation systems for loan equipment and materials.

Supervision of the clerical and technical functions of the Media Resource Centre.

C. Related to Technological Processes and Operations.

Examination of each request for production with the interested party to determine the best medium (or combination of media), format, and other technical aspects most likely to achieve the desired educational goals within the available budget.

- Arrangements for media equipment maintenance.

Conclusion

In the field of media in Canada, two documents which are very helpful in addressing the Media Personnel Crisis are:

(1) *Educational Media Personnel Classification Series* (June, 1974), prepared by the Media Directors of Ontario Universities by David Bennett and D. Douglas Todgham; and, (2) *Resource Services for Canadian Schools* (1977), by F. R. Branscombe and Harry E. Newsom, published by McGraw-Hill Ryerson.

The second document was the source from which the above Media Coordinator's duties were drawn. This text is a "must read" for all media personnel as it addresses roles across the spectrum in any media operation. It is also an excellent planner to deal with most facets of media services.

Sixth International Conference on TV Research

Concordia University, Montreal: June 18 - 21,1986

The Conference continues a tradition of meetings formerly held at Memorial University of Newfoundland. The series stresses the uses of theory and research in practical aspects of TV production, and has attracted TV researchers, producers and policy-makers from all continents.

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Manfred Meyer
Internationales Zentralinstitut fur das Jugend und Bildsfernsehn
Munich

Robin Moss
Head of Educational Programmes Services,
Independent Broadcasting Authority, U.K.

Takashi Sakamoto
Professor of Educational Methods,
Tokyo Institute of Technology

Further Details and application forms are available upon request. (Delagates to the AMTEC conference, ending May 18, may apply for a reduced rate)

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FINGERPRINT PLUS Parallel/Serial Printer Interface with Print Screen Key

Available From: Thirdware Computer Products, 4747 N.W. 72nd Ave., Miami, FL 33166. Cost: $100 to $150 (US).

How many times have you been using your favorite Apple II computer to generate tutorial material and said "gee whiz, I wish that I could print that screen on paper to show my students exactly how this part of the program should look"! In a nutshell, the Finger-Print Plus printer-interface card gives the Apple II computer the much needed screen print function. The user needs only to press one "activator" button and the program (copy protected or otherwise) will freeze. Then, whatever is on the monitor, picture or text, can be printed on paper or dumped to disk. Once the printer or disk operation has been completed, pressing escape returns the program to operating status without the program having to retrace its steps to the point at which it was frozen.

The FingerPrint Plus card contains both parallel and serial interface capabilities. The parallel configuration emulates a Grappler Plus interface card and the serial configuration emulates the Apple Super Serial card. By maintaining this type of popular card emulation, Thirdware Computer Products has made it difficult to find a pieci of software that will not run with this equipment. While the cable for only one type of interface is normally supplied with the card, the alternate form of the cable can be purchased at any time. Hence it is also difficult to find a printer that cannot be used with the FingerPrint Plus interface card.

As is illustrated in this sample screen dump (Figure 1 on next page), in addition to its "print and save" function, FingerPrint Plus also provides more that 30 different yes/no command options on the main menu screen. These options permit the user to format the printed output, examine the program code and/or manipulate the graphics screen images. Access to these options is gained by pressing the space bar to toggle between the main functions listed at the top line and the enhancement options listed in the menu. The arrow keys enable movement among the options and when the desired choices have been made, pressing the return key activates the desired printing function.

In the top line functions are the global functions. *Display,* allows the user to preview text, graphics or mixed text and graphics screens. *Print,* sends the output to the printer. *Type,* turns the computer into a typewriter by sending the output directly to the printer upon every keystroke. Commands to the card itself can also be issued from this function.

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FIGURE 1.
Functions in Fingerprint Plus.

```
FUNCTIONS:DISPLAY PRINT TYPE DISK/JUMP
######################################## 000
OPTIONS:

APPLE TEXT          Y     GRAPH PAGE 1        N
VIDEX               N     GRAPH PAGE 2        N
STATUS SCREEN       N     DOUBLE HIRES        N
LINEFEED            Y     LOW RES             N
LEFT MARGIN  000    N     MIXED MODE          N
LINE WIDTH   080    N     INVERSE             N
PAGE LENGTH  000    N     DOUBLE WIDTH        N
PAGE NUMBER  000    N     ROTATE 90           N
PAGE HEADING        N     X AXIS  FOOOTOOO    N
SERIAL PORT         Y     Y AXIS  FOOOTOOO    N
PARALLEL PORT       Y     COLOR               N
DEFAULT SET         Y     BACKGROUND   0      N
JUMP TO MONITOR     N     FOREGROUND   0      N
JUMP TO FP RAM      N     8TH BIT             N
LOCK                N     SWITCH:12345678     N


ESCAPE "ESC" TO RESUME
```

Disk/jump, provides the user with the ability to jump to the monitor or to the FingerPrint Plus RAM. If these functions are not invoked from the menu, then the screen image can be saved to disk.

Finally, the support materials deserve some comment. For example, a test disk is supplied with the card. The program on this disk verifies the proper functioning of the card. In the event of the user experiencing difficulties during the installation process, which only requires inserting the card into the motherboard and setting the dip switches, this feature can be helpful in demonstrating to the user that the problem lies somewhere outside the computer and is not the result of a malfunctioning interface card.

Two weaknesses have been identified thus far in the six months of use that this card has seen. These are in the owner's manual and the binary image storage system. In the manual, all the necessary information seems to be there, but the treatment of the topics is rather sketchy. For example, in the explanation of how suffixes are used to determine the type of screen being saved, the last line states that "further information is available from Thirdware Computer Products." This is nice, but why not be a little more detailed in the manual and save the user what could be an unnecessary delay. In the second case, the storage system used to store the screen image on disk does not use a standard DOS 3.3 binary format. Thus, it is a bit difficult to access this image with a standard word processor to incorporate it into the desired place in the text of a document. Fortunately, to rectify this deficiency, the magazine InCider came to the rescue and published a program called "Screen Saver" earlier this year.

On a more positive note, it is only fair to say that the Thirdware technical support staff deserves a pat-on-the-back. In the two times that I have had to call for assistance, they have been both knowledgeable and willing to provide the assistance desired. It is indeed reassuring to find a third party product that has quality, utility and has technical support available when it is needed.

From the Media Periodicals

Richard Ellis, Editor

This column is a listing of articles that have appeared recently in the literature of educational media and technology.

BRITISH JOURNAL OF EDUCATIONAL TECHNOLOGY, 16 (3), 1986.

Jennings-Wray, Z. I., & Wellington, P. I. "Educational Technology utilization in Jamaica's secondary school system: Present problems and future prospects."
Harvey, T. J., & Wilson, B. "Gender differences in attitudes towards microcomputers shown by primary and secondary school pupils."
Johnston, V. M. "Introducing the microcomputer into English, parts 1-3."
Barker, P., & Singh, R. "A practical introduction to authoring for computer-assisted instruction. Part 5: PHILVAS."

CLASSROOM COMPUTER LEARNING, 6 (3), November/December, 1985.

Brady, H. "Hang on to the power to imagine: An interview with Joseph Weizenbaum."
Burch, F., & Aaronson, T. "The rocky road to logical thinking."

CLASSROOM COMPUTER LEARNING, 6 (2), October, 1985.

Huber, L. N. "Computer learning through Piaget's eyes."
Olds, H. F., Jr., & Dickenson, A. "Move over, word processors - here come the databases."

CLASSROOM COMPUTER LEARNING 6 (4), January, 1986.

Brady, H. "Artificial intelligence: What's in it for educators?"
Becker, H. J. "Our national report card: Preliminary results from the new John Hopkins survey."
Sneider, C., & DeVore, E. "Halley's Comet and beyond."
"Classroom and Computer Learning 1986-87 buyers' directory."

COMPUTERS IN EDUCATION, November, 1985.

Lenk, F. "Clones in education."
Dvorchik, S., & Waseylenki, L. "Word processing activities III: Resume writing."

Richard Ellis is with the D. S. Woods Educational Library at The University of Manitoba, Winnipeg, Manitoba.

Adams, C. "Composing with computers?"

COMPUTERS IN EDUCATION, December, 1985.

Eiser, L. "It's time for the school bake sale - and a spreadsheet can help."
Aubie, R. H. "A computer club in your school."
"Canadian Educational Microcomputer Director."
Cathcart, W. G., & Cathcart, G. M. "Finding the range of a set of data using Logo."
Nicklin, R. C. "Armadillo: A CG4 project."

COMPUTERS IN EDUCATION, January, 1986.

Junyk, M. "Computers in kindergarten."
Woods, G. "Basic motivation."
Cathcart, G. M., & Cathcart, W. G. "Let's make a Logo quilt."
Nicklin, R. C. "Analog to digital converter and the C64."

EDUCATIONAL TECHNOLOGY, 25 (11), November, 1985.

Butler, F. C. "The teaching/learning process: A unified interactive model (part three)."
Hazen, M. "Instructional software design principles."
Wisely, F. G., & Streeter, C. E. "Toward defining the function of visuals used to support a verbal narration."
Lindelow, J. "Decision support systems and the microcomputer revolution."
Carter, A., & Schmidt, K. C. "An assessment of the production and utilization of instructional media by student teachers."
Moonen, J. "The Dutch information stimulation plan: activities of the Center for Education and Information Technology."
Pollock, J. "Authoring courseware: No skills necessary?"
Fellmy, W. R., & Nicholson, E. W. "School computer priorities in the information society."

EDUCATIONAL TECHNOLOGY, 25 (12), December, 1985.

Costanzo, W. V. "Interactive text editors: A new generation of teaching tools.[1]
Sawada, D. "New metaphoric images for computers in education."
McKeen, G. R. "Video game violence in computer software/courseware."
Johnson, J. F., & others. "Storyboarding for interactive videodisc courseware."

EDUCATIONAL TECHNOLOGY, 26 (1), January, 1986.

Schiffman, S. S. "Software infusion: Using computers to enhance instruction. Part one: What does software infusion look like?"
Johnson, D. W., & Johnson, R. T. "Computer-assisted cooperative learning."
Will, B., et al. "The design and application of a distance education system using teleconferencing and computer graphics."

Kaufman, R. "Obtaining functional results: Relating needs assessment, needs analysis and objectives."
Dalton, D. W. "How effective is interactive video in improving performance and attitude?"
Reilly, S. S., & Roach, J. W. "Designing human/computer interfaces: A comparison of human factors and graphic arts principles."
Vermette, S. M., Orr, R. R., & Hall, M. H. "Attitudes of elementary school students and teachers."
Findley, C. A. "Gaming simulation in management education: State-of-the-art.'

MEDIA IN EDUCATION AND DEVELOPMENT, 18 (4), December, 1985.

Bradley, J. "Distance teaching in developing countries."
Harper, M. "Scitech: An open learning programme for educational laboratory technicians."
Gartside, P. "ICDE conference - Melbourne '85."
Ward, P. "The BBC help-yourself approach to learning."
Bright, S. "Video for extension workers in Zimbabwe."
Garforth, C. "Mass media and communications technology."
Nicol, D. "New information technologies in higher education."
Wiio, O. A. "Information economy and the information society."

MEDIA & METHODS, 2 (3), January/February, 1986.

Ferralli, A., & Ferralli, K. "Interactive video: A tool for changing times."
"1986 buyer's guide and reference directory."
Price, R. V., & Fred, B. "Automated circulation in the school library: A case study."

PROGRAMMED LEARNING & EDUCATIONAL TECHNOLOGY, 22 (4), November, 1985.

Yule, R. M. "The problem of pacing a student learning at home."
Taylor, P. C. "Illuminating primary distance education in Australia."
Winders, R. "Teleconferencing student interaction by telephone - the PACNET experience."
Morpeth, R., & Lo. J. "English for driving."
Buter, E. M. "Teacher training technology revisited."
Dunnett, C. W. "The technologies of education, communication and distance education."
Tinsley, D. "The Open Tech Programme."
Mitchell, A., Perfect, H., & Body, J. "Scope for profiling: Computer support for teachers in developing profiled reports."

SCHOOL LIBRARY MEDIA QUARTERLY, 13 (3 & 4), Summer, 1985.

Considine, D. "Media, technology, and teaching: What's wrong and why?"
Hodges, Y. A., Gray, J., & Reeves, W. J. "High school student's attitudes towards the library media centers in networks."

Doan, J. K. "School library media centers in networks."
Baker, P. R. "Adoption of a computer software cataloging system at an elementary school."

SCHOOL LIBRARY MEDIA QUARTERLY, 14 (1).

Liesener, J. W. "Learning at risk: School library media programs in an information world."

Are there special topics that you would like to see in *CJEC* columns?

If so, send your ideas or submissions directly to the column editors.

MEDIA MANAGERS deals with issues and topics related to all aspects of media management.
Send submissions (four page maximum) to:

Mr. Al LeBlanc
Media Resource Centre
Separate School Board
395 Korah Road
Sault Ste. Marie, Ontario P6C 4H5

MICROWARE REVIEW addresses topics related to the use of microcomputer software.
Send ideas or topics to:

Dr. Len Proctor
College of Education
University of Saskatchewan
Saskatoon, Saskatchewan S7N OWO

BOOK REVIEWS reviews recent books in the area of educational communication and technology.
Send review submissions (six page maximum) or titles of books to be reviewed to:

Ms. Suzanne Daningburg
Department of Education
Concordia University
1455 de Maisonneuve Blvd W.
Montreal, Quebec H3G1M8

Mediography

Nancy L. Lane, Editor

This column contains titles and a brief annotation of media products that are currently available on the market. In each issue of *CJEC,* a different theme is researched.

TECHNOLOGY AND THE CLASSROOM

The effects of technology in the classroom are of great importance to educators. Listed below are a number of programs relevant to the topic.

COMPUTER AND THE HUMAN SPIRIT

TVO 1985, 30 minutes. From the *Reality Series,* this program explores the effects of computers on language, culture and society.

DONT BOTHER ME: ADVENTURES IN COMPUTER EDUCATION

MGHT 1981, 24 minutes. A motivating program on the revolutionary use of the computer in the classroom.

EDUCATION

EB/VEC 1985, 30 minutes. From the series *Computer Applications,* this program investigates and discusses the role of computers in education.

KALEIDOSCOPE : REFLECTIONS ON RESOURCES

NYB/Marlin 1984, 16 minutes. This program demonstrates the involvement of teacher-librarians in the educational process.

LEARNING WITH FILM AND VIDEO

Gordon Watt 1985, 15 minutes. For teachers, this program discusses film and video as valuable and essential classroom aids.

MASS COMMUNICATIONS IN CANADA

Sim. Fr. U/Mag. Lant. (10 programs in production). These programs will explore communication technologies in Canada.

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THE MEDIA BETWEEN US

NFB 1969, 20 minutes. A documentation of the 1968 Summer Research Institute of Screen Study. Much of the discussion centered around the impact of technology. An interesting document.

MICROS IN THE CLASSROOM

BBC 1982, 25 minutes each. This series of five programs depicts examples of a number of ways computers are being used in schools.

THE NEW COMPUTER KIDS

TVO 1985, 30 minutes. From the *Realities Series,* the relationships of children of different ages, with computers is the focus of this interview.

NEW TECHNOLOGY IN EDUCATION

Univ. of N. Y. 1982 16 (16 programs, various lengths). A wide range of programs - titles include *Why Should Education Be Interested in Technology* and *Computer Literacy: A New Subject in the Curriculum.*

NEXT STEPS WITH COMPUTERS IN THE CLASSROOM

PBS 1985 (12 - 30 minute programs). Designed for educators, this series examines technology as a tool in the educational process.

TECHNOLOGY AND THE CANADIAN MIND

TVO 1985, 30 minutes. From the *Realities Series,* the thoughts of Harold Innis, Marshall McLuhan, and George Grant are discussed.

USING MEDIA FOR LEARNING

Assoc. Ed. Com. & Tech. 1983 (20 programs, 30 minutes each). These programs explore the use of media for teaching and learning. Titles include *Instructional Environments* and *Resource Centers and Trends in Instructional Technology.*

WELCOME TO THE FUTURE: COMPUTERS IN THE CLASSROOM

MFF/VEC 1983, 28 minutes. Educators demonstrate a variety of ways computers can be used in schools.

YOU, ME, AND TECHNOLOGY

AIT/Kinetic 1983 (2 - 20 minute programs). The first is titled *Living with Technology;* the second *Decisions; Decisions, Decisions.*

Book Reviews

Suzanne Daningburg, Editor

Two books are reviewed: *The Canadian Encyclopedia* and *The Videotex and Teletext Handbook - Home and Office Communication Using Microcomputers and Terminals* by Paul Hurly, Mathias Laucht and Denis Hylnka.

The Canadian Encyclopedia (1985). Edmonton: Hurtig Publishers, 3 Vols., 2089 pages.

Reviewed by Denis Hlynka

Everyone is talking about it. Canada finally has, once again, its own encyclopedia. At the pre-publication price of $125, it was the best book bargain around. Even at $175, if you can still find one, it's worth the price.

Educational technologists in Canada will of course want to know what is in it for them. The quick answer is, "a lot," although there is never quite a specific mention or reference of a field of educational technology or even educational media in Canada. Certainly this is one omission which Mr. Hurtig and company should consider for a future edition.

Three sub-domains of educational technology do get an entry in the encyclopedia, namely "educational broadcasting," "computer assisted instruction," and "distance education." Of course, practitioners in those fields may not necessarily consider themselves within educational technology. Such has often been the case.

The *Educational Broadcasting* article provides as good an overview as any of both the history and state of the art. Three minor points however deserve comment. The author equates distance education with "learning by yourself, in the home." On the contrary, distance education is NOT a contemporary term for *correspondence education.* "Distance education" more often takes place in a classroom where a small group can take part in a course at-a-distance, offered usually from some central institution, often a university. Although broadcasting media may indeed provide an adjunct to distance education, the major medium of distance education is in fact the amplified telephone. There is, as we have already noted a separate entry in the encyclopedia on "distance education." Oddly, neither article refers to the other. Obviously both were written in isolation.

The same paper also makes reference to *Sash Media,* without mentioning that that experiment is now defunct, and has been for several year.

Finally, other articles of the size of this one include at least a short bibliography. This one has none, even though the literature on Canadian educational broadcasting is quite substantial.

Computer Assisted Learning is a second article which has direct relevance to Canadian

educational technologists. It provides an excellent overview of a rapidly changing and developing field. I do take issue with the author's attempt at distinguishing between CAI and CAL: "The first is often called computer assisted instruction, and can best be described as learning through a computer...the second major use of CAL is one in which students tend to write their own programs to solve problems, this is described as 'learning with computers' or, more simply, using computers as tools." While the distinction of learning *through* and learning *with* as related to computers is a neat one, it unfortunately does not reflect historical reality. There is no doubt that several authors have attempted to distinguish between the two terms, just as twenty years earlier, attempts were made to distinguish programmed instruction and programmed learning. Yet when all is said and done, it is quite arguable that the terms are synonymous, and reflect only a cultural difference. Ivor Davies in particular has convincingly argued that the word *learning* is simply the preferred term in Britain, while the term *instruction* is preferred in the USA. Whether there is any real philosophic rationale behind the use of each term is debatable. I recall once reading an author who tried to distinguish between programmed instruction with two m's and programmed instruction with one m, in much the same way. What the writer (who shall go unidentified) didn't realize was that the differences reflected purely a cultural difference (this time spelling), between Britain and the US. So it is with CAI and CAL.

A last comment on the CAL article: The narrow title excludes any potential discussion of "computer literacy," which certainly is equally important today in terms of educational use of the computer.

Distance Learning receives detailed and adequate treatment, and provides an excellent overview of what in many ways is a uniquely Canadian solution to an educational problem.

While the above articles are the only three directly relevant to educational technology, there are a host of entries of indirect interest. Some of these can be found under headings of computers and society, curriculum development, copyright law, communications studies, communications, Canadian Broadcasting Corporation, National Film Board, satellite communications, Telidon, McLuhan, media ownership, photography, radio programming, and communications in the north, to name only a handful.

Two quick points in passing: 1) The "communications" article erroneously refers to videotex as videotext. 2) The copyright article quotes the classic understatement which every educational technologist knows by memory, namely that copying is acceptable when it is "fair dealing with any work for the purposes of private study, research, criticism, review, or newspaper summary." We all know that such a statement tells us absolutely nothing. The article does go on, interestingly, to suggest that under Canadian law, audio and visual recording at home "would most likely be considered (an) infringement of copyright." Another statement suggests that "the technology of reproduction that includes photocopying is an infringement of copyright in literary work; the difficulty in detection arise..." One is tempted to suggest that there is no problem in detecting someone sitting at a photocopy machine at all, the problem is in the ridiculousness of an uninforceable law which takes no consideration of the needs of education.

If the above comments seem picky and detailed, it is only because this reviewer believes in a good Canadian encyclopedia, and applauds the efforts of its developers. Some errors have crept in; some contradictions exist, but these can be corrected next time round. There are also a few missing articles. *Educational technology* is one of them, especially since the parts of educational technology do get included. Again, this can be corrected in a new edition.

In general, the encyclopedia is necessary, it works, and it is very needed. Congratulations to all those involved in helping Canadians'to better know themselves. And if educa-

tional technology is not yet given the prominence it deserves, perhaps that is an issue for AMTEG to address in the near future.

The VIDEOTEX and TELETEXT Handbook - Home and Office Communications Using Microcomputers and Terminals, by Paul Hurly, Matthias Laucht and Denis Hlynka. New York: Harper & Row, 1985. 404 pp. ($21.95 US, paperback).

Reviewed by Gary Boyd

Probably the first question to ask when'reviewing a book is: "Who can be nourished by this book"? In the context of *CJEC,* the question becomes; who among our readers will be nourished by the *VIDEOTEX and TELETEXT Handbook?* The communication services discussed are of a public nature; potentially everyone is a user. These systems have been used experimentally, and are being used for delivering distance education. The alpha-geometric graphics encoding techniques (and the NAPLPS standard) are applicable to many forms of computer-generated instructional graphics, and to the production of graphics for television and for optical videodisc media. Consequently, if you are an educational technologist working in distance education or in media production, this book may be valuable to you.

The preface says: "This handbook will introduce readers to the facts and the myths, the potential promises and the perils that videotex information technology offers." In other words, it is a handbook for *beginners* and for those wishing an introductory overview. It is not intended as a handbook for advanced workers in the field, although it does have much information which should be of value to them. In actual fact, the book gives a good introductory coverage of facts, exemplifies some of the myths and exhibits a few of the promises and perils.

This book is about public computer-mediated communication. The authors re-define VIDEOTEX very broadly as "a generic term for systems that provide easy-to-use, low cost computer-based services and communication facilities." This is a curiously broad definition of VIDEOTEX, since the term actually was defined by the CCITT' to cover such systems as PRESTEL, TELIDON and ANTIOPE (which have not been notably successful). To use the term in such a broad way as to include the PC-oriented successful networks (e.g., The Source, COMPUSERVE, etc.) in with the stumbling, TV-oriented systems is rather as though a hundred years ago some influential people insisted on using the term "telegraph" to include the telephone as well! The trouble with this is that it blurs over a profound distinction in *accessibility* between VIDEOTEX and PC telecommunications. Therefore, it is not surprising to find that what this handbook does *not* do is relate these new technologies to the underlying politico-economic struggles of modern society. There seems to be an unspoken assumption that the readers are or will be largely passive consumers of this technology rather than being protagonists who are actively shaping it.

It is to be hoped that the scientific and professional expertise of educational technologists can be mobilized to shape these technologies into forms which will best serve a

[1] C.C.I.T.T Regulation S70, November, 1980.

pluralistic multitude of societal clients, not just large corporations and governments. In a paper entitled "Four Ways of Providing Computer Assisted Learning and their Probable Impacts" (Boyd, 1982), I have dealt with the differential impact on client groups which different configurations of these "compunications" or "computercations" systems do have. There is a need to be very clear about *which interest* groups we are supporting, and how the technical aspects of hardware, and the technical aspects of message design and control *differentially* help or hurt these groups. This type of discussion does not occur and is not alluded to in this handbook. That is my main caveat about it.

A secondary reservation is that the technical expositions seem to cater more toward a superficial familiarity with appearances and vocabulary than with the deeper more coherent understanding which is needed in our profession. I think Dean Gengle's (competing) book the *Netweaver's Sourcebook* is much more thorough in this respect. (It also is valuably humorous at times.) Admittedly, any book such as *The Videotex and Teletext Handbook* which is attempting to cover a dozen engineering technologies and a half dozen fields of application must rely on references and bibliographies to provide much of the depth.

The bibliographies of the Handbook are quite good and quite up to date in the technical, social and educational fields. There are notable omissions like Gengle's book, and the educational teleconferencing books by Lome Parker and some important papers by G.A.B. Moore (1985), Geoff Potter (1985), and Boyd (1982). But considering that the book is packaged for an American audience by a U.S. publisher, it does manage to retain a remarkable amount of Canadian material. This is a valid tribute to the amount of Canadian foresight and industry which has been exercised in this area.

The *Videotex and Teletext Handbook* provides a great deal of valuable technical information on protocols, ISO standards, and hardware characteristics which is nowhere else so simply explained and handily packaged. There is also useful commercial and organization information such as the directory of Canadian VIDEOTEX firms and their capabilities, as well as market size and growth tables, which may be of considerable use to entrepreneurs in the field. (The principal Montreal-based firm in this field, Formic Videotex, is however omitted).

The book appears to be the latest in a series of similar works advocating TELIDON/ VIDEOTEX as a super tool that ought to be used by everybody. Other books in this genre are: Godfrey and Chang's (1981) *The Telidon Book,* which is cited and James Martin's (1982) *Videodata and the Information Society* which is not. A more profound work is Hiltz and Turoffs' (1978) *The Network Notion,* which I like for its deeper coverage of the nature and implications of social group processes on-line.

In my opinion, VIDEOTEX is an educationally disappointing medium for three reasons. Two of these reasons are purely technical, while the third results from the specific mixture of techni-political and economic forces involved. First, the cheap decoder and display hardware now available yields only low resolution graphics which experimental work, such as that of Geoff Potter and others in Alberta, has shown to be severely limiting for instructional purposes above the primary school level. Second, there is no encoding/ decoding standard for audio even though sounds and speech are not only important, but necessary for many educational purposes. Finally, VIDEOTEX systems are, for the most part, centralized "totalitarian" systems where a few priveledged and powerful, so-called "IPS" (Information Providers), broadcast their material for the edification of all.

The practical and technical side of this is that ordinary teachers cannot cheaply encode their own graphics or video clips or transmit their contributions to the data base and to students because the *affordable* NAPLPS hardware available is for display only. Moreover, most of the central computer systems are set up to discriminate against user input, and

against user-to-user communication. For example, the major system in the United Kingdom, PRESTEL, has a 1200 baud rate channel *out* for pictures and words going from the IP to the users, but only a 75 baud rate channel for the users return contributions or user-to-user mail. 75 baud is painfully slow.

Systems such as the SOURCE, CompuServe, I.P. Sharp, Guelph University's CoSy and UBC's Forum are much more democratic. These systems, however, are mainly for text transmission albeit at a comfortable 300 or 1200 baud rate.

Also, the total costs of these services are very high ($5/hour and up) in terms of an average student's budget. However, college level courses and training courses are now being given on the Guelph University system and soon will be given, I understand, by Quebec's TELUQ and by Athabasca University.

Although the book does have some information on how lessons are actually structured to be delivered by videotex, it does not summarize the research on the effectiveness and ineffectiveness of such use. Nor does it mention which courses, such as the QUBE courses for firemen and the Alberta primary school experiments, have proven to be effective educationally. In actual fact, the low-resolution slow build-up graphics and the very limited interactivity available with most current NAPLPS systems severely restrict worthwhile usage of the medium to simple subject matter and to introductory courses (Potter, 1985).

Even if one likes the idea of promoting NAPLPS/VIDEOTEX for educational and training purposes, one still may feel that this book does not do so effectively. For example, the CONSORTEL library of courseware (Hart, 1985) incorporating NAPLPS graphics is not mentioned. The Guelph University experiments of G.A.B. Moore, combining NAPLPS graphics and computer aided learning are not alluded to. To be fair, it should be stated that chapter 4 has a very good bibliography on uses of videotex in education and training. Three important works which I would add are: Rudy Bretz' (1983) *Media for Interactive Communication* and Lome Parker's two books *Teletechniques: An Instructional Model* and *Teletraining Means Business*. Parker's books, while largely audio oriented, do give a better indication of the educational potential which lies around the corner if and when computer communications become able to cheaply handle high resolution graphics, animation and audio in fully reciprocal modes.

Chapter 13 does a good job of discussing doubts about VIDEOTEX as well as the major factors limiting its growth. It points out the seriousness of not providing, for example, unique options, low cost service, and network interconnecting gateways. With its length of only 5 pages, however, this chapter is disproportionately small compared to the many pages of reproductions of crude VIDEOTEX screens which are reminiscent of the TELIDON and PRESTEL publicity leaflets of years gone by.

The future of VIDEOTEX in education may actually be very bright if we form coalitions to make it so. But, more *educational* research with computer-mediated telecommunications is badly needed now to determine optimal configurations and protocols before we rush into implementation. In my view these technologies are too inaccessible and rudimentary yet for widespread educational use. We need cheap fully reciprocal access with real animated graphics and audio, as well as coloured text.

The time will come when all that we need is technologically possible at low cost. But, the question remains whether financial and political interest groups will see fit to allow us to have the best configurations of such services for education. There is a tremendous amount of, in a sense fully justified, fear of really effective education, and of really open public communication. If truly potent educational communication ever becomes widely available, important new public interest coalitions will arise. If we want this we will have to fight for it. Technology implementation is shaped by vested interests. There is but little intimation in

this book of the huge political and cultural struggle which must be fought for the evolution of the kinds of publicly accessible communications that can ensure more potent education. Nonetheless, the technical introduction that this book provides could well be your first step toward such effective engagement.

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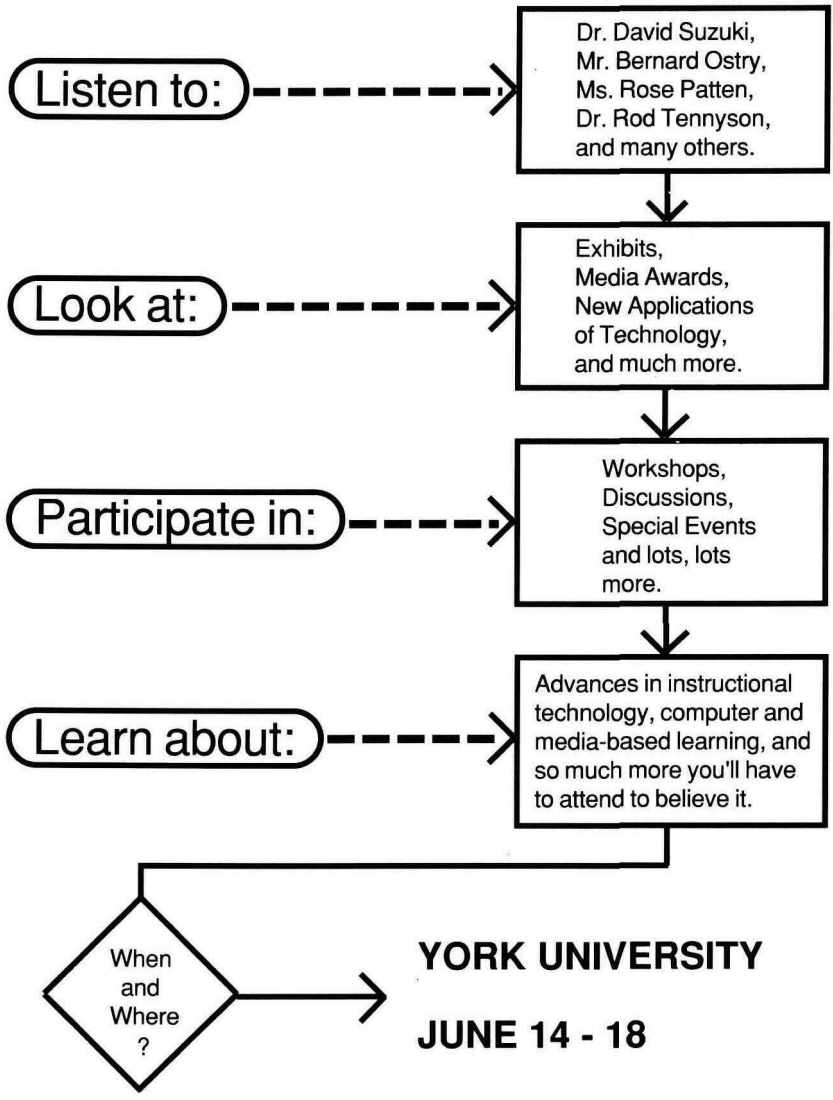

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