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ERRATUM

The article entitled, "The Formative Evaluation of a University Videotext System" by Richard T. Hezel and Karen R. Miller was omitted inadvertently from the front cover contents. The Editor apologizes sincerely to the authors for this mistake.

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Perspective

Theoretical Bases for Research in Media

G. M. Torkelson

A persistent problem facing teachers and researchers alike is finding answers to the questions: what point of view should I assume and what evidence should I use to determine the effects of media upon learners and the ways that learners utilize media to perceive and process information? After many years of research in media these same questions are still being asked and are still largely unanswered, at least to the degree that 'there are absolutes to guide educators in making decisions. Yet, looking at this situation from an historical perspective, developments over the past ten to fifteen years give promise of more definitive directions.

It is probably fair to say that most studies of media applications to instruction in the first five or six decades of this century were built upon narrower theoretical positions than today. That is, the effects of media upon learners were analyzed primarily as stimulus presentations which were to have a direct influence upon subsequent behavior. Learners were assumed to be reactive and under stimulus control. For example, in 1963, Finn, in defining "instructional technology", suggested that it was "...a branch of educational theory and practice concerned with the design and use of messages which control the learning process." But there were others who had a different view. Several years earlier than Finn, Carpenter (1957) contended that "...teaching materials are effective...depending on the degrees of their personal relevance to learners... The organism or individual interposes its entire relevant life history between the stimulus material and his or her response." In a similar vein, Hartman (1963) in a review of learning theory, emphasized ". . .that facilitation or interference with learning arises from the cognitive organization the respondent imposes upon the message."

While there were others thinking as Carpenter and Hartman, most media studies were characterized in the familiar gross *comparisons* format. Such research seemed a natural reaction to the expanding availability of media through federal funding and the need to prove the utility of media for the improvement of education rather than a need to analyze the peculiar characteristics of media themselves. Much research studied learning with media rather than studying *about* media effects. All of us are familiar with the oft-repeated phrase

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"no significant differences." Subsequent analyses have criticized the assumption that global forms of media, such as television and films, were unambiguous entities that somehow could be described and controlled to determine a cause and effect relationship with any precision. Additional criticism focussed on the theoretical assumption that learner responses were directly influenced by the stimulus input, with little regard for either the contributions of learner idiosyncracies or the peculiar characteristics of media themselves.

More recent analyses of viable ways to conduct research and to define the nature of fundamental research questions have focussed on the confounding effects of uncontrolled variables. Clark (1983), for example, has suggested that much of media research -- that is, that which has been reported as media research -- has actually been a study of variable methodologies and settings in the uses of media. I would tend to agree, but with a recognition that there have been exceptions. One that comes to mind were the film studies done under Carpenter's direction in the Instructional Film Program at Penn State back in the 40s and 50s. In some of those studies there were careful analyses of variables within films as these affected the performance of subjects. On the other hand, subjects were not questioned to determine which variables were preferred; neither were learner repertoires explored to determine what affected their interpretation of stimulus elements.

Added to the problem of determining defensible theoretical paradigms for research in media are assumptions about the conditions necessary in a research setting to derive generalizations from methods and statistical analyses. I refer to the controversy between the reductionist view of research and those who advocate naturalistic inquiry as a more realistic approach to what life is outside the laboratory setting (Magoon, 1977; Guba, 1981). I do not intend to discuss the intricacies of each point of view, but rather to suggest that our initial orientations to what needs to be investigated and under what conditions quite logically affects our theoretical bases for research. For example, our attempts to control all conditions, either by statistical manipulations or tight controls of the situation and subjects, are based on assumptions that such controls are possible in the first place and that validity and generalizability are possible outcomes. An assumption is also made that reactions of learners as groups are indicative of the true picture about individuals in that group. The opposite view espoused by those who advocate naturalistic inquiry is that the assumptions of the reductionists are untenable, given the interaction of social, contextual, and personal factors which affect learner responses. Each approach to inquiry assumes its own conceptualizations about the nature of learners and becomes the starting point for judging what should be observed. On the other hand, both methods do provide a framework for the study of effects of variable media characteristics. But the extent to which each method takes into account relevant factors becomes an argument that inevitably leads to judging the results of each type of research paradigm.

Most of us are familiar with conditions that have brought changes in views about media/learning relationships since the days when media were considered primarily as stimulus control mechanisms. Government sponsored research through the National Defense Education Act in the U. S., for example, supported traditional gross comparative studies, but also fostered studies of programming of instructional materials, which in turn had an important influence on greater interest among researchers in determining how learners perceived and processed information. While some studies compared the relative advantages of linear versus branching programming, there was also, through the so-called 90-90 criterion for the validation of materials, attention paid to the reaction of individuals to specifics in information displays.

A more recent movement, Trait-Treatment-Interaction (TTI) is based on the premise that knowledge of the interactive effects of learner aptitudes with instructional treatments would make it possible to predict the proper types of materials and methods to insure desired learner responses. But TTI has also to contend with basing measurement on a *moment-in-time* in the life of a learner as a defensible basis for predicting future performance. The continuing problem, not only for TTI but for all types of research methodologies and theoretical orientations, is that learners are dynamic individuals changing constantly as more information from many diverse sources is processed each passing day. What causes idiosyncratic responses among learners is still quite elusive.

Clearly, the major focus today is upon the processes by which a learner perceives the environment, processes and stores information, and retrieves it for use. This emphasis has come about because of the recognition that indeed each learner is unique, a product of many experiences, and that messages appear to be meaningful only as each person gives them meaning.

There are current opinions that media, in fact, do not make any difference in learning, at least as measured by typical research paradigms that tend to manipulate situational variables rather than intrinsic attributes of media themselves. But there has been a shift from the more incidental role of media in instruction to a greater emphasis upon the interacting relationships among content and symbol systems with specific learner characteristics. A case in point is the hypothesis of Salomon that the greater the similarity between the coding systems in the message and the coding system in the repertoire of the learner, the more likely learning will occur. Such a shift is also seen in Olson's (1972) theory of instructional means which says that technologies and techniques used with learners are accompanied by the development in learners of relevant cognitive skills.

What, then, are some prominent theories which have evolved in the last decade? For current opinions I am indebted to Clark and Salomon's (1984) final draft of a manuscript they prepared for the *Third Handbook of Research on Teaching.* Those of you who have studied the 1974 volume by the National Society for the Study of Education, *Media and Symbols*, will find some of these theories familiar.

The first has to do with the nature of symbol systems. This model offers a theoretical foundation for differentiating among symbol systems and may provide a systematic way for defining those aspects of symbols that may not only be pertinent to certain types of information, but also which may serve as devices by which learners process information. I am referring to Goodman's Symbol System Theory, discussed by Gardner (1974) and others. Goodman divides symbols into two categories as being either notational or non-notational. By notational, he means that a symbol must meet the criteria of being unambiguous, such as the concept "one is always one"; it must be semantically disjointed -- that is, no two characters can have a common referent -- and it must have a finite differentiation. For example, the signs for the bass and treble clef in musical notation are finite differentiations and remain so, assuming no other meaning. Non-notationality, on the other hand, suggests symbols that are dense, replete with information, and subject to a variety of interpretations. A picture may be classified as non-notational because in may be interpreted in a variety of ways. There can, however, be symbols within the picture which can be finite in their meaning and designation, and hence notational. While this discussion is not the place for a detailed explanation of Goodman's model, there is an additional model worth mentioning which complements Goodman's work. It is Gross's identification of various information modes that contain symbol systems peculiar to given sets or types of information. The

modes, which he calls primary, are linguistic, socio-gestural, iconic, logico-mathematical, and musical. Each of these categories provides a system for differentiating among symbols used by learners to acquire and process certain kinds of information. They may also be useful for determining whether learners utilize these symbols as tools in their own cognitive processing.

Gross has also formulated two other general symbol classifications which utilize primary modes in idiosyncratic ways. One is the derived mode, such as poetry, dance, and film. The other is the technical mode, suggesting the peculiar language of the sciences, engineering, technologies, and architecture.

A second prominent theoretical formulation of is that of Olson (1972, 1974), referred to earlier. Calling his theory one of instructional means, Olson pinpoints two aspects of media which affect learning. One is that content may assist in the acquisition of rules and principles. The other aspect relates to the acquisition of skills which are required to utilize the information presented in the medium. Thus, the coding system and means for presenting information may become tools for utilizing similar coding systems and means.

Olson also points out that there is a significant difference between *an utterance* and *text* which have direct implications for our understanding of the functions of media. Olson defined an utterance as oral language that is flexible, unspecified, with a low degree of conventionalization, and that it is negotiable in a social setting. Written language, on the other hand, generally demands precision and explicitness of meaning. It serves to maintain philosophical, scientific, or analytic knowledge. Thus, as learners are schooled in written language, they develop the skill and habituation to textual material. For purposes of analyzing the effect of various forms of media, it may be important to note that long training and practice in text materials may inhibit learning from other than text. This may be a partial explanation for the discovery of Guba when he observed the visual attention of subjects who watched science demonstrations on television. At times their eyes went out of focus and they tended to watch the mouth of the demonstrator more often that the details of the demonstration. Do we perpetuate -dependence upon text by utilizing it continuously in our testing procedures and thus condition learners not to observe other forms of information? Perhaps we need to spend more time in conditioning learners to interpret and glean information from non-textual materials.

The third theoretical model is Salomon's Media Attribute Theory (1979, 198 1). The theory says, in effect, that both media and the human mind employ symbol systems for acquiring, storing, and manipulating information. Also, some of the tools of cognition are the consequence of employing symbols that were inherent in the media. In essence, he has suggested a supplantation theory which says that it is possible for technological devices, such as a zoom lens, to provide an observable analogy to the mental process of proceeding from a generalization to a particular and back to a generalization again. The use of a zoom lens to assist field-dependent students to observe details in a picture is offered by Salomon as tentative evidence of this phenomenon. Clark (1983), on the other hand, argued that zooming is not a media attribute, but a method of enlarging and focussing.

In addition to these three theories, there is a controversy that cuts across all of them. It is the controversy whether humans process information through images or propositions. Those who support the imaging hypothesis contend that a mental image is analogous to the perception of the actual object. In the opposite camp, those who deny the possibility of imaging see no direct connection between what one observes and the final knowledge acquired, because all stimulus situations are affected by beliefs, goals, previous knowledge,

experience, and emotional states. Final knowledge is governed by rationality, that is, all stimuli are acted upon by the learner's repertoire of the moment.

There is some evidence supporting the notion that factors other than media have more influence on learner responses to media than the elements or coding systems within media themselves. Clark and Salomon (1984) suggest that one relates to the effects of learner anticipation of media in terms of efforts that must be invested in their use. It appears that where media are perceived as critical to future performance, learners will expend more effort. Where media are perceived as entertainment, less effort is expended. Twenty years ago Greenhill (1967) wondered why television instruction did not often prove superior when compared with traditional university instruction. He hypothesized that good television instruction required less expenditure of effort by students; therefore, they put more time into traditional courses which were less well presented, thereby diminishing television effects.

Clark (1983), in reviewing studies of student effort found that high-ability students chose structured methods and media because they perceived that they would have to expend less effort. Lower-ability students, on the other hand, chose less-structured media and more discovery-oriented methods because they wished to avoid the failure that may have come from being unable to fulfil1 the requirements of the structured and directed situation. In a letter to me, Clark (1 l/15/83) said, "I have arrived at a very reluctant conclusion that media do not contribute much to leaming...and only minimally to decoding. I do think that the symbol system approach has promise for instructional design but not much theoretical importance....". He thinks media contribute only ". ..indirectly through variations in persistence which are contributed by our subjective impressions of how much effort is required to learn from various media."

Where, then, are we in our search for theoretical foundations that have viability? Theoretical bases for research have proceeded from one of regarding the learner as reactive and under stimulus control, to one in which the learner is much more a participant in determining what effects media have upon the transmission of information, upon perceptions, and upon cognitive processes themselves. It is not only a matter of how learners perceive the messages conveyed via media, but also one of discovering whether and how learners utilize the coding systems of media as tools for manipulating information. It seems that the attempt to prove media utility is a dead issue, as is the attempt to depend upon gross comparative studies for definitive answers about media characteristics and their influences upon learner behavior. Yet some fruitful questions still need to be asked for research purposes:

-- Do the coding systems of media actually serve as tools for cognition?
-- Do skills required for utilizing media content and methodologies become skills in cognition?
-- What methods might we use with learners to discover the uniqueness of media?
-- Can qualities of media and technological devices supplant or support given mental activities?
-- Are notationality and non-notationality viable for analyzing coding systems effects?
-- What methodologies best complement the uses of media?
-- Do unique qualities of media support particular learning needs, or is it methodologies which contribute the differences in learner responses to media?

-- Are learner attitudes and motivations the only dependable evidence to account for media effects?

Finally, let's turn to a questionnaire survey four graduate students and I conducted to determine which of fifty propositions about media characteristics and use would be judged valid or invalid and important for research by a random selection of the membership of the Research and Theory Division, AECT. Nine of the hundred questionnaires were sent to persons outside the Division. Forty two returns were used in data analysis. The fourteen statements regarded valid and important for research follow:

- The greater the match between learner experience and media attributes the greater the likelihood of learner acceptance of media content.
- Overt/covert responses of learners to media experiences are more likely to result in greater memory storage that covert/passive responses.
- The more a symbol system matches the criteria1 features of an idea or event, the more appropriate it is.
- Fitness of a message form depends upon the characteristics of the in formation.
- Negative teacher attitude toward a media presentation creates negative student attitudes.
- Presenting various forms of media provides the greatest compatibility with the nature of idiosyncratic brains.
- It is critical for effective media usage to know the range of coding elements available in each learner's repertoire.
- Sequential build-up of illustrations leads to better understanding.
- Excessive detail interferes with transmission of intended information.
- The advantage of visual over auditory materials increases for more difficult material.
- The more similar the coding schemes in the teacher's and student's repertoires the greater the possibility for learning to take place.
- Message, message forms, and conveyance systems interact to convey the intended message.
- Cultural differences affect learner interpretations of media.
- Learners have difficulty discriminating between subjectivity and objectivity in their interpretation of messages.

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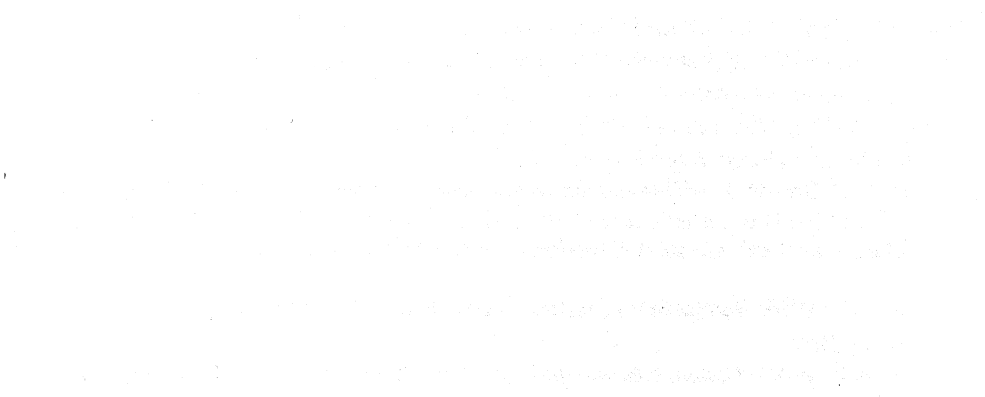

Evaluating Educational Software Environments Using a Model Based on Software Engineering and Instrucfional Design Principles

Betty A. Collis
Marilyn Gore

Abstract: This study suggests a new model for the evaluation of educational software authoring systems and applies this model to the evaluation of a particular authoring system. The model used for the evaluation is based on an integrated set of software engineering and instructional design principles. We argue that the model is appropriate as a basis for the evaluation of authoring environments in that it does not consider authoring materials as isolated entities, but rather, evaluates them in terms of how well they integrate with and facilitate an overall process of courseware design.

Production of educational software is expensive and time-consuming. The majority of educators involved in instructional software development typically lack an appropriate background in computer science and hence require considerable technical or authoring support. In addition, those educators who do have technical expertise also seek specialized authoring support in order to facilitate the software development process in both time and scope. In response to this general need, a considerable amount of research and commercial activity focuses on the design, attributes, production and evaluation of authoring support environments. For example, on the program for the March 1985 ADCIS conference held in Philadelphia there were more than 20 sessions focussing on authoring systems or authoring languages, while the program for the May 1986 Canadian Symposium for Instructional Technology featured approximately 30 such sessions. Many authoring materials are developed by their eventual users, especially in large-scale software production research and development units. However, a continually-increasing number of commercially available authoring packages are being marketed toward the individual educator, who wishes to develop some specialized C.A.I. but who does not have the support of a professional development team. In this paper we present an approach to the evaluation of authoring environments that is particulary appropriate in situations where the educator is not part of a large-scale production group and is not able to be involved in a substantial long-term investment of training time in the package itself.

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DEFINITION OF 'AUTHORING ENVIRONMENT'

We define the general category of authoring environments as including at least three subcategories of support tools, with considerable overlap between the three groups. Although classifications and nomenclature vary considerably among implementations, these three groups may be defined as a) authoring languages, b) authoring systems, and c) authoring tool kits.

Authoring languages are programming languages used for instructional software development, with at least 26 identified as languages developed specifically for courseware development (Brahan, Farley, & Orchard, 1983). The number of these languages continues to grow. BASIC, C, Pascal, and LISP are examples of general purpose programming languages which are used for educational software authoring, while Pilot and Natal are examples of authoring languages with specialized features for instructional software development. Authoring languages are not based on any specific instructional development model. All of the instructional sequencing in a program, as well as the particular content, needs to be specified by the ‘developer. The price of this flexibility is complexity. Programming languages, including so-called authoring languages, require a considerable investment of technical training and expertise to use at all. To use them intelligently and efficiently, we believe, requires the application of computer science perspectives and software engineering principles.

Authoring systems may be defined as preprogrammed sets of procedures from which courseware can be developed (Cyrs, 1985). These sets of procedures can be rigidly defined around a particular instructional strategy and presentation format or may vary in the flexibility and options available to the author. Their goal is to automate the programming aspect of courseware production by producing an executable program based on the dialogue maintained between the system and the developer (Quick, 1985). Although their particulars vary greatly, commercially available authoring systems share the goals of “allowing novices to easily create computer-based instructional courseware without programming knowledge” (Cyrs, 1985, p. 3) and of reducing the time required to produce executable code. In theory, authoring systems function “as a mediational link between instructional logic and computer logic” (Jonassen, 1985, p. 40), and supposedly allow the instructor to concentrate on the design of interactive instructional experiences which will take effective advantage of the capabilities of the computer. Estimates vary concerning the number of authoring systems available, because new or modified systems “are appearing weekly on the market” (Cyrs, 1985, p. 1) and many independent research projects involving the development of authoring systems are in place in university research and development centers (see for example, Hunka, 1986; Szabo, Jensen & Bagnall, 1986).

Authoring tools are less well-defined. They may include modules or other utilities provided in subroutine libraries which can be reused in various software development projects, streamlining the particular project by allowing its more predictable components to be based on preprogrammed utility modules (Wilson & McCrum, 1984; Collis Gore, 1986). While this approach is common in large-scale software development centres where the technical experts involved in the projects have the skill and understanding to develop specialized software tools, it is relatively uncommon in commercial materials aimed at the individual educator-author. This is probably because its use requires a level of technical programming knowledge inconsistent with a general goal of automating the production process for the novice courseware developer.

EVALUATING AUTHORING ENVIRONMENTS

Although most of the literature on authoring environments tends to be descriptive in nature (or to have as its purpose the conveyance of an enthusiastic endorsement of a particular authoring approach) a few studies have focussed on the evaluation of authoring languages and systems. Burger (1985) evaluated 12 *authoring languages/systems* on the basis of various attributes relating to lesson delivery, student management and production support. Lesson delivery attributes (evaluated by Burger on a 'yes-no' basis) include provision for automatic line spacing in text displays; availability of colour for text displays; availability of primitive graphic forms, sound, and animation capabilities; availability of various feedback characteristics; acceptance of string and numeric variables; and various answer processing attributes, such as timing, wild card designation and range specification. Student management attributes include security of student records and access, and availability of storage and analysis options relative to student records. Production support criteria include provisions for text and graphics editing, timing and complexity of movement between authoring and testing modes, and thoroughness of documentation. Cyrs (1985) established criteria relative to vendor reputation, purchase and licensing costs, documentation, equipment requirements, re-entry provisions when moving between authoring and testing modes, input manipulation, availability of various test formats and questioning strategies, record keeping provisions, portability, windowing capabilities, graphics, text-related variables, and presumed target audience.

Barker (1986) used a similar attribute-based framework in his checklist of 66 features to consider in the evaluation of "author languages for CAL." Barker and Singh (1983) based an evaluation of a particular authoring language on the ratings of various groups of educators who used the language in a workshop environment and were asked to rate the experience in terms of the value of the demonstration materials, ease of use, and likelihood of wishing to use the language again. Merrill (1985) discussed advantages and disadvantages of authoring systems and languages in a particularly useful and well-informed critique. Merrill's work differs from the other evaluation schemes in that he also discussed how the *frame assumption* inherent in the model of interaction supported by most authoring systems places limitations on the instructional design of the courseware itself. Merrill concluded his'critique by noting that "none of the existing authoring systems provide any assistance in the authoring or instructional design process" (p. 96). Overall, however, most evaluations of authoring support seem to reflect a framework emphasizing an assortment of possible implementation attributes but other than Merrill's, give no particular evidence of being based on a more theoretical consideration of how well the system mediates a particular model of educational software development.

THE COLLABORATIVE MODEL OF EDUCATIONAL SOFTWARE DEVELOPMENT

The collaborative model is one such model for educational software development (Gore & Collis, 1986). This model reflects the integration of three sets of principles:

A) Principles Reflecting the Needs of the Software Engineer

1) Using documentation as a software design medium.

2) Writing software requirements that are as complete as possible.
3) Structuring the development process so that distinct times are provided for planning and evaluation prior to implementation.
4) Partitioning software projects into components that can be developed and tested independently.
5) Designing systems so that they are easily contracted or extended.

B) Instructional Design Principles

1) Identifying intentions of the material relative to learning objectives, target learners and overall instructional strategy.
2) Delimiting the scope and sequence of the instructional content.
3) Specifying the methodological decisions involved in delivering the content.
4) Establishing evaluative processes for both the learner and the designer/instructor.

C) Collaboration Principles

1) Designing through iteration and compromise.
2) Assessing congruency at specific points in the development process.
3) Minimizing the common knowledge necessary for all participants and documenting this shared knowledge in a *collaborative filter.*

The procedure which operationalizes the collaborative model has been expressed by a timeline with seven phases. The model and its 7-phase timeline have been used in a variety of collaborative educational software developments at the University of Victoria under the support of the IBM Canada-University of Victoria Software Engineering Education Cooperative Project and is proving to be an efficient and effective structure for both computer scientists and educators (Gore Collis, 1986).

AN EVALUATION PERSPECTIVE BASED ON THE COLLABORATIVE MODEL

If we assume that this integrated set of software engineering, instructional design, and collaboration principles can be taken as an appropriate basis for educational software development, we claim it is also reasonable to use the same set of principles as the theoretical foundation of an evaluation model for authoring environments, The overall criterion for such an evaluation becomes the extent to which the authoring environment -- language, system or toolkit -- supports and mediates a theoretically-based model of educational software development. Unlike evaluative procedures which are primarily based on attribute checklists, this evaluation model is based on software engineering and instructional design principles re-expressed as evaluation criteria, and focuses on authoring support within the larger context of design and development.

The overall question asked by this evaluation model is how well does the authoring environment facilitate or constrain the educator in the overall design and development process.

General Evaluation Criteria

The following questions illustrate this evaluation perspective. The word *system* is used throughout these questions instead of the phrase *authoring environment.* This is done for economy of expression although we are aware that the word *system* can also denote the higher-level interaction of people, machines, software and methodologies involved in software design and development. We expect that an evaluation of the sort we are describing would be more likely to be applied to a commercially available software package described as an *authoring system,* which a consumer may be considering purchasing, than it would to the more general categories of authoring language or toolkits. The questions are asked from the perspective of the educator/user who is not a technical specialist.

A. Principles Reflecting the Needs of the Software Engineer

A.1. Design through documentation. Does the system stimulate or encourage adequate attention to design before using the authoring package for technical implementation? Does the system stimulate the development of appropriate documentation?

A.2. Writing software requirements that are as complete as possible. Does the system stimulate or require the developer to produce the necessary and sufficient amount of documentation for each phase of the development process?

A.3. Structuring the development process so that distinct times are provided for planning and evaluation prior to implementation. For a single-developer, does the system emphasize a distinct time for design and evaluation as opposed to programming and compiling?

A.4. Partitioning software projects into components that can be developed and tested independently. Can the various components of the program be developed and tested independently, and linked together when convenient? Can components (modules) of the program be reused as parts of other programs?

A5. Designing systems so that they are easily contracted or extended. Does the system produce software that can be conveniently altered or extended in response to specific student needs? Does the system facilitate the development of a prototype of the extended program, for evaluation and refinement of design decisions?

B. Instructional Design Principles

Intents. Does the system in any way promote reflection and evaluation concerning the intentions and value of the program itself! Does the system, especially through its documentation, emphasize to the developer that decisions involving basic educational needs, objectives and user characteristics must be adequately addressed before other decisions are confronted?

B.2. Content. Does the system allow data to be treated independently from the main problem?

B.3. Methodology. Does the system allow the designer to postpone secondary methodological decisions until more fundamental decisions are confirmed? Does the system provide tools that help the designer to develop, test and implement his methodological decisions? Does the system unduly influence the designer, or constrain him from implementing his methodological decisions? (As an example, an educator using an authoring system that emphasizes multiple-choice, true-false, or matching templates may base his instructional plans around one of these methodologies without fully considering the

relevance of other strategies, such as simulations). Do the *secrets* of implementation prematurely or otherwise inappropriately restrict or constrain the conceptual development of the program by the educator?

B.4. Evaluation. Does the system support the variety and quality of feedback appropriate for the intended user? Does the system support the capture of information on student performance that the teacher defines as useful for subsequent analysis? Does the system facilitate testing and editing during the development process?

C. Collaboration Principles

C.l. Iteration and compromise. Does the system facilitate iterative and on-going compromises between various participants in a collaborative environment?

C.2. Congruency. Which of the participants in a collaborative team is the intended user of the system -- the educator or the computer scientist? Is the system appropriate for the intended user? How much training is required for the user of the system before it can be used as a facilitating tool rather than a focus of attention and effort?

APPLICATION OF THE EVALUATION CRITERIA TO A PARTICULAR AUTHORING SYSTEM

CSR Trainer 4000 is an authoring system produced by Computer Systems Research, Inc., 40 Darling Drive, Avon Park South, Avon, Connecticut 06001. This system was purchased for software development because it promised to be a "complete instructional system designed to meet the needs of CAI authors at all levels.,.flexible, structured, use, sophisticated, and a pleasure to work with" (Computer Systems Research, 1985, p. i). The overview of the system described it as "state of the art" and further indicated that novice users would be "amazed" at the ease of using the system while advanced authors "will be amazed at its power and flexibility." In order to evaluate their claims of ease and simplicity, we used the system as *is* and did not seek assistance from the Trainer 4000 office after an initial visit from their representatives. We felt that this would more realistically reflect the situation of the individual purchaser of a commercial package such as this which bases its appeal on being easy to use and appropriate for the novice user. The system includes five disks for authoring, presentation and administration and two manuals. Only one backup copy may be made of each of the disks. The system requires an MS-DOS environment with a minimum of 256K memory and two disk drives (or one drive and a fixed disk).

The system was used first by one of the researchers, an educator with experience in the design and development of educational software using both authoring languages and systems. Working together with a computer scientist , a short tutorial and drill program was designed and developed using the collaborative model and the Trainer 4000 system. Following this experience, nine students involved in a senior-level faculty of education course in educational software design and development were given a summary of the steps involved in using Trainer 4000 to generate a simple instructional program. The education students worked with the instructor and three computer scientists to translate a simple design into a program using Trainer 4000. All nine education students were experienced teachers and computer users and had previous experience in designing and developing educational software using the BASIC language.

Following this guided practice, the education students were divided into four groups and, as a course assignment, were required to design, a short educational program using the

documentation requirements and seven-phase timeline prescribed by the collaborative model, and to develop the program using only the Trainer 4000 system. The groups of students were given three weeks for this assignment. Each group of education students worked with a computer scientist during the production phases of the model. Students were encouraged to be modest in their plans for the program; four or five tutorial sequences each with one or two accompanying drill questions was suggested as a reasonable expectation of program scope given the shortness of course time available for the assignment. The students were experienced in designing simple programs and moved quickly through the planning phases of the model. The use of Trainer 4000, however, presented all the participants with considerable difficulties. Rather than itemizing the many particular difficulties however, the Trainer 4000 system will be evaluated using the criteria described previously in this paper.

A.1. and A.2. Appropriate Documentation

Only one sentence in the manuals of Trainer 4000 seems to suggest the concept of design through documentation -- "It will be helpful to completely outline your course." This admonition is not expanded, nor are the ideas of documentation and preplanning mentioned again.

Although principles A.1 and A.2 relate to the use of documentation during the development process, it is convenient to discuss documentation for the end user in the context of these principles. As a model of documentation in itself, the manual of Trainer 4000 is seriously flawed and was the basis of much of the frustration experienced by all who used the system. Although the manual was lengthy (approximately 400 pages of text in two looseleaf binders), pertinent information was frequently lacking or difficult to find. No complete example programs were provided and critical steps in the authoring procedure were not well-described. The "amazing flexibility and power" of the system seems to rely in part on its ability to utilize a particular mainframe authoring system (not available at our institution) and on the ability to build macros using something called the CSF language. This language, although alluded to frequently and necessary for designs above the template level, was not referenced or defined in the documentation. The documentation provided no useful progression of instructions for the user and was extremely difficult to interpret. We felt that instructions were unnecessarily verbose and repetitious in some instances and incomplete or missing entirely in others. We find it highly unlikely that any individual without extensive technical skill could interpret the manual or use the system beyond its most simplistic It proved a time-consuming enterprise for experienced software developers and computer scientists, and many major components of the system never were deciphered or operationalized. As models or stimulants of appropriate documentation, the Trainer 4000 manuals were, in our opinion, failures.

A.3. Premature Implementation

The Trainer 4000 system, used at its *novice* level, severely constrains the author to a pretest-tutorial-posttest model without options for branching or randomized question selection. The latter two options are available using the *more advanced* (and; to us, undecipherable) features of the system. For users who wish to utilize more than the novice features of the system, various *secrets* of implementation must be penetrated before production can continue, and this penetration requires working in a programming language environment which is neither conceptually easy or well-defined. Although the development system is organized around a hierarchical set of menus, the use of most of the options

available from the menus involves immediate grappling with the *secrets* of implementation. Because of their interdependent complexity, we fell the implementation features of Trainer 4000 may severely constrain the author in the development of the program itself because of the technical complexities they present throughout the development process.

A.4. and A.5. Partitioning and modifiability

As far as we could determine, and at the level at which we were able to use the system without additional documentation, the Trainer 4000 system requires the developer to construct his program as a linear sequence of frames before program generation and real testing can take place. Additional frames cannot be inserted within the sequence, and once the *final quiz* option is invoked, it does not seem possible (at least at the levels explained in the documentation) to add additional frames to the lesson. This constraint violates software engineering principles relating to modularization, reusability, and contractability. The various components of the program cannot be developed and tested as independent entities, nor can any of the text screens be reused in other programs.

These are, however, some aspects of the development process which do reflect the software engineering criteria relating to modularity and modifiability. Graphics screens are created separately, under a different editor, and saved as separate entities on a disk. They are called when required from within frames of the program itself. This means that each graphics screen is developed and tested independently and is available for subsequent reuse within the program or within other programs. In addition, Trainer 4000 reflects one aspect of modularity in that the developer can initially create each frame as an essentially empty placeholder and can then develop and edit each frame independently. (Testing,however, can only take place by going through the frames sequentially). This approach does allow a form of prototype to be generated and tested before full development of each frame takes place. However, the extraordinarily cumbersome compiling process, requiring an extra three data disks and approximately 10 to 15 minutes of disk swapping in a two-drive system, serves as a real and practical deterrent to any iterative refinement or evaluative efforts. Overall, therefore, we feel Trainer 4000 does not support the principles of modularity or of modifiability in a way which would be satisfactory to either a software engineer or an educator.

B.1. Intents of Instruction

Only two pages of the manuals of Trainer 4000 include specific comments on the value of making instructional decisions before using the authoring system. The documentation is entirely lacking in any sense of educational context or evaluation. No example programs are included and no recommendations made regarding specification of learning goals or characteristics of the intended users. While we realize that no authoring system can make these sorts of decisions for the developer, we still feel that some recognition of the primary importance of these considerations ought to be included and perhaps illustrated in the context of an example program.

B.2. Contents of Instruction

At the novice user's level, data cannot be stored independently of the program. This is a serious constraint, especially given the technical difficulties involved in editing and regenerating lessons. At the more advanced levels, it is possible to create independent question pools which can be accessed randomly or sequentially at specific points in the program. However, the same question pool does not appear to be reutilizable within the program, and

editing of the question pools apparently requires editing of the overall lesson itself.

B.3. Methods of Instructional Delivery

It is within *methodology* that particularly frustrating problems occurred in the Trainer 4000 environment. For example, the graphics editor provided a number of useful features for the construction of attractive visual displays, but did not allow the development of an interactive graphics screen. Thus, a student could look at an attractive visual (and animation was reasonably easy to include) but any input situation required clearing the graphic from the screen and replacing it with a text screen. This proved to be a serious pedagogical constraint for every one of our development projects, in that interactive involvement with the material displayed on a graphic screen was always desired. Having to ask questions with the graphics screen no longer available was wrong pedagogically in all of our instructional designs. In addition, Trainer 4000 apparently does not even allow the option of moving back in a program to examine a previous screen and then returning to the question frame. More generally, the inability to accommodate branching prevented implementation of most of our designs. We were unable to structure lessons so that the student could control his own movement; standard features in computer-based instruction, such as options menus and optional help screens did not seem to be feasible within the Trainer environment, at least as far as we could interpret from the documentation for the system.

B.4. Evaluation Facilities

Trainer 4000 was well-structured with regard to evaluating student responses to multiple-choice, true-false and matching questions, However, passing through the lengthy series of prompts each time a question was built or edited was time-consuming and often inefficient for the author. The administration system did seem to allow the educator to design a variety of data-capturing and display procedures for monitoring student activity and responses to quizzes. However, because of the many technical difficulties we had with the authoring system itself, we did not have the time to use the administration utility. One management aspect did appear to be built into the student presentation system.' A student returning to a lesson is automatically reentered at the place in which he or she exited. We found this unacceptable, as we believe both the student and the instructor should have the choice of reviewing previous material if desired. This pedagogical decision of restarting a student where he or she left off should be an option available to the educator or student, not a requirement of the system.

C. Collaboration Principles

Trainer 4000 did facilitate collaboration between educators and computer scientists involved in a software development project but the communication occurred as a reaction to problems rather than being motivated by a desire for constructive collaboration. It is our opinion that the technical demands of the system made it virtually unusable for independent educator-authors. This reflects a fundamental criticism of the Trainer 4000 system and also of many authoring environments in general -- who was this system designed for? Who is the intended user? If designed for a novice educator-author or member of a production team with limited time available for technical support, the system was totally inaccessible. If designed for a more experienced educator/author, the system did not appropriately provide adequate support for implementing many of the features that an individual might wish to include in his or her program design. If (and since) the package requires technical support for

its use, then the system was not described or organized in a way appropriate to the computer scientist who will become involved, in that the structures provided were not only poorly designed and documented, but also were inhibiting.

CONCLUSION

We feel an evaluation mode1 based on the software engineering and instructional design principles which underlie the collaborative model of software development provides a useful framework for the evaluation of a particular authoring system. By applying the evaluation criteria specified by our mode1 to our experiences with a particular authoring system, we can organize our criticism of the system within a theoretical framework rather than utilize an approach which would discuss the presence or absence of particular attributes which may be important in one program design but not in another. We feel the *fit* of any authoring environment within the broader design and development process is critical, as otherwise too much attention is given to a tool and too little to the overall system in which the tool is to be applied. Our evaluation criteria are sensitive to this larger system. We feel the design and development process, as well as any evaluation of this overall process or its component parts, can be enhanced by applying an orientation which is based on both software engineering and instructional design principles.

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The Formative Evaluation of a University Videotext System

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Abstract: A university videotext system, INTERACT, was developed, and information and graphics were designed using a systematic multi-stage formative approach. An assessment of information providers' and subscribers' potential information needs was done anda pre-release test of the system was undertaken. An evaluation of INTERACT use during its first five weeks of operation was completed. The evaluation included unobtrusive observation, mall-intercept interviews of users and non-users to assess ease of using the system, enjoyment of the system, and flow analysis and frequency of frame access. Results of the evaluation are discussed.

In the explosive development of new electronic media during the past ten years we have witnessed marvelous successes among technologies that have promised to expand the traditional uses of television. Satellite and cable delivery systems, for example, have enjoyed healthy growth. The recent dramatic increases in VCR saturation in the USA represents perhaps the most rapid technology adoption since the arrival of television itself in the 1940s. Home use of videodiscs has plummeted, however, while corporate and educational use of videodiscs has expanded.

Teletext and videotext systems have experience moderate to high success in most nations: Canada, Great Britain and France appear to be developing successful teletext and videotext systems, though not entirely with clear purposes (Scrivens, 1982). In the USA, however, text services directed to the home market have not enjoyed such prosperity, and one can read nearly every month of the demise or diminuation of some teletext or videotext system.

The factors contributing to the success or failure of teletext and videotext systems are varied, but part of the problem in the USA is that teletext and videotext have been conceived as an extension or alternate use of standard television and targeted to the home consumer

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market (Greenberg, 1979). Teletext systems are one-way information systems that utilize television broadcast frequencies or cable for delivery, and the information is usually *piggy-backed* on the vertical blanking interval (VBI) of the standard television picture scan of a regular over-the-air television broadcast or transmitted as full-channel text. Teletext is not interactive, and VBI teletext has severe speed limitations. Videotext systems are two-way interactive, or transactional, systems delivered via telephone or cable, and generally videotext permits access to a far wider diversity of information than teletext (cf. Tydeman, Lipinski, Adler, Nyhan, & Zwimpfer, 1982).

Both teletext and videotext have relied on a home television set for the display of information, and that is both an advantage and a disadvantage of the systems. That reliance presents an advantage in that 98% of all homes in the USA have television sets and the technology uses existing equipment for reception, but it is a disadvantage in that the use of television sets is under increasing competitive demand for viewing broadcast and cable programs, as well as VCR programming, video games, and text services.

In the USA, CBS television has attempted to maximize the utilization of home TV sets and to supplement CBS television programming by offering *Extravision*, a teletext service carried on the VBI of the network signal. CBS envisioned a teletext service that would promote the network and its programs, returning higher program ratings to the network, but it also expected that consumers would be lured to the CBS network by Extravision providing national and international news, stock market reports, program information, and an array of local information. CBS recently scaled down its involvement in the service because of low consumer demand aggravated by high decoder costs and lack of commitment by affiliated stations.

Videotext services such as Viewtron and Gateway also attempted to serve the home market by offering a wide range of interactive and transactional services such as electronic banking, retail purchasing, and electronic mail. Both services have ceased functioning, despite initial highly favorable evaluation reports (cf. Silverstein, 1983).

Videotext services that have been directed toward specific user groups or businesses have been more successful than those aimed at general audiences (Changing priorities, 1985; Sigel, 1983). It is much more difficult to predict which information is central in importance to a general consumer market, and it is more difficult to design wide ranges of information to fit the broad needs of the general public than of specific, targetable groups (cf. Channel 2000, 1981). Furthermore, it appears that research on consumer text services may mislead developmental decisions because results overestimate positive consumer response to the systems (Moschis & Stanley, 1983).

Against this background we made the decision to develop a videotext service, INTERACT, for a closed-user group comprised of students, faculty, and staff of Syracuse University. Not at all coincidental to the decision was AT&T's beneficent donation of a videotext management system, several frame creation systems, and Sceptre terminals to Syracuse University. During the planning stages, the university opened a new student center, which would be the focus of student activity. It was decided that during the pilot project, INTERACT would initially serve student information needs through a single terminal in the student center. The terminal was to be located adjacent to an information desk in the middle of the student center's main lobby, where pedestrian traffic flow was projected to exceed 8000 per week. As a consequence of its physical location, INTERACT was designed, in large part, to convey student life information.

INTERACT Goals

The system was designed for the benefit of several university constituencies, whose needs are reflected in the goals established to guide the development of INTERACT. The goals were also used as the basis for more specific objectives of the system and as the milestones against which progress in the development of the system could be assessed. The goals of INTERACT were:

1) to provide SU students, faculty, and staff with a simple, convenient, pleasant, efficient, attractive, and adaptable system for obtaining needed information;

2) to act as a gateway among information providers, advertisers, and Syracuse University users;

3) to provide an interactive channel and services among information providers, advertisers, and users;

4) to provide faculty and students with a system for carrying out research about electronic media and human behavior;

5) to provide faculty and staff with a system for the electronic delivery of text and graphics for instructional purposes;

6) to reach breakeven point by the third year of operation; and

7) to provide an educational laboratory experience for students in preparation for future careers in electronic media.

The database structure and page were designed through a marketing-systems design approach with evaluation stages built into the developmental phases. Such an approach requires a) a market study to determine demand for the variety of information considered for inclusion in the system; b) diagnostic testing of a prototype system and its contents; and c) assessment of perceptions and uses of an on-line system. A videotext system, as an alternative form of television, could be evaluated applying many of the same staging processes used in the formative evaluation of television programs and in the development of new teletext and videotext services (cf. Cox Research, 1980). Such an evaluation model seems particularly appropriate to technological systems that have both information providing, or purposive, and profit-making, or commercial, orientations.

There were several aspects of the INTERACT system whose development needed to be guided by formative evaluation: the structure and organization of information on the system through the use of menus (cf. Elton, Harris, Thompson, & Zimmerbaum, 1983); the design of pages, legibility of text, and aesthetics of graphics (cf. Godfrey & Chang, 1981; Reynolds, 1979); and the efficiency and usefulness of the system.

The following phases constituted the stages of system development that pertained to evaluation: 1) information needs assessment; 2) information provider survey; 3) pretest of system; and 4) field evaluation of system.

Information Needs Assessment

Information needs of Syracuse University students were first determined by mall intercept interviews with 100 undergraduate and graduate students at various locations on campus. Students expressed interest in news, weather, entertainment (e.g., movies, plays, theatre), campus events, and academic information (e.g., financial aid, placement service). These information categories became part of a general guide by which designers could create an information structure or menu for the system.

To avoid the duplication of information services already available, to get an understanding of students' current information sources and information-seeking behavior, and to identify competition, students were asked about their media use. The majority of students reported that they obtained their information about the most-needed topics from daily and weekly campus newspapers. Radio and television were cited as secondary media for the needed information, and the local daily newspapers were least important. In fact, a majority of respondents (85%) reported that they are not regular readers of the local daily newspapers.

Information Provider Survey

The development of the videotext system required an assessment of potential information providers' communication needs and their commitment to using INTERACT for the transmission of messages and announcements to the Syracuse University community. Attempting to serve the information needs of students would be futile without the maintenance of a steady stream of information from the individuals and groups that have the information. A survey questionnaire was developed for approximately 50 targeted potential information providers, among whom were the registrar's office, placement, admissions, athletics, the music school, student organizations, and the theater department. Information providers were asked about the kinds of information they provide, which information channels they use to reach the student body, which information channel they feel is most effective, and whether they felt that videotext could enable them to reach their target groups more efficiently. Not surprisingly, most of the information providers (89%) felt that videotex could help supplement their current information channels. Furthermore, 63% of the information provers said that a system that featured graphics could help convey their message. Approximately 55% of the information providers were currently relying on letters, staffed tables, personal contact, and word of mouth to convey their messages. The rest relied on campus newspapers or posters to inform the students.

The information needs assessment and the information providers survey results guided the development of a menu structure for INTERACT. Through a process of logical categorization and intuitive judgments, all information was divided among six areas, which constituted the main menu choices:

1) academic calendar/deadlines;
2) entertainment;
3) news headlines;
4) Schine Student Center information;
5) sports and recreation; and
6) student services.

Each of the choices offered a submenu with two or more alternative frame selections that contained information from information providers.

System Pretest

The pretest of the system prepared designers for what might occur during the actual operation of the system. In order to assess the design of INTERACT before making it public, the system was pretested with undergraduate communication students. Three methods were used in the pretest: a questionnaire, a path analysis, and the collection of encouraged verbal comments by students while using the system. The comments gave indicators of trouble spots in the design of the graphics, text, or database structure. The follow-up questionnaire obtained subjective judgments of enjoyability, annoyance, speed of information access, completeness of information, ease or difficulty in using INTERACT, and ease or difficulty of locating the function keys needed to operate the system. The questionnaire also obtained measures of frame aesthetics (readability of text, attractiveness of graphics), frequency of student center use by the student, and his/her expected use of INTERACT.

Path analysis. The path analysis traced the student's path from the entry point of the main menu through each submenu and subsequent information frames on the system. In the path analysis an observer recorded the sequence of frames selected by pretest subjects in order to verify the information needs assessment results regarding priorities of information categories to be included in INTERACT. The assumption of the path analysis is that the order in which the student selects frames is indicative of the importance and centrality the student assigns to the frame's information, but the analysis also provides critical information about potential problems or confusion the user might experience in switching from one submenu to another.

As expected, the highest percentage of students selected the entertainment submenu first (39%), whereas 26% chose sports and recreation, and academic calendar/deadlines and news headlines were each chosen first by 13% of students. Student services and Schine Student Center information submenus were each selected by only 4% of students, perhaps because the pretest was not carried out in the Schine Center, and the need for that particular information was not salient to the pretest subjects.

Questionnaire and verbal comments. Students ranked the submenus they found most useful, and in contrast with the path analysis, the most students (45%) stated that academic calendar/deadlines was most useful, while somewhat fewer (36%) reported entertainment as most useful. Schine information (15%), news headlines (10%), student services (5%), and sports and recreation (0%) were ranked as most useful by fewer students. The rank ordering, when compared with the path analysis, gave us valuable information about whether students' needs would be met by INTERACT in its developmental stage. We judged that INTERACT was on target in academic calendar and entertainment, and therefore would remain on the main menu, but that sports and recreation, student services, and news headlines needed to be improved or removed from the system, depending on further evaluations. It was also determined that the structure of certain sections could be improved in order to facilitate users' flow through INTERACT.

An overwhelming majority (94%) of the respondents found INTERACT above average in enjoyability. No students found the experience *very annoying,* and only 13% reported the experience *somewhat annoying.* Students who commented on the annoyance of the service said that slow building graphics that appeared prior to the text were most annoying. A great majority (82%) of the respondents felt they could access information either very *quickly* or *somewhat quickly.* However, students commented that the information provided was either incomplete or could be obtained more easily from a newspaper. Approximately 99% of the

respondents reported that it was either *somewhat easy* or very *easy* to use the system, and 17% reported that it was *somewhat easy* to locate the appropriate function keys on the Sceptre keyboard to use the system. Most (82%) found it very *easy* to locate the keys. One slight problem among respondents was confusion as to which function keys to press. The confusion was later resolved by the placement of brief keyboard instructions on each frame: A small standard banner was inserted into each page instructing the user to press a numeric key to proceed for further information, F1 to return to the main menu, or F3 to return to the previous menu.

Most of the students found the graphics and text very attractive. Some students, however, reported that they had trouble reading the text due to its color combination with the background -- in one case cursive lettering was too thin to read, in another case the highly saturated background chroma bled into the text lettering.

The results of the questionnaire and comments offered during the pretest helped designers refine the system by changing the color combination of some frames, for example reducing the saturation of background colors to reduce bleed. Cursive lettering strokes were either broadened to increase legibility or replaced with block lettering. In order to reduce annoyance over the slow appearance of essential information, designers 'reversed the building sequence of frames such that essential information and menu choices appeared first, then non-essential information, decorative graphics followed. The reversed order permitted familiar users to search for information more rapidly, while still maintaining the attractive and entertaining graphics for new users. In response to the demand for more detailed information, the information gathering team broadened the scope and sources of information used for INTERACT. Given the information from the pretest, designers changed various elements of the structure as well as individual frames. For example, the Schine Center information submenu was temporarily removed for further development, and an electronic bulletin board was added for timely, if haphazardly organized, information.

Field Evaluation

The final stage of the formative evaluation of INTERACT began immediately after the opening of service in the Schine Center. The on-site evaluation comprised four elements: a frame frequency-of-access count, a path analysis, a user interview, and a non-user interview.

Frame access frequencies. The AT&T host computer permits frequency tabulations on frames by day and by hour of the day, enabling the system manager to evaluate gross access to the system in general and to each frame. The frequencies gave us behavioral field information about the use of the system and the popularity of each submenu and each of the 178 frames on the system. Frequencies were collected at. the end of week one and week two, and again at the end of week five, which roughly corresponded with the end of the school year. For brevity's sake, only the cumulative totals after five weeks are presented (See next page).

It is apparent that entertainment information continued to be the most accessed frames on INTERACT. News headlines were second, and sports and recreation, and academic calendar third and fourth, respectively. Actual use data followed quite closely the information needs assessment results, which had shown that entertainment. and news were students' top information priorities.

The frame access frequencies were analyzed, by day. of the week in order to determine the trends of use of INTERACT. Amount of use across days varied from week to week, In general, it was observed that INTERACT users tended to seek certain types of information

TABLE 1
INTERACT Frames Accessed First Five Weeks, Cumulative Frequencies

Menu	Access Frequency	Access Percentage
Main Menu	18,121	27
Entertainment	19,570	30
News Headlines	7,866	12
Sports and Recreation	4,987	8
Academic Calendar	4,180	6
Student Services	3,545	5
Bulletin Board	3,223	5
Graduation	2,513	4
Help	1,339	2
Schine Center Information	648	.1
Advertising	253	.004
Total Frames Accessed	66,245	100.0 %

Note: Graduation, Schine Center Information and Advertising submenus were added to INTERACT after three weeks of service, hence access frequency is comparatively low for each.

at different times of the week, reflecting their activities on those days. Users sought more academic information on Mondays, Tuesdays, and Wednesdays, and more entertainment information toward the end of the week. The day-by-day trends were used to determine the most effective frame up-date days. As a result, a management decision was made to assure that all academic information was updated by Friday for the following Monday, and all entertainment information was updated by Wednesday.

During the second through the fifth week of operation INTERACT expanded to meet the needs of important school events, such as graduation and a class reunion. The system acquired several advertising clients, and the Schine Center information submenu was reintroduced. The access frequency data revealed some novelty usage during the first week with a slight decline in the second week, suggesting some novelty wear-off. Nevertheless, users' clear preferences for entertainment-related information and news headlines became apparent during the second and third weeks of operation.

Path analysis. As in the pretest, observations were made of users' path or flow through the menus and frames. Of five submenus, news headlines were selected first by the most users (32%), followed closely by the academic calendar and entertainment (24%). Primary interest in student services (8%) and sports and recreation (2%) flagged by comparison, probably because the semester was ending.

The path observation included a measure of duration of user sessions. Users spent nearly four minutes using the system. Most users tended to browse through the information; very few appeared to have specific frames they were trying to access. The average number of frame accesses was 11 per session.

TABLE 2
Field Survey Results

Question 1 · How enjoyable was the experience?	
very enjoyable	36%
somewhat enjoyable	53%
not at all enjoyable	11%
Question 2 · How quickly do you feel you can get information using INTERACT?	
very quickly	30%
somewhat quickly	59%
somewhat slowly	11%
very slowly	0%
Question 3 · How complete do you feel the information on INTERACT is?	
very complete	0%
somewhat complete	62%
somewhat incomplete	19%
very incomplete	19%
Question 4 · How difficult or easy was the text to read?	
easy to read	94%
somewhat difficult to read	6%
very difficult to read	0%
Question 5 · Was the keyboard confusing?	
Yes	17%
No	63%

Note: N = 86

Users' survey. Interviewers intercepted 86 users immediately after they had completed their sessions on INTERACT. The survey was similar to the pretest questionnaire in its assessment of enjoyability, speed of access, completeness of information, clarity of the keyboard and system use instructions, frame access instructions, and text readability. In addition, users were asked about their use of the Schine Center, and they were asked to estimate how often they thought they would use INTERACT.

Responses were generally very favorable toward INTERACT. In particular, more users reported the experience as very enjoyable than not enjoyable, 89% of users felt they could get information very quickly or somewhat quickly, that the keyboard was not confusing

(83%). Keyboard confusion was reduced by placing a *help* frame into the system as well as more clear directions in the introductory cycling frames. Most users (94%) reported that the text was easy to read -- a manifestation of definite improvement over the pretest results. The completeness of the information appeared to be a continuing problem, as 38% of users found the information either somewhat complete or very incomplete.

Passers-by survey. In order to find out why some individuals were not using INTERACT, interviewers intercepted people who passed by the INTERACT kiosk. The interviewer asked whether passers-by had every used INTERACT, if so, their frequency of use; if not, their reasons for not using it. Despite nearly equal use of the Schine Center by males and females, observation had consistently revealed that about two-thirds of users were male, an observation made in other teletext and videotext trials. Hence, the passers-by survey deliberately oversampled women to obtain a better understanding as to why so few women were using INTERACT. The survey revealed that 47% of female passers-by had never used INTERACT, 43% of those who said they had not used INTERACT cited "do not know what INTERACT is" as their main reason for not using the system. The greatest number of males (33%) and females (38%) reported that they use INTERACT less than once a week. Approximately 42% of the females who had used INTERACT planned to use it again, whereas only 29% of the males who had used the system planned to use it again, a disturbing finding that merits further research, Of the passers-by who had used INTERACT, on!y 24% used the system l-4 times a week. Most (62%) of the passers-by who had used the system reported they use INTERACT less than once a week.

Summary and Conclusion

Through the process of formative evaluation designers were able to assess the problems in the INTERACT system, and then take corrective action. With each stage of evaluation designers learned more about the system and its main uses among students, faculty, and staff. INTERACT is mostly used as a source of information about entertainment and various timely events on campus. This conforms to the students stated needs assessed in the student information needs survey. The success of INTERACT will depend on its ability to continue to provide students, faculty and staff with the kinds of information they want, One way to insure this will be through continued evaluation of the system as it progresses.

The development of INTERACT, like any teletext or videotext service, demands consistent updating of information and improving the quality of information -- both text and graphics -- to its subscribers. The implication is that the system serves the information needs of its subscribers with new and different information, that those needs are assessed periodically, and that the use of the system is evaluated from time to time.

Clearly, needs assessment and evaluation are relatively simplified in a closed-user system such as INTERACT, particularly where only one kiosk is used. As the system expands to other campus locations and later to access by students and city residents who have personal computers, the challenge of evaluation will be greater, and the danger of failure due to misreading of needs will be greater.

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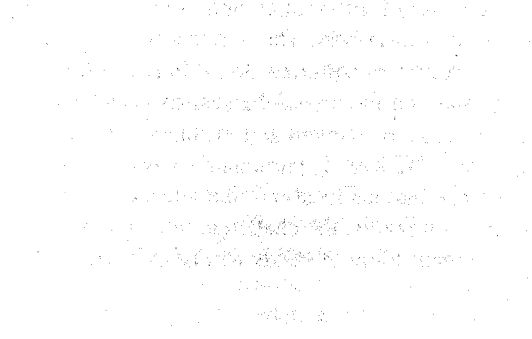

How Costly Are Computer-Based Instructional Systems? A Look At Two Approaches

George A. B. Moore

Abstract: An increasing number of universities are investing in computer-based instructional (CBI) systems but the costs of operation are in dispute. Alpert and Biker' s estimate of costs per student hour for PLATO has been challenged by Kearsley while Hofstetter attempts to demonstrate a more favourable cost for the University of Delaware' s PLATO system. This paper demonstrates that the PLATO costs are higher than its proponents claim. A cost analysis of the VITAL microcomputer-based system is offered as an alternative to the high cost entry into CBI via mainframe systems. The major costs of computer-based instructional systems are not in the computing component, as costly as that is, but in the preparation and production of courseware. When compared to the cost of face-to-face classroom instruction, mainframe systems are at least four times more costly on a student hour basis even when using the large number of 500 students. Realistic instructional goals and clear priorities are argued to be the essential ingredients of effective computer-based learning rather than the expectation of efficiency and cost benefits.

INTRODUCTION

In the introduction to a series of working papers, *Computers on Campus,* Tucker (1983-84) names three American universities* which he states, "to my knowledge, outrank all others in the nation with respect to current scale of investment in information technology for instruction purposes -- close to $200,000,000 all told over the next few years." With costs of that magnitude, teachers in many other resource-starved North American universities may be excused if they think the bill for computers in education is too big. One Canadian university Vice-President remarked recently, "Don't talk to me about computing costs; it is just one big sink-hole." Systems predicted to cost pennies per hour of student contact time when purchased have shown a tendency to run into many dollars per hour. What are the costs which a teacher may expect to be incurred on liis or her behalf when using a computer-based learning system for instructional purposes? This paper will discuss large and small computer-based instructional systems and present an analysis of predicted

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and actual costs in two systems. It is offered as a contribution to clearing the air about the true costs of using computers for instructional purposes.

Philosophical and Historical Perspective

This article is written from the position that the computer in education is a tool, a means to an end, but that too frequently the hardware comes close to being viewed as an end in itself with the instructional application being left to someone else. The use of the computer in education should be seen as an integrated undertaking, including both the instructional application and the hardware. Such an integration is a complex process in that it draws first on theories of learning and instruction; second, on principles of instructional design; third, on matters of staff development and the adoption of innovations; fourth, on considerations of logistics and organization; and last, on the technical aspects of the hardware itself.

Many of us lived and worked through the heady decade of the 60's when communication technology was widely heralded as ushering in a transformation of education. The most spectacular example of the day was television with such massive projects, by the standards of the day, as Scarborough College's television teaching system (Lee, 1971). While television by the early 70's was beginning to be rejected, it did find its way into many classrooms in schools, colleges and universities. The question might be asked, "What makes computers in education in the 80's and 90's that much different from television in education in the 60's?" It can be argued that both represent instructional tools, and while they are different in their technical manifestations, they share an essential similarity as technical devices applied to education. Missing frequently in the 60's was adequate attention to the instructional design process along with satisfactory consideration of the impact on those with the instructional responsibility -- the teachers. It was not uncommon in the 60's to find those promoting educational technology to complain, with some derision, that education was the last remnant of the cottage industry and that it had to change to keep up with the times. Some of those sentiments are expressed in the 80's with reference to a different set of instructional devices.

Finally, it is the position of this paper that the only people who can effect change in instructional practices to incorporate the newer technologies are the professional educators themselves. This change will not come about by cajoling instructors or applying top-down administrative pressure but by an intrinsic belief that these new instructional devices offer something of value to learner and instructor alike.

Communication Technology and Computer-Based Instructional Approaches

Several parallels may be drawn between the use of television and computers in education. In the 60's the technology of the day required large central television production installations with a centralized coaxial distribution system. The use of such a system demanded major adjustments on the part of teachers and the yielding of large areas of control to the technical specialists. In the 70's this technology began to change with the appearance of low-cost half-inch video record and playback. machines and low-cost cameras. This enabled the teacher-user to regain some control over the instructional environment they had lost to the large central television system.

In the same decade of the 60's the first instructional applications of the computer began. The best known and perhaps the oldest established computer-based learning system in American and some international universities is PLATO. PLATO is considered by many

to be the state-of-the-art system for computer-based instruction (CBI) providing a rich CBI environment with high-resolution graphics, student control keys, touch input screens and a large number of connections to external systems such as heart-rate monitors, slide projectors, videodisc players and speech synthesizers, to name only a few of the peripherals which may be connected to it. To support this range of features a computing resource of considerable size is required.

Computer-based instructional systems of the PLATO type require a highly centralized organizational structure which is removed from the normal academic environment in which most teachers find themselves. Without attempting to force the analogy between instructional television in the 60's and mainframe computer-based instruction, it is argued that both systems demand a high capital investment and a specialized operating establishment. If the instructional priorities require this type of system, then there can be no quarrel with the resulting costs and the technical and organizational infrastructures required to support it. A system such as PLATO works well in this environment and it is especially appropriate for the military or large industrial organizations.

However, one of the lessons of television in the 60's was that education required greater flexibility and more alternatives than the technology of the day allowed. That flexibility began to emerge in the 70's for video equipment with the rapid progress in the miniaturization of electronic components. The same process led to the development of microcomputers in the early 80's which now offer alternatives to the use of computer-based instruction. CBI is no longer restricted to the large mainframe or medium-sized mini-computer systems.

During the decade of the 60's another much heralded educational medium appeared on the instructional stage. It was the super 8mm camera and projection system. While its potential, as promoted, was never realized it did make one major contribution, later picked up by low-cost video recording equipment. It enabled teachers and students to work with a visual recording medium previously beyond their reach because of the high cost and technical sophistication of semi-professional 16mm equipment. Professor Lou Forsdale of Columbia University, a leading proponent of 8mm film in education, advised his audience to look upon the expenditures in 8mm film production as an investment in building experience and skill rather than an investment in equipment. That advice seems to be as true today in working with computer-based instruction as it was two decades ago in working with new visual communication media. There is an unfortunate tendency to await the latest technical improvements before committing even a part of one's instruction to a new medium. The trouble with that approach is that there will probably be no end to new developments, which only serves to justify procrastination. The large investments required for mainframe systems have tended to restrict the opportunity of the majority of teachers to explore the power of computer-based instruction. The advent of the microcomputer has changed this restriction by opening up alternatives which can be explored on today's budgets.

The computer hardware is only one piece of the picture. The essential requirement is that the system help students learn and this requires some content or courseware. Unless adequate arrangements can be made to provide for the teaching preparation time to create the materials or to acquire and adapt existing materials from a resource collection of courseware, the expenditure of funds on computer equipment could be a costly mistake.

One attempt to ease the burden of creating computer-based learning materials has been the development of course authoring systems. These are software packages which allow a person not sophisticated in computer programming to produce instructional sequences using

English and the simplified structures of the authoring system. These authoring packages may be compared to word processing, spreadsheet, or file management packages. They require the user to acquire a knowledge of the system to use its potential effectively, but they make it possible for the non-programmer to do useful work with the computer in a fraction of the time necessary to gain proficiency with a programming language. PLATO Tutor was developed as the authoring system for PLATO. NATAL and CAN7 are Canadian contributions for larger systems. PILOT in various versions - Apple Super PILOT, E-Z PILOT and Softcrates - are current authoring systems designed for the microcomputer.

A project at the University of Guelph has developed another authoring system using Telidon/NAPLPS* as the vehicle for creating and displaying the instructional materials. This project has moved away from Telidon as a unique equipment system requiring special purpose decoder terminals, to a computer based system ranging from a single micro-computer in a stand-alone configuration to a small network system of up to 24 student study stations. The system called VITAL (Versatile Interactive Teaching and Learning) incorporates a number of Canadian-designed features. These include the Telidon/NAPLPS computer code, software decoders for the microcomputer by FBN, Microstar and Microtaure and hardware electronics developed by NORPAK. VITAL is a software authoring package which integrates these elements to operate on an IBM PC or compatible equipment. (For a fuller treatment of VITAL, see Moore, 1986). The original contribution of VITAL, beyond integrating the various off-the-shelf elements, lies in the programming sequence which enables teachers or their assistants, without computer language skills, to create visual and text reference materials, tutorials and interactive quizzes with immediate judging and feedback capability. VITAL has been written in BASIC and operates on PC DOS although it could be converted to C to operate on UNIX making it suitable for a mini-computer environment approaching mainframe capability. However, its developers see its main contribution at the lower end of the cost/complexity scale to enable teachers and administrators to gain experience in the effective and efficient use of computer-based instructional applications while minimizing the expense normally associated with computer based instruction.

Cost Comparisons Between Two Systems

The two systems chosen for this analysis are PLATO and VITAL. PLATO was chosen since it is the most strongly established and widely recognized mainframe computer-based instructional system which incorporates audio visual devices in its display. VITAL was chosen for comparison since it provides a graphic visual display, multi-user capability, and record keeping functions, along with interactive programming and judging capability operating on a microcomputer-based network or single stand-alone study station.

Reported Costs for Operating PLATO

Hofstetter reported that at the University of Delaware the PLATO system installed in 1975 with 32 terminals had grown to 330 terminals with planned expansion to 560 terminals. The total investment in equipment for this system was reported to be $3,801,971 as of October, 1981 (Hofstetter, 1983). The annual operating cost for the system in 1981-82 was $3,164,698 of which $3,335,049 or 42 percent was derived form external grants and contracts, leaving a net operating cost to the University of $1,829,649 for its computer-

* NAPLPS - North American Presentation Level Protocol Syntax.

based instructional service. Both in terms of capital investment and in operating costs, the use of computers on the scale of PLATO makes major long-term demands on the instructional budget. At this level the costs are aggregated as a total budget expenditure for the institution.

It is also customary to analyze the costs on a per student contact hour basis. This is the figure which is frequently used to interpret the large total outlays. In 1970, Alpert and Bitzer (1970) projected a range of $0.34 to $0.68 per hour per student contact hour. When this projection is adjusted for inflation using a 14 year inflation factor of 2.63, those 1970 dollar costs become $0.89-$1.79 per hour, still a reasonable figure. However, Kearsley (1977) reported that the cost per hour for a single PLATO terminal leased on an annual basis would cost $7.20 per hour or 4 to 8 times the cost originally projected.

Hofstetter (1983) has analyzed the actual costs at the University of Delaware and argues that the costs are, in adjusted-for-inflation dollars, only twice the Alpert and Bitzer projection. His argument, however, is flawed in that he calculates an hourly cost in 1982 of $2.47 per hour using all 330 connected terminals for an annual per terminal cost of $3,816. He concedes that the actual average number of terminals in use at peak demand time is 140. If this is the average peak load then non-peak periods would be something below that. The average peak demand then is 42.4 percent of capacity. He uses Alpert and Bitzer's estimate of 2,000 hours of use per terminal per year in arriving at his cost of $2.47 per hour. A more accurate analysis would take into account actual student use rather than a projected capacity figure in calculating a per student hour cost. If one uses the 140 terminal per hour peak demand (the 190 non-used terminals are assigned an overhead status for redundancy or developmental purposes) the annual operating cost is $8,994 per student-used terminal or an hourly cost of $4.48 per student for the PLATO mainframe. To this must be added the amortized cost of the student terminal, annual maintenance costs on the terminal, and communication costs between the student terminal and the mainframe. Thus to the costs of the central system must be added a per hour cost for the student terminal of $1.51 per hour. The hourly cost per student, using a more realistic analysis in terms of student demand, becomes $5.99 or somewhat less than Kearsley's figure of $7.20 per hour. However, since this analysis has taken the average peak demand as the basis it may have erred on the generous side and one would be included to accept Kearsley's estimate of what the real costs are in terms of students served.

Thus far the discussion has been restricted to the costs of purchasing and operating the hardware system. Of equal, if not greater, importance is the cost of creating or procuring the course materials. Hofstetter (1983) gives evidence based on the University of Delaware's experience that the typical tutorial with good interaction takes 200 hours to produce -- 55-60 hours by the instructor and 140 by the programmer. Hourly costs for developing a lesson are given as $2,500 for material without graphics or judging features to $8,000 for a simulation. Other estimates for program preparation range from 100 hours per hour of instruction to 400 hours where graphics, sophisticated judging and simulations are required. There is no reason to dispute these high costs since they have been determined by experience.

Capital Equipment, Operating and Courseware Costs for VITAL

VITAL has been designed to operate on readily available MS-DOS equipment over a range of configurations from a single stand-alone unit to a small network system of up to 24 student terminals. This gives flexibility in terms of entry costs based upon the needs of

the instructional program. It does not replace the power of large mainframe systems but it does provide the alternative of a decentralized facility while allowing advantages in the network mode not associated with single CPU licensed software on stand-alone units.

Courseware produced using the VITAL authoring system operates in any one of three modes -- a single stand-alone unit, a two station mini-network or a local network of up to 24 stations. It requires off-the-shelf equipment subject only to the installation of the appropriate colour graphics board and colour monitor. The use of Telidon/NAPLPS as the standard for computer storage and display enables a variety of student study stations to be chosen from videotex hardware units through a range of microcomputers from the Commodore 64, Apple IIe, Macintosh to MS-DOS compatibles.

The starter system comprises a Personal Computer with 256K of RAM, twin disc drives, a monochrome driver and monitor, colour card and an RGB monitor. The VITAL software for this single system costs $1,200. The combined hardware and software for this VITAL/Single-system costs approximately $4,000. This unit can be used to create the study materials and can also serve as a single student study station, A more efficient application is to equip any number of student microcomputers with a colour card, colour monitor and dual disc drives. A single floppy system disc called the TOAD (Teaching On A Disc) is loaded into drive A with the course files loaded from drive B. TOAD is designed to be purchased once per user at $49.95 and will operate any number of VITAL produced course files giving the same interactive branching and judging features as the network. TOAD, however, does not readily allow record keeping of student performance.

The next step up in providing increased capacity is the VITAL/Twin which uses a PC with a hard disc as the file server to drive two student terminals, Depending on the quality of the student terminals selected, the VITAL/Twin will cost between $8,600 and $11,200 for a two student station installation which includes a separate instructor course authoring station. VITAL/Twin provides a mini network with record keeping functions of individual student performance as well as summary records of all session activities,

The largest application of VITAL is in the network version which provides for up to 1000 student study hours per week for 48 weeks at 40 hours per week for an annual total of 48,000 hours. This configuration will accommodate up to 24 terminals which yields the lowest per hour unit cost of $1.21 on annualized costs of $57,781 for the system. The cost comparisons of the VITAL configurations are shown in Table 1 (see next page) which range from less than $10,000 for an authoring terminal and two student study stations to about $95,000 for a 24 station network. A single student station, using material produced elsewhere, costs $2,350 including the TOAD software. This is the unit suitable for home study or libraries and requires no running costs for telecommunication or data transmission apart from the mailing costs of the file discs for the courses being used.

The unit cost of using the VITAL system in a microcomputer environment, as shown in Table 1, will be influenced by the actual demand placed by students. However, the commitment of funds can be selected to fit within the requirements of the instructional program. While the smaller systems are more costly on a unit basis, they represent a much lower gross capital outlay. The microcomputer allows the institution or single academic department to *start small* and grow with experience and the needs of the instructional program.

A comparison of the VITAL microcomputer costs with the projection of Alpert and Bitzer in adjusted-for-inflation dollars reveals that these costs per student hour are comparable. In 1986 the Canadian dollar at 72 cents to the US dollar brings the Alpert and

TABLE 1
Capital Cost for Three Vital System Configurations

	Single	Twin	10 Network Stations	24 Network Stations
A. *System Purchase Costs*				
1. Authoring Terminal PC with colour card and 2 monitors	3,000	3,000	3,000	3,000
2. Server				
PC with 20 meg drive		2,250		
PC with 35 meg drive			8,000	8,000
3. Student Terminals				
2 x 2,300	4,600			
2 x 2,300		4,800		
10 x 2,300			23,000	
24 x 2,300				55,200
4. Network (10 terminals)			11,000	
(24 terminals)				21,460
5. Software				
VITALS	1,200			
VITAL/Twin		1,350		
VITAL/Net			8,000	6,000
VITAL/TOAD (2)	100			
Total Cost of Equipment and Software	8,900	11,200	51,000	*93,660*
B. *Annual Costs*				
Equipment amortized over 4 years	2,225	2,800	12,750	23,415
Maintenance @ 10% of Equipment Cost	760	985	4,500	9,366
Operator	2,500	5,000	12,500	25,000
Total Operating Cost	5,485	8,785	29,750	57,781
Cost per Student Station per year	2,743	4,393	2,975	2,408
Cost per Student Hour				
@ 2,000 hours per annum	1.38	2.20	1.49	1.21
@ 1,200 hours per annum	2.29	3.66	2.50	2.00

Bitzer figure ($1.79 US) to $2.50. The cost range for VITAL at 2000 hours per year is $1.15 to $2.20 depending on the configuration of the system or $1.92 to $3.66 for 1200 hours per year per student terminal. This is a favourable cost in contrast to Kearsley's figure of $7.20 US or $10.08 Canadian per student hour for PLATO.

The costs shown in Table 1, as in the case for PLATO, are related to the acquisition and operation of the equipment. The preparation of course materials adds a significant cost to the decision to use computer-based learning materials. The first element in the use of these materials is the instructor's time in the preparation, selection and supervision of the courseware production. In most established systems a trained programmer is essential to support the instructor. The VITAL system, using the simplified commands of Telidon/ NAPLPS and its own menu driven programming, eliminates the requirement for a computer programmer. Teachers and their teaching assistants are able to produce their own material without the need for such programmers. Where special graphic effects such as animation are desired the assistance of a trained graphic illustrator will enhance the visual elements, but such assistance is not essential for the bulk of the instructional programming.

The figure given by Hofstetter for the cost of producing computer based courseware ranges from $2,500 to $8,000 per student contact hour or $3,500 to $11,200 in Canadian dollars. Much of this cost is independent of the computer system used since it relates to academic time spent in planning the materials as well as to the technical time in programming or encoding the lessons. Any simplification of this process will introduce significant cost savings and enhance the prospect of expanded utilization.

Studies to date at the University of Guelph (Moore, 1986) indicate that the production time for creating instructional materials with VITAL ranges from 22 hours to 88 hours per hour of instruction or about one-third the time required for similar materials using traditional CAI approaches. Using an average cost of $30 per staff hour* in the preparation and production of computer-based courseware, VITAL shows a cost of $660 to $2,640 per student contact hour module or substantially less than that reported in the literature and by Hofstetter for traditional Computer-Assisted Instruction materials. A cost comparison between a comprehensive mainframe system such as PLATO and a less powerful but sophisticated authoring system such as VITAL on a microcomputer is summarized in Table 2 (see next page). It should be recognized that such comparisons are of limited value since the systems are different in capacity and capabilities. However, from the perspective of administrators providing funds and instructors wishing to explore the application of CBI, the comparison is valid in that it shows relative entry and operating costs. The microcomputer does provide for computer-based learning materials in the curriculum at lower cost and with minimal risk. Using standard microcomputers makes the equipment investment recoverable for other purposes.

To complete this analysis, the cost of courseware development must be combined with the costs of computer operations. Assuming 10 hours of computer-based material, class sizes of 30, 50, 100 and 500 students and life cycle of three years for the computer materials, Table 3 (see next page) provides an approximation of the hourly cost per student. In this table, the previously reported costs of $11,200 for PLATO and $2,640 for VITAL have been used. The data presented in Table 3 reveal that the major costs in using computer-based

* This figure was arrived at by averaging academic, professional and technical annual staff salaries of $57,000, $37,000 and $27,000 respectively and using 1,350 applied hours per annum.

TABLE 2
Cost Comparisons Between PLATO and VITAL

	PLATO	VITAL
A. *Capital Costs*		
a) PLATO - mainframe facility with 330 installed terminals (Hofstetter, 1983)	$3,801,971	
b) VITAL - local network with course authoring system and 24 student stations		93,660
B. *Annualized Operating and Capital Costs*		
PLATO - 7 year amortized equipment cost	543,138	
VITAL - 4 year amortized equipment cost		23,415
Operating Costs	1,829,649	34,366
Total Annual Costs	US$ 2,372,787	
	C$ 3,321,902	57,781
Hourly Cost of Operation per Terminal 2,000 hours per annum	C$ 8.37	1.21
C. Courseware Preparation Costs in Canadian Dollars		
PLATO - per student hour	3,500-l 1,200	
VITAL - per student hour		660-2,640

TABLE 3
Courseware Development and Computer Operating Costs for PLATO and VITAL

	PLATO	VITAL
Materials production costs per hour of student instruction	11,200	2,640
Class Size		
30 students - instructional cost	124.00	29.33
- operating cost	8.37	1.21
Total Cost per Hour	132.37	30.54
50 students - instructional cost	74.70	17.60
- operating cost	8.37	1.21
Total Cost per Hour	83.07	18.81
100 students - instructional cost	37.35	8.80
- operating cost	8.37	1.21
Total Cost per Hour	45.72	10.01
. 500 students - instructional cost	7.46	1.76
- operating cost	8.37	1.21
Total Cost per Hour	15.83	2.97

instruction are not in the computer component but in the preparation of the instructional materials with the latter accounting for 80 to 90 percent of the total, The data further indicate that computer-based materials begin to approach a reasonable cost only when classes or class combinations have relatively large numbers of students. By way of comparison to face-to-face instruction, costs per student contact hour in university classes of 30, 50 and 100 students are $4.87, $2.92 and $1.46 respectively using an average salary of $57,000 and a teaching effort of 60 percent of a total faculty member's assignment for teaching, research and institutional service. From the data in Table 3 and the per student cost of face-to-face instruction, it can be seen that PLATO, even under conditions of very large student numbers, is approximately four times more costly than instruction in classes of 30 students ($15.83 and $4.87) while VITAL costs with 500 students are similar to face-to-face instruction in classes of 50 students, $2.97 and $2.92 respectively.

Summary and Conclusion

In this analysis a comparison has been made between the preparation and delivery of computer-based learning material in a mainframe system using PLATO and a microcomputer network system using VITAL. Costs of both systems are considerably more expensive than face-to-face instruction in class sizes generally found in most colleges and universities. Even with classes of 500 students, the cost of PLATO delivered instruction was found to be four times greater than the cost of face-to-face instruction in classes of 30 students. VITAL, on the other hand, was found to have hourly student costs similar to classes of 50 students when VITAL materials were given to 500 students.

The major implication of these findings is that computer-based materials cannot be justified on the basis of cost efficiency in the class sizes likely to be found in most institutions. The decision to develop and use these materials must be based on other factors which derive from a careful analysis of instructional requirements and student learning outcomes. Mainframe computer systems are likely to be too costly in the initial capital outlay and recurring operating costs to be widely used in most institutions. Microcomputer-based systems offer a less costly but acceptable alternative, one which can be phased in gradually with institutional priorities and available resources. However, such applications will require careful planning and realistic expectations to prevent disillusionment and frustration.

Naisbitt (1982) suggests five directions in which the adoption of technology is moving. These are:

Force Technology	High Tech/High Touch
Centralization	Decentralization
Institutional Help	Self-Help
Hierarchies	Networking
Either/or	Multiple Option

Upon reflection it may be seen that large scale systems such as mainframe instructional computer applications exhibit the characteristics on the left hand of Naisbitt's schema while smaller micro-based systems tend to be more compatible with the emerging factors on the right of the schema. This observation suggests that the exploration of microcomputer-based instructional systems is compatible with the prevailing forces in technological developments generally.

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Profile

The Importance of Involving Experts and Learners in Formative Evaluation

Cynthia B. Weston

Abstract: It is widely advocated that, during development, instructional materials be reviewed by experts and tried out with learners in order to revise the materials and improve the final product. The role of learners and various kinds of experts as sources of input in formative evaluation is briefly discussed. A case study describing the evaluation of a filmstrip/audiotape program. by experts (subject matter and instructional design) and learners is presented. The results illustrate the importance of gathering feedback from multiple sources before making revision decisions.

INTRODUCTION

The literature of formative evaluation indicates that instructional materials should be reviewed and revised during their development in order to improve them (e.g., Andrews and Goodson, 1980). Some authors suggest that various types of experts be asked to review the materials (e.g., Montague, Ellis & Wulfeck, 1983). Others suggest that materials should be tried out with a sample of the target audience or learners for whom the materials are intended (e.g., Henderson & Nathenson, 1976). The vast majority, however, suggest that a combination of experts and learners be involved in the formative evaluation of the materials due to the different kinds of feedback which each can provide (e.g., Thiagarajan, 1978). article will discuss various sources which can be consulted during formative evaluation in terms of the different kinds of information which each can provide. Then a case study will be presented of a recent formative evaluation project which illustrates the importance of gathering information from a combination of sources rather than allowing a single source to drive revision decisions.

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Experts

For many publishers and curriculum developers, formative evaluation means asking experts of various kinds to review and suggest revisions to materials while they are being developed (e.g., Grobman, 1971; Kline, 1984; Truett, 1984). Even in the field of instructional design some have gone as far as to suggest the exclusive use of experts to review and revise materials (e.g., Montague, Ellis & Wulfeck, 1983) because of concerns about cost effectiveness of tryouts with learners.

Those consulted might include content or subject matter experts, pedagogical experts, instructionaldesign experts and media experts, among others. Each type of expert tends to focus and comment upon that aspect of the material which falls within his/her own area of expertise. Thiagarajan (1978) and Stolovitch (1982) have each discussed in detail various experts and their specific role during materials development. The list below shows the range of information which experts can provide:

- Subject matter *expert:* content accuracy, up-to-dateness, comprehensiveness;
- Pedagogical *expert:* appropriateness of level of language, objectives and content for target population, suitability for use within a specific instructional setting;
- *Instructional design expert:* clarity of objectives, sequence and relationship of ideas within the content;
- *Presentation expert:* technical quality, media, graphics; and
- *Curriculum expert:* compatibility of materials with program and other instructional materials in use.

Learners

While tryouts of prototype materials with learners may be less cost effective than reviews by a few experts, much has been written about the valuable feedback that learners can provide during the materials development process. Only the intended learners can help, for example, to identify where an important step has been left out (a step that may seem obvious to an expert), to indicate whether vocabulary is at an appropriate level, or to demonstrate whether or not the intended learning has occurred. Standard textbooks in instructional design, such as Dick and Carey (1985) and many articles (e.g., Geis, Burt & Weston, 1984; Henderson & Natbenson, 1976; Komoski, 1985; Stolovitch, 1982; Thiagarajan, 1978) present detailed explanations of the use of learners during formative evaluation. Included in these articles are descriptions of aspects such as what kind of learners to use, how many to use, how often to do tryouts, what techniques to use for data gathering and what kind of data to gather. In general, materials that have been revised based upon feedback from learners seem to be more effective than the original unrevised materials.

A Combination of Experts and Learners

Reliance upon experts only or learners only can result in an unbalanced picture of the problem. Involvement of a combination of experts and learners in the formative evaluation

process is widely advocated in prescription (e.g., Dick & Carey,1985; Geis,1986; Kandaswamy, 1980; Stolovitch, 1982; Thiagarajan, 1978; Weston, 1986) as well as practice (Burt & Geis, 1986). Recommendations differ as to level of involvement of both experts and learners, when to involve each in the process, techniques for gathering feedback, and kind of information gathered.

In general, however, the message is consistent. Experts should be used to identify problems within their area of professional competence, but should not be relied upon to accurately predict how the target population will respond to or learn from the materials. Depending upon the kind of materials being developed, one could consult some or all of the above mentioned experts. Learners, on the other hand, should be relied upon to provide feedback about their reactions to the materials and whether the materials actually help them to achieve the intended objectives. Learners cannot be expected to assess whether, for example, new content being presented is accurate, up-to-date or appropriate. .

A CASE STUDY

A recent request to carry out a formative evaluation of an instructional kit gave our research group the opportunity to explore the importance of gathering feedback from both experts and learners. The request came from an executive of Association, a national organization whose main area of concern is world food problems. This group had a clear commitment to the concept of formative evaluation. With the kit slated for distribution to all school boards across Canada in 1987, the organization built into their development schedule almost a full year for tryout and revision of the materials before distribution. An Educational Advisory 'Committee was set up to work with the organization at each step in the development of the kit. As well, a tryout of the kit at 70 high schools across Canada was carried out. High school teachers, the perceived target audience for the materials, were asked to respond to the materials in order to provide feedback from the user's and pedagogical expert's perspective. The fact that formulative evaluation was built into the materials development process is particularly impressive when considered in the light of Stolovitch's findings (1982) that in Quebec, for example, only 1% of materials produced in the schools undergo any kind of formative evaluation.

The Materials

The instructional materials were packaged in the form of a teaching kit. The stated objective or purpose of the kit was to provide a context for understanding the world food issue and a framework for discussion and decisionmaking. It was designed to be used with senior high school students as a complement to a range of courses, such as geography, history and economics. The kit included a 20-minute filmstrip/audiotape, a teacher's manual and a set of resource readings. The unit could take anywhere from several hours to several days to complete, depending upon which activities a teacher decided to implement.'

In the audiovisual presentation the world food problem was developed. First, food was discussed as a global commodity within the world market. It was pointed out that inequities in the market have created a situation in which many do not have enough food and famine recurs. Africa is then presented as a case study within which to consider the causes of famine

(e.g., colonial influence resulting in the production of cash crops, overcultivation, rising populations, droughts). Similar symptoms, it is said, can now be seen in developed countries such as Canada. The need to learn from what has happened in Africa and search for solutions concludes the presentation. The audiovisual presentation was apparently designed to achieve the affective component of the objective (stimulating discussion).

The teacher's manual provided the overall structure for the kit. It included the narrative from the audiovisual presentation coupled with discussion questions that could be asked at specific points. As well, a list of suggested activities related to the resource readings was provided. The resource readings consisted of a series of one page texts on a variety of topics related to the world food issue. The activities and readings were apparently designed to lead towards cognitive components of the objective (understanding, problem-solving and decisionmaking).

We decided to focus our evaluation on the filmstrip/audiotape component of the kit for two reasons. First, evaluation of the entire kit, with emphasis on the teacher's manual and readings, was already done by senior high school teachers at 70 Canadian high schools and we wished to provide complementary information. Second, due to the current time and curriculum constraints that exist in many schools it seemed that the audiovisual component might be used independent of the supporting materials and therefore should be able to stand alone effectively.

Constraints

A number of constraints were operating in this formative evaluation situation: the materials were in an almost final form, we had been called in at the last moment as external evaluators and our portion of the evaluation had to be completed within three weeks. These constraints affected the process in several ways.

Ideally, formative evaluation should occur in a number of progressive steps. The first reviews and tryouts should begin when the materials are in very rough form, (e.g., first typewritten draft of written materials, rough sketches of graphics, a set of handmade or temporary slides with the script read out loud). These can be done with individual learners and experts in a very clinical manner. In this case, the Educational Advisory Committee, which consisted primarily of pedagogical experts from across Canada, did the initial reviews and revisions.

As a result of these initial revisions, the materials we received were already in semi-final form (i.e., the audiotape had sound effects and music, the filmstrip had an almost professional finish). The state of the materials and the fact that we had only three weeks to complete the evaluation had an effect on the methods chosen to gather feedback. It was decided that the tryouts and reviews should be done with groups of learners and experts instead of in one-to-one situations, which are immensely more time consuming. As well, it was decided that it would be most efficient to gather information by using prepared questionnaires instead of general discussions. Again, due to the time pressures, different members of our research group handled distinct aspects of the evaluation which accounts for the differences in the questionnaires which are described below. Such differences are not unusual since few heuristics are available which advocate the best methods to use and questions to ask in order to elicit feedback from participants in formative evaluation.

The Sources of Feedback

The filmstrip/audiotape program was evaluated with several groups of experts and users. Two Faculty of Agriculture professors, specialists in nutrition and economics, provided subject matter expertise. Two Faculty of Education professors and one graduate student provided expertise in instructional design. Eight Faculty of Agriculture graduate students enrolled in an education course on instructional planning provided a unique combination of subject matter and instructional design perspectives. One-hundred and sixty-eight high school students were involved in the learner tryouts. Specific instruments were adapted from the literature or designed in order to elicit a particular kind of information from each group.

Subject Matter Experts (SMEs)

In order to gather information about the content of the presentation, the two subject matter experts were shown the program and then asked to respond to five open-ended items on a written questionnaire. The following questions were included:

- Is the information conveyed by this instructional package accurate?
- Are there any errors in the narrative? If yes, please comment.
- Does the narrative correspond to the filmstrip? If no, please comment.
- Is the content up-to-date? Does it reflect the current thinking in your area?
- Given the general topic "world food problems" and the limitations of time (20 minutes) and medium (filmstrip and tape), what topics would you include in such a presentation?

Instructional Design (ID) Experts

Instructional design experts were included for their expertise in clarity and organization of information. After viewing the program, they were asked to respond to questions designed to determine whether the program adhered to systematic design guidelines. Specifically, they were asked to focus on the following aspects:

- Are the objectives clearly stated?
- Is there a clear relationship between content and objectives?
- Is the information well structured? (e.g., advance organizer, summary)
- Is there a logical sequence of topics?
- Is each topic presented clearly?
- Is the relationship among topics maintained?
- Are the examples appropriate?
- Are there an adequate number of examples?
- Is the content appropriate for the intended audience?
- Is the evaluation appropriate for the objectives?
- Are the media appropriate to the topic?

Agriculture Graduate Students in an Instructional Planning Course

To get feedback on the content of the presentation, eight Faculty of Agriculture graduate students enrolled in an instructional planning course were included in the evaluation primarily for their subject matter expertise. As a group, they were shown the

filmstrip/audiotape program and asked to respond in writing to eight open-ended content related items (questionnaire adapted from Aversa & Forman, 1978):

- Are there content errors?
- Is the content comprehensive?
- Is all the information given necessary? (i.e., Is there anything superfluous?)
- Are there ambiguous content areas?
- Is the content important?
- Is there an appropriate amount of content?
- Is the level of the program appropriate to the level of the audience?
- Does the program present interesting and challenging ideas?

High School Learners

The presentation was tried out with high school learners so that reactions and response of the target audience could be assessed. The filmstrip/audiotape program was shown to six high school classes; a total of 168 students. In an attempt to make them feel like partners in the development process, they were told that their task was to help with the improvement of the materials by critically appraising them. They were then asked to respond, using a scale of 1 (strongly agree) to 5 (strongly disagree), to a 21 item reactionnaire adapted from Abedor (1971). These same items appear in abbreviated form in Table 1.

- I had sufficient background information to prepare me for this lesson.
- I was very sure of what I was supposed to be learning.
- After viewing the program, I felt that what I learned was important.
- The audiovisual equipment often distracted my attention.
- Listening to the tape and watching the filmstrip became boring.
- This program was very well organized. The ideas were well related to each other.
- A professional speaker should be used to make the tape.
- The audiotape moved too fast for me. There was too much information.
- I was bored by the repetition of ideas.
- There was a lot of useless information in this program.
- Often the tape and filmstrip seemed unrelated to each other.
- There was a lot of information missing from this program.
- The examples used to illustrate main points were excellent.
- The vocabulary used contained many unfamiliar words. I often did not understand what was going on.
- Discussion after the program would have helped me to understand better.
- I believe I learned a lot from viewing program.
- I would recommend many changes to the program before using it with other students.
- I think this whole idea of trying out new materials with students is a waste of time.
- I would prefer a textbook or a lecture version of this program rather than the filmstrip/tape version.
- I would like to review parts of the program to understand it better.
- After viewing the program, I was more interested in the subject than I was before.

In addition, they were asked to respond in writing to a few open-ended questions:

- For you, what was the least interesting part of the program?
- What was the most interesting part?
- In a few words, explain what you think the point of this program was.

In a more realistic situation the teachers of these classes would have been asked to use the entire kit with their students and gather information directly from them. As well, the teachers would have been asked to comment on the content, educational value and appropriateness of the package for a specific group of students. Due to time constraints, the teachers of these high school students were not able to familiarize themselves with the complete package. Since this kind of information was being gathered from other teachers across Canada, this aspect of the evaluation was not emphasized.

Results

The results of the evaluations are presented below. The characteristics of the group (e.g., adult expert vs. young learner), the size of the group (e.g., two or three vs. a large class), and the form of the information gathered (e.g., oral vs. written) affected the nature of the results. Feedback from the small groups of SMEs, ID experts and Agriculture students came almost exclusively from discussions, and summaries of those comments are presented. Feedback from the large groups of high school learners came only from written reactions, which facilitated tabulation. As much as possible, these results are summarized in tabular form.

Subject Matter Experts (SMEs)

Although the SMEs were asked to respond in writing to a questionnaire, in fact, they were somewhat reluctant to limit their reactions to written comments and so their feedback emerged from discussions. As anticipated, the SMEs focussed primarily on content issues, specifically accuracy, comprehensiveness and hidden messages conveyed by the program.

The number of hungry in the world is an example of the type of inaccuracy identified, although this later turned out to be a typographical error. In terms of comprehensiveness, the SMEs felt that there was a lack of emphasis on the other significant issues that have contributed to the world food problem, such as social, economic, political, and religious sources of influence. Although it was acknowledged that teacher initiated discussions and activities were meant to complement the package, it was felt that the filmstrip/audiotape program should have independently conveyed a more global view of food problems.

The second category of comments concerned hidden messages. The participants, both from developing areas of the world, felt that the program presented a biased view of the people of developing areas. They also objected to the perpetuation of myths such as "hunger exists because there is not ample food" (there is ample food, they insisted, but hunger exists because of unequal distribution).

The SMEs also commented upon the suitability of the program for high school students. One participant thought that it could be an effective tool in promoting awareness at an introductory level, the other participant was less enthusiastic. It should be noted, however, that the SMEs were university professors without high school teaching

experience. It might be argued that the suitability of materials for a particular group of learners falls more within the domain of pedagogical experts.

Instructional Design (ID) Experts

These experts focussed their comments on design issues. Basically, the comments addressed the original questions and can be summarized in several categories.

The absence of a statement of objectives was the major area of concern for the ID experts. In fact they, were concerned that the learners would not understand the main point of the program without some explicit guidance. Although the Teacher's Manual contained a general statement about the purpose of the kit, it was felt that the audiovisual presentation, being a discrete component, should convey clear objectives independently.

Among the many issues raised were several related to the structure of the content. The ID experts said that it was difficult to evaluate several of the content questions, such as relationship of content to objectives, since the objectives were so vague. While they did say that there seemed to be a progression of ideas, they felt that the use of an advance organizer and summary would additionally clarify the the content and assist the learner in achieving the objectives. As well, there was some concern about the relationship or match between the message of the visuals and the message of the narration.

Agriculture Students in an Instructional Planning Course

While we expected this group to function as subject matter experts, in fact they were also quite concerned with instructional design issues. This may be due to the fact that the tryout took place within the context of the instructional planning course. As with the SMEs, there was some reluctance on the part of these respondents to limit themselves to written comments and most of their feedback came from the discussion. Their responses were considered to be relevant to the subject matter and instructional design evaluations.

Issues related to the instructional design of the program predominated. The participants initially said that they were unable to respond to any of the questionnaire items because the objective or purpose of the presentation was not clear to them. They felt it was impossible to determine if, for example, content was comprehensive since the objectives of the audiovisual presentation were neither explicit nor implicit.

In regard to content, some particularly useful perspectives were provided due to the unusual cultural mix of the group which included students from Kenya, Uganda, Brazil, India and Canada. Responding to the issue of comprehensiveness, those from developing countries felt strongly that the program focussed too much on technical causes of the world food problem and did not present the social causes. As well, they said that the program should have included more about the world food situation rather than focussing on Africa alone. They agreed that the content was important and that this kind of information should be presented to high school students.

High School Learners

The learner's perspective was provided by high school students. The results of the responses to the 21 scale items on the questionnaire are presented in Table 1. (See next page). In general, the students responded favorably to the presentation. They perceived it as being interesting, informative and well-organized.

TABLE 1
Summary of High School Learner Responses to Reactionnaire Scale Items

Question (abbreviated)	Frequency 1	2	3	4	5
Sufficient background	**44**	**81**	**13**	**25**	**3**
Sure of what learned	**52**	**75**	**28**	**8**	**3**
What learned important	**76**	**56**	19	9	**6**
Equipment distracting	15	31	**24**	**53**	**45**
Filmstrip boring	17	**37**	**25**	**52**	**37**
Well organized	29	**83**	**37**	**12**	**7**
Use professional speaker	**28**	80	40	**16**	**4**
Tape too fast	**6**	29	**26**	**56**	50
Repetitious ideas	**4**	**24**	**41**	**66**	**33**
Useless information	**8**	**13**	**33**	59	**53**
Filmstrip/tape unrelated	10	**34**	**36**	49	39
Information missing	**8**	**31**	**62**	**45**	**21**
Excellent examples	**25**	80	40	**16**	**4**
Unfamiliar vocabulary	**8**	11	**23**	**61**	**62**
Discussion would help	29	**57**	**36**	**25**	19
Learned a lot	30	**57**	**45**	**22**	**14**
Recommend changes	16	**24**	**45**	**58**	**23**
Tryout a waste of time	**5**	**26**	**38**	**46**	30
Prefer text or lecture	**5**	**6**	10	**35**	109
Like to review program	**27**	**54**	**44**	29	**14**
Program generated interest	21	**56**	**51**	**24**	**15**

Note: Frequency indicates the number of individuals who responded at each point on the five-point rating scale: 1 = strongly agree; 2 = agree; 3 = uncertain; 4 = disagree; 5 = strongly disagree. Nranged from 165 to 168.

A few responses revealed some uncertainty on the part of the learners. When asked whether they felt that any information was missing from the presentation and if they felt that the filmstrip and tape were well related, there was a great amount of variance in responses.

An open-ended question asked the learners to provide a brief explanation of the main point of the program. In reviewing the 168 reactionnaires, fifteen major categories of response emerged (Table 2 on next page). Results indicated that, in general, the learners understood the message that the presentation was attempting to convey. A large percentage (30%) felt that the main point of the program was to make viewers aware of the world food problem, and to inform them of the situation. Typical comments were, “The program was to let us know what happens in the other parts of the world and the struggle they have to eat

TABLE 2
Main Point of the Program According to High School Learner Written Comments

	Number of Responses*	%
Awareness of the world food problem	60	30
We can help - do something about it	39	20
The food problem in Africa	24	12
Change before too late for Canada	15	7
Life in Africa - Ethiopia	7	3
We waste	7	3
We're lucky	6	3
Others are suffering	6	3
Famine can happen anywhere	6	3
Importance of food	6	3
Causes of world hunger	3	2
Start caring	3	2
Issues concerning world food day	1	1
The problem of surviving in third world countries	1	1
No response	14	7
Totals	198	100

* Total is greater than Nas some learners indicated that there were one or more main points to the presentation

and live day by day" and "To make us aware of the problem of food". Another 20% felt that the main point was to inform that we can all do something to alleviate the problem, for example, "It helped us understand that there are many people dying of hunger and we should help them" and "To show that we should try to help these people, that it can be done".

Considering that the learners indicated that they wanted more discussion on the topic, would like to review the program, that the program generated their interest (Table 1, items 15, 20 and 21) and that they understood the main point of the presentation, it can be concluded that the objective of the presentation was indeed achieved.

Summary

The information resulting from reviews and tryouts with the four groups was sometimes in agreement, sometimes complementary and sometimes conflicting. Major examples of the differential information provided by the various sources are presented below.

Errors. The SMEs were the only group to focus on content inaccuracies. This supports the claim that experts should be asked to validate any materials being developed. Thiagarajan (1978) suggests that experts review materials before they are tried out with members of the

target audience so that learners are exposed to accurate content. Experts should be asked to review again after revisions have been made to ensure that content has not been distorted by by the revision process.

Up-to-datedness. The SMEs were also the only group who expressed concern that the presentation perpetuated certain myths that not only depart from current thinking in the field but are also counterproductive to current efforts towards improving the situation (e.g., hunger exists because there is not ample food). Once again, this indicates the kind of unique feedback that only a subject matter expert can provide.

Comprehensiveness. Both the SMEs and the agriculture students raised issues regarding the comprehensiveness of the presentation. Both groups felt that other causes of world hunger needed to be included, even if they were briefly presented as a context within which to explore a single cause. From the design perspective, the ID experts presented complementary information. They felt that an overview and summary were needed to clarify the context of the topics being treated in the presentation.

SMEs and agriculture students also agreed that the presentation focussed too much on Africa hence implying that the food problem was specific to that part of the world. This concern was substantiated in the learner data. At least 15% of the responses (Table 2) indicated that the main point of the program was the food problem in Africa, rather than the world food problem.

Objectives. This is an area where conflicting information was provided by different sources. The ID experts and the agriculture students felt strongly that the objectives of the presentation had to be clarified and made explicit to the learner in order for the presentation to achieve its purpose, The learner data indicates that the learners understood the objectives of the program in spite of the fact that they were vague and not explicit.

Organization. The instructional design experts and the agriculture students felt that the overall organization of the presentation was weak. They indicated that, in part, this was due to the lack of objectives which made it difficult to judge if content was related to objectives. But, as well, they felt that the internal flow of topics and relationship among topics needed to be strengthened. The ID experts felt that an advance organizer of some kind would assist with clarifying this structure. The high school learners again presented conflicting information. They said that the presentation was well organized but one might ask whether these learners have adequate skills to judge this issue.

Relationship of narration to visuals. The instructional designers and the high school learners both expressed concern about the match between the narration and the visuals. In fact the same example of mismatch was mentioned by each group. Both felt that depicting colonialism with a picture of lush vegetation tended to convey the impression that conditions under colonialism were more desirable, when in fact the message was the colonial rule was a contributing factor to food problems.

CONCLUSIONS

As external evaluators, it was not within our mandate to make revisions to the materials, although we did provide a few general recommendations for the consideration of the producers. In the end, of course, it was their decision as to what changes should be made to the materials based upon the feedback from our experts and learners, the Educational Advisory Committee and teacher tryouts done across Canada.

We did recognize, however, that decisions as to how to revise the program would probably be quite different if one had to rely upon information from experts only or learners only rather than feedback from the combined sources. For example, if solely the feedback from the SMEs was relied upon, decision-makers might be inclined to totally rewrite the script in order to include a more comprehensive picture of the causes of the world food problem and to include more on problems in areas other than Africa. If solely the information from the ID experts was relied upon, decision-makers might be inclined again, to rewrite the script in order to provide an advance organizer, a clear statement of purpose or objective, and to carefully sequence the content in order to achieve the objective. If solely the feedback from learners was relied upon, decision-makers might be unaware of the peculiarly North American perspective being conveyed by the program.

When the combined information is reviewed, rather different decisions might be made. The objective of the program was to provide a context and framework for discussion of world food issues. While this is a very broad objective, the learners apparently understood the main point of the program and as well indicated that they were interested in and wanted to have discussions on the topic. Since it could be said that the program was basically effective in achieving its goals with the learners, it might not seem imperative to invest the extra time and expense of totally revising the program to satisfy all of the concerns of the experts.

Thiagarajan (1978) provides some particularly useful suggestions as to how one might go about deciding which expert suggestions to implement. First, he cautions that "Too many experts . . . spoil the product with contradictory and counterproductive suggestions. One or two experts in each area provide an appropriate panel..." (p.136). He adds that it is not always feasible to revise based on every expert comment. One approach to assigning priority to revisions suggested by experts is to tabulate them and use those which have the highest frequency count.

Loose Ends

There are a number of loose ends in this discussion which cannot yet be tied up due to some missing links in the research.

One of the most pressing questions that remains is how does one actually make revisions based upon any kind of data, whether it be from experts, learners or a combination of the two. There are suggestions as to how data can be translated into an informed revision decision (e.g., Gropper, 1975), however most revision is still done intuitively. In fact, the situation has not improved greatly since Thiagarajan wrote in 1978, "A recent informal study confirms our experience that different developers may come up with entirely contradictory revisions (e.g., delete the paragraph versus add more explanation to the paragraph) based on the same learner feedback. We need a set of heuristics for translating learner feedback into revisions" (p. 140).

Other unresolved questions concern experts. What defines an expert and an area of competence? A brief list was provided earlier in this article but many other combinations or distinctions are possible. What are the specific contributions of experts in the process of formative evaluation? Saroyan (1987) is currently investigating these two areas and will report some initial findings at a conference early in 1987. What are the most appropriate ways to elicit feedback from experts? In this study, for example, we found that experts were somewhat reluctant to respond to a written questionnaire.

Even though unresolved issues remain, the literature does tend to indicate that revised materials are more effective than unrevised materials. Intuitive revision based on feedback from experts and learners still seems preferable to no revision at all.

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Profile

The Status of Media Centres in Canadian Universities

Esio Marzotto

Abstract: The budgets, personnel levels, and activities of Media Centres in Canadian Universities are compared to develop a profile of the conditions existing in these centres. In an era of restricted university budgets, the effect of financial constraints and the moral support of upper level administration for Media Centres is assessed. The study explored the broad range of activities of media centres in both revenue generation and instructional support areas. Findings in this study suggest the direction of future development in media centres and the challenges faced by current university media directors.

INTRODUCTION

In December of 1983, a task force of AECT, titled The Task Force on the Status of Media Centres in Higher Education, under the chairmanship of Michael J. Albright, published the results of a study which developed a profile of the conditions existing in higher education Media Centres.

The purpose of the task force was to investigate and document such factors as:

1) current trends in budget and personnel levels;
2) the degree of moral support provided by supervisors and the faculty clientele;
3) the extent to which media centres participate in those areas that might strengthen their status on campus, such as providing instructional computing services or contributing to the institution's distance learning effort;
4) the degree to which media centres support their operations by generating income and promoting their services; and
5) media directors' own perceptions of the overall health of their centres, particularly from the perspective of whether this health has improved or deteriorated over the past five years.

Eslo Marzotto is on leave from his position as Director of the University of Windsor Media Centre, a position he has held since 1970. He is currently Director of the Centre for Educational Technology at Sultan Quaboos University in the Sultanate of Oman. The author wishes to thank the Media Directors of Ontario Universities, the University of Windsor and Sultan Quaboos University for their contributions to this research. An earlier version of this paper was presented at the 1986 AMTEC annual conference, Toronto, ON.

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The report of the study came to the attention of the Ontario Universities' Media Directors in the spring of 1984 and generated lengthy discussion. The directors found that the study seemed to confirm their own informal views of Media Centres in Ontario. At the 1985 fall meeting of the Ontario Universities' Media Directors the decision was made to conduct a study of media centres in Canadian Universities using the AECT study as a model. There were several advantages to this approach:

1) the objectives of the AECT study were in line with those of the Ontario directors;
2) the survey instrument had been designed and tested and only required modification in updating and translation to the Canadian instructional media scene; and
3) a comparison of the profiles of the U.S. to Canadian centres could be conducted at the conclusion of the Canadian study.

DATA COLLECTION

Forty-two media centres were identified in Canadian Universities from the mailing lists of AMTEC and the AUCC. This was deemed a manageable number and survey questionnaires were mailed to all of the forty-two institutions in January, 1986. Completed questionnaires were received from nineteen institutions or 45% of the total. Time did not allow a follow-up mailing. Questionnaires were received from universities reaching from Nova Scotia to British Columbia (See Table 1) and the response was judged to be representative of Canadian university media centres.

TABLE 1
Distribution of Sample Across Canada

Provinces	f	%
Nova Scotia	1	.05
Quebec	4	.21
Ontario	10	.53
Saskatchewan	1	.05
Alberta	1	.05
British Columbia	2	.11

RESULTS

Health of Media Centres

Media directors were asked how they perceived the health of their centre. First they were requested to describe the trend between 1977 and 1982 and then the 1985-86 health status. In general, the directors were positive about the health of their centres. Approximately 58% rated their centre as improved during the five year period, 10.5% saw it as unchanged and 31.6% perceived it to have deteriorated during the period.

Directors were asked to give their perceptions of the current health of their centres. The response supported the trend of improved health; 78.9% considered their centres to be healthy while 2 1.1% felt their centres were in trouble.

Directors were asked to explain why they believed their centres were healthy or unhealthy. The two reasons cited most often were: 1) appreciation for the value of instructional technology and 2) the centre's quality of service. These were followed closely by attitude and ability of staff and moral support of the administration. Only six directors gave reasons for their centre's lack of health. Budget cuts were the only reason mentioned more than once.

Funding Patterns

In 1972-73 the number and size of media centres was quite small. Over the 13-year period, 1972-73 to 1985-86, both the number of centres and their budgets increased considerably (See Table 2). During this period, five centres reported budget cuts and one centre remained unchanged in its level of funding.

Over the same period, the median budget level increased approximately 20% per year. Those centres with increases totalling less than 60%, lost ground in terms of the inflation factor, all other things remaining equal (e.g., staff levels).

TABLE 2
Minimum, Median and Maximum Budget Levels

Year	*n*	Minimum	Median	Maximum
1972- 1973	9	$37,321	$130,000	$357,232
1977- 1978	13	65,000	364,272	1,723,000
1981- 1982	14	80,000	437,000	3,547,000
1985- 1986	16	125,000	492,000	4,000,000

Revenue Generation

Of the 19 media centres reporting only two indicated that they did not generate revenue. Of the remaining 17, fourteen retained the revenue, one retained 80% and two contributed it all to the university's general fund. Three did not report the amount generated.

Most media centres reported generating revenue through the sale of supplies and by renting facilities and equipment to non-university clients. Most said that they use the revenue in support of the services. Only two centres were required to support the university general fund with the revenue. The amount of revenue generated is considerable. Seven centres generated from $50,000 to $200,000 while eight centres each earned under $50,000 in 1984-85.

Revenue Producing Activities

Directors were asked to identify the revenue generating activities from a list. The most frequently mentioned revenue producing activities were: 1) charges assessed for AV services; 2) sale of supplies; 3) equipment rental; and 4) sale of film and tape programs.

PATTERNS IN PERSONNEL LEVELS

Sixty-three percent of the media centres surveyed had between 5 and 29 full-time employees in 1985-86, 15% had less than 5 staff, while 22% had more than 30. In terms of

change in staffing over the 9 year period, 1972-73 to 1981-82, 42% of the centres increased the number of full time positions, 32% suffered reductions and 26% experienced no change in staff. As a net increase in staff was experienced, one may interpret the period as one of growth -- a healthy sign. On the other hand, during the period 1981-82 to 20% experienced increases in staff positions while 41% suffered position losses and 37% maintained staff levels. The net decrease in positions may be considered a sign of deteriorating health. Technical and production positions were most often deleted in the reduction process.

Part-Time Non-Student Personnel

Trends in the employment of non-student personnel can not be determined from the data reported. A few centres (3) use a great many part-time, non-student employees. A larger number (7) employ four or fewer and the largest number of centres (9) employ none at all. In 1977-78 only four centres employed part-time, non-student employees. In 1985-86 this grew to ten centres.

Part-Time Student Employees

Media centres generally made extensive use of part-time student personnel. Sixty-six percent of reporting centres used part-time student employees to supplement the staff in 1985-86. A trend has developed over the 13 year period with the number of part-time student positions increasing at a greater rate than full-time positions. One may conclude that budget restraints have caused centres to employ more low-wage personnel than might otherwise have been their choice.

The number employed by individual centres varies from 0 and 1 to over 60. In 1972-73 eight centres employed a total of 92 students, in 1977-78 nine centres employed 214, in 1981-82 thirteen employed 167 and in 1985-86 fourteen centres employed 210 students.

PATTERNS AND TRENDS IN MORAL SUPPORT

Media directors felt the moral support provided by senior administrators is very high. No less than 90% rated their immediate supervisor as supportive. This perception extended to the next echelon as well, with 69% indicating positive moral support from senior management. Faculty support is positive too; 83% of the respondents rated their faculty as moderately supportive.

The trend in morale on the part of the immediate supervisor was rated as 42% holding about the same, and 37% improving slightly. For the next higher echelon supervisor, the ratings are 61% holding about the same and 22% improving slightly. For the faculty in general, 53% reported the morale trend holding about the same while 31% reported that it was improving slightly. The trend in morale as perceived by the directors is indicative of healthy media centres.

COMPUTING SERVICES PROVIDED

Respondents were asked if their centres provided any kind of instructional computing service. Only three directors responded affirmatively. The kinds of services are equipment maintenance and computing laboratory administration. Serving the universities' computing needs is not a function of media centres in general.

SUPPORT FOR DISTANCE LEARNING

Respondents were asked to indicate if their media centres were involved in the production of course materials for, or the delivery of instruction to off-campus students receiving credit at their institutions. And, if so, what delivery systems were employed. Twelve of nineteen centres (63%) are involved in distance education. The frequency of mode of delivery of instruction is shown in Table 3.

TABLE 1
Frequency of Mode of Delivering Instruction

Mode of Delivery	f	%
Circulatirtg videocassettes	11	41.0
Open-circuit television	5	19.0
Cable television	5	19.0
Computer programs	2	7.0
Dial-access audio	2	7.0
Audio teleconference	2	7.0
Total	27	100.0

PROMOTION OF MEDIA SERVICES AND COMPETING CAMPUS SERVICES

Most media centres promote their services. Flyers and brochures, media workshops and periodic workshops were reported with high frequency. Healthy centres give promotion a high priority.

Respondents were asked if their media centres were being hurt by competition from departmental or other special purpose media operations on campus. Twenty-seven percent of the respondents indicated that they were faced with competition from other university departments.

MOST SERIOUS CHALLENGE

Budgets dominate the list of most serious challenges facing media directors. Equipment replacement and maintaining services are primary concerns. Next in importance is the changing of administrators' and users' attitudes toward the use of instructional media. This is inconsistent with the perception of positive moral support from both groups.

CONCLUSION

Canadian University Media Centres as perceived by their Directors are in a state of relatively good health. Growth is limited but support from University Administrators is

positive. Most Media Centres generate revenue by charging for services and/or making services available to clients outside the University. A few are required to recover operating costs. Distance Learning is the direction of future development while CAI, CM1 or CBI have not been an areas of growth. The most serious challenges for the future are: keeping up with new technology, replacing obsolete and worn out equipment and maintaining service levels during periods of fiscal restraint.

Media Managers Column

Developing a Survival Strategy: Supporting a College or University Learning Resources Center

Marvin E. Duncan

Financial pressures are forcing many colleges and universities to cut back on certain programs. In some instances, service areas such as learning resources centers are substantially affected by these cuts. Academic areas are also affected by cutbacks but not necessarily to the same extent as service areas. Programs which have obtained funds from governmental sources and private agencies many times fail to receive funding at previous levels. As a result, these programs depend more and more on institutional funding even though at reduced levels for survival. This means that learning resources centers became one of numerous hands reaching for and depending on institutional funding for their survival. Thus, both academic areas and academic support areas are competing for the dollar. It may well be that this situation may result in academic support areas receiving inadequate funding.

Robert M. Diamond (1984) appears to be in agreement with the above interpretation and recently wrote:

> The years ahead will not be easy ones for colleges and universities. Inflation will continue, and energy and legal costs will continue to consume a large proportion of total operational budgets. For many, there will be a decline in overall enrollment. As a result, support agencies such as instructional development centers will find themselves constantly fighting for their share of scarce resources and, in some instances, for survival.
>
> Offices of this type are particularly vulnerable in times of fiscal stress for several reasons. First, they are not a traditional part of the university. They do not have the historical base associated with the various academic departments, the library and computing center. Second, since units may not have direct contact with the total academic community, they are often not perceived by the faculty and by administrators as vital to the institution and its survival; and, third, as easily-identified units with discrete budgets, they are extremely accessible to a budget committee's axe, or an administrator's trade-off. (Diamond, P. 71)

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Although this article by Diamond is one of a few which addresses itself to survival, a few other voices have been heard on this subject. Much of the literature on the subject discusses ways of either improving existing services or expanding services. For example, Barson, Haney and Lange give strategies for improving and/or expanding services in their article, *The Heuristic Dimensions of Instructional Development* (1968). Other writers have since added heuristics. The point is that little and certainly not enough attention has been focussed on the survival of the instructional development centers or learning resources centers in times of financial stringency in higher education. Still further, in this literature, survival has not been related directly to financial support.

Jacquelyn B. Hill (1983, 32) quoted from Alvin Kent's address in which he remarked, "I think media professionals should have a chance to hear from someone who doesn't have a horror story to tell." Kent listed four factors which he feels created a successful media resources center at Iowa State University: money, management, media resources and an interactive environment i.e., one that interacts with people to produce either success or failure. Kent believes, however, that money is the key to a successful media operation and that more dollars result in stronger programs. For example, from 1975 through 1982, the center at Iowa State University showed a 50 percent increase in support after adjusting for inflation. It is hoped and assumed that services were improved as a result of increased financing and that they were expanded in both quantity and quality.

J. Andrew Walcott stated, "as a media specialist you have to go to Muhammad's mountain and establish yourself as a presence" (1984, p. 23). Once the center becomes known for quality services, there are recommended techniques (but no guarantees) which the director and staff can employ that may result in greater financial support.

Obtaining Financial Support

David Berlo once wrote, "we are in the people business." Thus, a warm smile, a courteous hello, may I help you? will be helpful in attracting people to the center. The staff of the center must make people feel welcome if they expect them to use the services of the center. The latest and most sophisticated materials and equipment may become no more than showcase displays if they are not used. Many faculty, staff and administrators do not know either what the center does or what it is capable of doing. By surveying the needs and expectations of the campus community and making sure that these needs are met to the extent of the center's responsibilities and capabilities, the director and the staff will be performing a supply and demand role. If the center has an academic program and offers a course in photography, filming or production, faculty and staff of the institution may be invited to enrol1 in one or more of these courses. Specifically, photography is a good selling point. People take vacations and like to record these experiences on film for *show and tell sessions* when they return home. The same is true with regard to filming. Those who do not take the course(s) can be invited (small numbers each semester) to *sit in* one or more of these courses. By initiating activities such as these, the director and the staff are advertising their knowledge and skills.

Advertise the center in the campus newspaper. Schedule a tour for new students, new faculty, staff, and administrators. Make a concerted effort to make the center visible in the community. A media presentation or a workshop can work wonders in advertising the center to this larger population. There may be businesses and other organizations in the community which may be looking for resource services such as those available in the center. For example, a community-based agency had a need for visuals in explaining its

program to a group of business executives in the community. After several meetings with the agency head and his staff, it was decided that the program could be visualized via slide-tape. A graduate student in educational technology (under the writers supervision) was assigned to work with the agency head and produce the slide-tape. Credit slides for the presentation included, among other things, the name of the university and the learning resources center. This program is now being shown to business personnel in the community. Similar programs have been developed by the center for other community businesses and agencies. The cost of these projects was minimal and was absorbed by the business or agency for which the presentation was produced.

No matter what system of reporting is used or how accurate are the annual reports on the operation of the center, funding is not always based on these factors. The writer's experience of twenty-three years has led to the belief that knowing who controls what and finding ways to be on a friendly yet professional basis with these individuals can promote substantial fund allocation. One suggestion is that directors should not become a part of the circle of campus gossip but should get close enough to the circle so as to know who makes decisions which affect the centers which they manage. In a way, this is an abbreviated form of Force-Field analysis in that the director studies the organization very carefully and identifies the forces as being positive, neutral, or negative forces. Positive forces can assist in goal attainment, neutral forces neither assist nor hinder progress, negative or restraining forces work against the goals of the center. Classify individuals, particularly administrators, into one of these force categories [Rather than providing a lengthy discussion of Force-Field Analysis at this point, for additional information the reader is referred to Gordon Lippett's discussion (1969) on the subject.]

Any service provided by the staff of a center relates directly to budget allocations. Therefore, the director should seek every possible means of obtaining financial support. The following suggestions, some of which were discussed in previous sections, may prove useful.

a) Cultivate a warm working relationship with those who control funds including the secretary. Although the secretary does not control funds *per se*, the secretary knows what funds are available and may have some influence on allocations.
b) Visit those who control funds, especially when you are not asking for additional funding. Stop by (call first) even if you give a false reason for the visit. This will help you get to know those who control funds.
c) Although there may not be a request, there are occasions when an administrator needs office signs. Check with the secretary to find out what information should appear on the sign(s). Make the sign(s) and present it/them to the secretary.
d) When funds are allocated, begin committing these funds immediately. Avoid waiting until the deadline for committing or expending funds.
e) Never be satisfied with what you get. Rarely will you get all that is request%. Have requisitions prepared for things you need but could not purchase due to inadequate funding. These requisitions should be typed and dated day after departments and schools should have committed funds. Since uncommitted funds are returned to the Office of Financial Affairs (or a similar office), take these requisitions to the person in charge. Rather than approve many requisitions from many different departments, the financial officer may approve three or four from your center. Three or four requisitions from your center may equal or exceed the amount of funds returned to the Office of Financial Affairs.

We in the media profession need to publish articles similar to this one in journals whose primary audience is administrators. As a result of reading articles of this sort, perhaps administrators who control funds would become more sensitive to the needs of a center. We continue to publish largely in *our* journals; we know our problems, but do administrators know our problems?

Summary

Programs which depend on institutional allocations to absorb operational costs are facing difficult times trying to survive. Less money is available than ever before with more *hands* reaching for these funds. This shortage of funds is affecting all university programs and particularly academic support programs which traditionally receive less financial support than their academic counterpart. Academic support areas are likely to continue to receive inadequate financial support. Therefore, it is extremely important for directors of these support areas to develop survival strategies. Many survival techniques have been tried. Some are suggested in this paper. However, there are no guarantees.

There is a scarcity of information in the literature which pertains to survival. Much of the literature deals with ways of expanding services in terms of quantity. Some of the literature suggests ways of improving existing services rather than expansion. What is needed, I feel, is to: 1) create a body of literature on the subject of survival strategies, and 2) publish as much of this information as possible in journals whose primary audience are those who make allocations to academic support areas such as learning resources centers. Otherwise, support areas will continue to struggle for survival.

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Microware Review

Len Proctor

The Sider Hard Disk and the Apple IIe

Ron Berntson
Guest Columnist

I've had experience with two different Sider hard disks connected to Apple IIes: a ten megabyte unit on my home computer for the past fourteen months and a twenty megabyte unit on learning Resource Center's IIe for the past eight months. I would be reluctant to use or buy another Apple computer Without having some form of mass disk storage greater than the 140K available on the standard 5 1/4" drive.

There are two reasons why you should consider some form of mass storage on your Apple II. First, the "floppy shuffle" might cause trouble: constantly swapping disks to use new programs or access new data. Second, the speed of the Disk II may slow your work, especially on disk intensive programs like AppleWorks.

Solving the first problem is, for me, the primary advantage of a hard disk: the ease of switching programs and data. I use AppleWorks more frequently than any other program. However, there are a number of other programs I want to use frequently. When I want to do serious word processing, I switch to AppleWriter. I do some programming in both Applesoft and Kyan Pascal. Since I'm the cook in our household, I have found Micro Cookbook to be a useful menu planner and shopping list generator. Finally I also frequently use a communications program, spelling checker, and an outlining program. Having all these programs loaded on the hard disk increases my speed and organization. My subjective tests give the hard disk a three to one speed advantage over a floppy drive -- without accounting for the time it takes to find and insert the correct floppies. Quitting Applewriter, loading Sensible Speller, checking (but not correcting) this article by searching a 90,000 word dictionary, returning to Applewriter, and loading the document takes just under two minutes using the hard drive. More important, for me, than speed is the organization. Keeping your floppies organized requires constant vigilance; organizing a hard disk requires only occasional maintenance.

However, this ease of use has three important implications. First, Prodos is the only practical operating system to use on a hard disk. The Sider will work with all four common Apple II operating systems (DOS 3.3, Prodos, Pascal, and CPM). However, Prodos allows you to flexibly partition your data and program files. With Prodos, you can keep your work processor program files in one subdirectory, letters in another, and so on. Since a 10

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megabyte Sider is the equivalent of seventy 5-l/4" disks, Prodos is the most effective way of organizing files. Second, any copy protected program that doesn't specifically allow for uploading onto the hard disk will not work: thankfully, most Prodos based programs are not copy protected. Third, in order to ease organization and switching among your programs, you need some *sort* of *desktop* program. Prodos includes special quit code that can be modified: you can customize Prodos to quit any program to another program. This uniform program can in turn be a program selector. There are several available, including Catalyst and Mousedesk. My personal favorite is PROSEL. It's written by Glen Bredon, the author of the Merlin assembler, and is available directly from the author for $40 US (Glen Bredon, 521 State Road, Princeton, NJ 08540). PROSEL's advantages over other selector programs are speed and reliability. Also included on the PROSEL disk are a dozen utility programs that will do backups, print directories, edit sectors, check blocks, and so on.

What are the disadvantages of a hard disk? Perhaps the greatest burden under which the hard disk user operates is the possibility of a crash or failure. This is fatal if you do not have adequate backups. There is no statisfactory answer to this problem. There are good backup programs. Again, the Bredon PROSEL disk has the best backup utility I've seen (including the ability to use 3.5 drives as the backup medium). However, most backup programs are block by block images of the hard disk. You have no access to your files until the hard disk has returned from the repair shop. What the hard disk market needs is a good file by file backup utility that updates only those files that have changed since the last backup. It should be possible, but I haven't seen one commercially available. From what I gather, hard disk backup is also a problem in the IBM world.

Hard disks are expensive. As I write this, First Class Peripherals, the makers of the Sider, are offering a special on the 10 meg Sider for $499.00 US. However, as you can see by the chart below, our weak Canadian dollar (calculated at 40% over the American) and our valiant Federal Government's efforts at encouraging Free Trade, up the price. Added to this chart is another viable mass storage alternative, Central Point Software's 3.5" disk drive. Again, as I write, an Apple 3.5" drive costs $600.00 in Saskatoon. For comparison's sake, here are the American alternatives:

	Sider 10 Meg	Sider 20 Meg	CPS 3.5"
Drive	$499.00	$799.00	$285.00
Shipping	79.95	79.95	79.95
Exchange	231.58	351.58	145.98
F.S.T.	76.85	123.05	43.89
Duty	34.93	55.93	19.95
Total	$922.3 1	$1,409.51	$574.77

If the money is available, the twenty megabyte unit is the better choice. It's surprising how quickly you can fill 10 megabytes. It took me six months.' We have yet to fill the 20 meg drive at school. If you are especially paranoid about loosing data and wanting to have ready access to a hard drive, I would consider buying a second Sider (it will daisy chain off the same drive controller). A tape backup unit costs about the same price as a second drive.

You could also consider a 3.5" drive and memory expansion card with one megabyte of memory instead of a hard drive. Files are portable with this medium -- you can stuff 800K of data in your shirt pocket. It is possible to set up your memory card as a ram disk, automatically load five or six programs and a program switcher from one 3.5" disk, and then use the 3.5" drive for data. A 3.5" disk can be copied in one pass with the right copy program and a megabyte of memory (again, Prose1 has the only such program I've seen). Finally, this configuration is the perfect AppleWorks machine. We've been using the Applied Engineering Ramworks II card at school and their AppleWorks modification program. Satisfaction is seeing AppleWorks tell you that there is 755K available on your desktop.

From the Media Periodicals

Richard Ellis, Editor

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

Classroom Computer Learning, 7 (3), November/December 1986.

Salpeter, J. "Interactive video: The truth behind the promises"
Schleifer, N. "Making the leap to desktop publishing"
Papert, S. "Different visions of LOGO"
Eiser, 'L. "I luv to rite! Spelling checkers in the writing classroom"

Classroom Computer Learning, 7 (2), October 1986.

Brady, H. "The Apple IIgs"
Eiser, L. "Regular software for special ed. students"
Kovacs, D. "Turning first drafts into final drafts"
Morrison, D. M., & Walters, J. "The Irish immigrant experience: Origins of the project"
Burch, F., Hamilton, M., & Calhoon, D. "Computer conversations"

Classroom Computer Learning, 7 (1), September 1986.

Grady, D. "You can't ignore the new generation forever!"
Parham, C. "Conquering the dreaded blank page"

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

Raleigh, L. "Interactive compact discs: The next step in CD technology"
"Welcome back: The best ideas for the new school year on how to make your computer lab a warm, inviting place to learn"

Computers in Education, 4 (3), November, 1986.

Humphreys, D. "Introduction to computer music"
Fransham, D. "Expert systems in education"
LeBel, C. An introduction to cartesian coordinates: A project-oriented approach"
Dvorchik, S., & Wasylenski, L. "Computer games and theatre arts: Novel uses of interesting software"
Norman, J. "Learning colours with a computer: A practical method'

Computers in Education, 4 (2), October 1986.

Malcomson, B. "Literature in the disk drive"
Humphreys, D. "The greening of databases"
More, G. "Computerizing media centre requirements: A case study"
Dvorchik, S. &, Wasylenski, L. "Spelling and vocabulary development"
Eiser, L. "Problem solving software"
Cathcart, W. G., & Cathcart, G. M. "Random musings with lists"
Drummond, R. J. "Microlab I"

Computers in Education, 4 (l), September 1986.

The G.E.M.S. program: An interview with the Honorable Sean Conway, Ontario's Minister of Education"
Gatley, W. "World Congress report: Technology and the human conversation"
Caissy, C. A. "Using computers in the classroom"
Goldberg, S. "The leaning game generator"
Eiser, L. "Hop, skip and jump animation software"
Humphreys, D. "Slipping between the sheets"
Cathcart, W. G. "Random musings LOGO style"

Educational Technology, 26 (11), November 1986.

Wilson, B. G., & Welsh, J. R. "Small knowledge-based systems in education and training: Something new under the sun"
Maker, J. A. "Applications of PC-based teletraining technology"
Kalmar, I. "Computer literacy as myth: A critique of the computer literacy credo"
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Mediography

Nancy L. Lane, Editor

This column features 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.

Media for Special Education

There is a focus today on the needs of special children. Listed below are media relevant to the topic.

AUTISM - DEVELOPING COMMUNICATING SKILLS

29 min. program, 1984, MAN EDUC/WPG FILM GRP. This videotape illustrates many ways of teaching autistic children to communicate.

AUTISM - DEVELOPING CURRICULUM

29 min. program, 1984, MAN EDUC/WPG FILM GRP. The focus of this program is on developing curricula for autistic children. Examples are presented.

BEAT THE STREET

12 min. program, 1985, CTV. From W.5, this program focuses on illiteracy and a program which helps street kids to read.

CHILD'S PLAY: PRODIGIES AND POSSIBILITIES

56 min. program, 1985, NOVA/MARLIN. This report examines the human achievement of several brilliant children including a 13-year-old mathematician and a 10-year-old chess whiz.

EDUCATING THE SPECIAL CHILD

3-30 min. programs, 1985, TVO. The special needs of children with learning disabilities or behavioral problems are explored in these programs. The titles are: "Stevie and the Dinosaurs", "Tigers in a Cage", "Birds of a Different Feather".

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EDUCATING THE SPECIAL STUDENT

15 programs of various lengths, 1981, CEN TEX. Experts in the field of gifted education discuss their areas of specialty. Titles include: “The Handicapped Gifted’, “Motivational Strategies”, “Curriculum Planning and Sample Units”.

GIFTED KIDS

25 min. program, 1984, NFB. Through interviews with teachers, parents, and gifted children, this program examines enrichment programs offered by the Coquitlam, B.C. School District.

A GIFTED PROGRAM IN ACTION

27 min. program, 1982, EB/VEC. From the series “Successful Teaching Practices” this program examines the Rensuli Triad Model for Talented and Gifted education.

THE GIFTEDNESS IN ALL CHILDREN

27 min. program, 1982, EB/VEC. From the series “Successful Teaching Practices”. Teaching techniques are illustrated such as: questions which generate creativity, how to stimulate both hemispheres of the brain: what role the teacher plays in inquiry-based learning, how to deal with a heterogeneous group, and how to positively support divergence in students.

METHODS AND MATERIALS FOR TEACHING CHILDREN WITH LEARNING DISABILITIES

28-30 min. programs, 1984, CEN TEX. This series concentrates on learning problems found in the elementary classroom.

ONE GIANT STEP: THE INTEGRATION OF CHILDREN WITH SPECIAL NEEDS

l0-20 min. programs, 1983, ACCESS. This series is designed for educators who are instructing students with learning disabilities, or mental or physical handicaps, or who are gifted. Titles include: “Trainable Mentally Handicapped”, "Behaviorally Disordered”, “Dependent Handicapped, and “Gifted”.

REACHING POTENTIAL

26 min. program, 1982, EB/VEC. An exploration of the integrating of disabled children into the school system. The experience of four visually impaired children is documented.

SPECIAL CHILDREN: RESPONDING TO THEIR NEEDS

6-15 min. programs, 1985, ACCESS. This series describes Early Childhood Services programs. The titles are: "Opportunities for Growth", "Identifying Differences", "Case Conferencing", "Individualizing the Program Plan", "Implementing the Program Plan", and "Parents are Special Too".

SPECIAL NEEDS IN EDUCATION

8-25 min. programs, 1983, OPEN U/ITF. The themes of this series are: understanding special education; relating special education to the educational system; meeting special needs; and integration of children with special needs.

TEACHING STRATEGIES FOR USE WITH GIFTED STUDENTS

7 programs in various lengths, 1984, CEN TEX. The focus here is on specific teaching strategies. Included are futuristics, diagonal curriculum, low-cost learning centers.

TEACHING STUDENTS WITH SPECIAL NEEDS

15-30 min. programs, 1981, MIT/PBS. This series presents a variety of instructional techniques. The programs incorporate commentary from educational consultants and role-playing dramatizations. Titles include: "Instruction in Written Expression", "Parent Conferencing", "Employability and the World of Work".

THURSDAYS CHILD

10 programs, 1-15 min.; 9-30 min., USASK/MAGLANT. This is a unique series designed to assist regular classroom teachers in developing their skills in educating children with special needs. The videotapes are interactive and intended to be used with a number of related activities.

This is the last time that Mediography will appear in CJEC. We are sincerely grateful for the time and effort that Nancy Lane has expended during her tenure as Editor of this excellent column. The Editor

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Book Reviews

Suzanne Daningburg, Editor

The two books reviewed in this issue are: *Television Production Handbook* by Herbert *Zettl* and *Practical Guide to Computers in Education* by Peter Coburn, Peter Kelman, Nancy Roberts, Thomas F. F. Snyder, Daniel H. Watt, and Cheryl Weiner.

Television Production Handbook, 4th Edition, by Herbert Zettl. Belmont, CA.: Wadsworth, 1984, 614 pages.

Reviewed by Rose Bene

Herbert Zettl's *Television Production Handbook, 4th Edition* showcases many of the advances in television technology which have occurred since the book's original publication in 1961. Some of these include: the evolution of color television, the transition from larger to smaller production formats and the computerization of most of the essential operations involved in assembling a television programme. Both those who are new to or familiar with the subject matter will find that this book is a very comprehensive and readable description of the many interrelated elements within production. In fact, Zettl's writing style encourages the reader to feel a personal commitment towards understanding the entire process of creating television.

In comparison to the 3rd edition, the author's treatment of the content in the 4th edition incorporates some major improvements. First, at the beginning of each chapter, he introduces the basic principles and techniques of a particular production phase, role or piece of equipment and then in part II of the chapter, elaborates on its functional qualities or applications. Second, Zettl takes a more systemic approach to the process of television production. Where appropriate, he also includes a discussion of the latest developments in remote or on-location ENG (Electronic News Gathering) and EFP (Electronic Field Production) equipment and procedures. Finally, Zettl speaks of the conventions of television shooting and editing. He recommends that neophytes learn the essential skills before attempting to utilize the medium in new ways.

Most equivalent textbooks end their coverage of topics at this point. However, Zettl goes one step further to examine the aesthetics and ethics of television production. He provokes the potential practitioner to not only learn about the unique qualities of the medium but to analyze the "rightness" of certain practices and their effects on audiences.

The fact that the topics in the book have been organized with an emphasis on studio production and from a network broadcaster's perspective is somewhat limiting. While the techniques and principles of producing a programme are similar for both studio and on-location projects, a more in-depth treatment of how high quality, small format products could be utilized would have been welcome since these will likely become the "modus operandi" of future broadcast and nonbroadcast operations.

It is also somewhat disappointing that Zettl only briefly mentions the technology associated with such computer/media hybrids as interactive videodiscs despite the increasing evidence of the application of these products in both commercial and educational contexts.

Two other minor weaknesses of this textbook are: 1) the transfer of many of the same illustrations from the 3rd edition to this edition and 2) the exclusive reference to American organizations. Although the most inappropriate photos (those showing early 70's fashion) have been eliminated, the majority are not new, as Zettl claims. Nevertheless, they are still valuable in illustrating the concepts to which they relate. In the same manner, Zettl's reference to American media networks and organizations does not limit the book's worth but Canadian readers should be aware of the Canadian equivalents. For example, ACTRA (Alliance of Canadian Cinema, Television and Radio Artists) is the Canadian equivalent of AFTRA (American Federation of Television and Radio Artists), the CRTC (Canadian Radio-Television and Telecommunications Commission) is the Canadian equivalent of the FCC (Federal Communications Commission).

Due to the immensity of this work, a precis of each chapter will be provided with a more detailed discussion of one or two topics which have some interest to those involved in the fields of educational communications and technology.

Throughout the book, Zettl employs an instructional design strategy such as that proposed by Fleming (1981). An 'advance organizer' informs the reader of the main content concepts to be dealt with in each chapter. Next, details of the particular topic, (each piece of equipment, its functions and operation and each production phase or role) is provided, followed by a summary of the main points in each chapter. Key concepts or vocabulary are defined at the beginning of each chapter and reiterated in a glossary at the end of the main body of the text.

In Chapter One, Zettl introduces the idea of television production as a system. However, he does not take this theme far enough. Periodically, he intersperses systems terminology throughout the descriptions of the equipment, roles and functions. Yet, he deals with these concepts individually and does not explain how they fit into the overall system of television production.

The process of assembling television programmes is not one system but a network of subsystems which operate together within a metasystem. In order to comprehend the task of sound production, for example, one would have to describe: 1) the inputs or the various sound sources which feed into the audio console; 2) the operations which occur within the audio console or black box (first order feedback loops which involve the monitoring, balancing, mixing, equalizing and sweetening of the sound); 3) the second order feedback loops which occur when using a digitalized audio console with a built-in 'memory system; 4) the noise in the system as caused by certain human variables, machine dysfunction, electronic interference, and other external, environmental sources; 5) the feedback loop which exists as a result of monitoring the final sound output before it is transmitted on the master lineout; and 6) the external feedback from the target audience who hears the final sound. Programmes with good audio are deviation-amplifying in that they encourage the replication of other, similar high quality programmes thereby adding to the network's inventory. They are also deviation-limiting in that they establish a certain standard of quality or homeostasis in sound production which is then maintained.

The more complex a system, the more difficult it is to understand the system's structure and predict its behavior. As components increase, the greater the interrelationships and the greater the variety within the system. It is perhaps due to this complexity that Zettl

steers away from discussing the cybernetic model of television production.

Chapter Two, section I deals with the camera and its functional properties. The information on digitally controlled cameras which use microprocessors to align and ensure optimal performance under a variety of shooting conditions is of particular interest. ENG/EFP cameras and their operational modes are described in the second part of this chapter.

Chapter Three focuses on the optical, operational and performance characteristics of different types of lenses, the most recent advance being the variable focal length zoom lens. Chapter Four explains the various camera mounts and mounting heads such as the pneumatic pedestals for studio cameras and the fluid head tripods for ENG/EFP cameras. Types of camera movements are also described. In Chapter Five, the step-by-step operation of both studio and ENG/EFP cameras is presented along with the major factors of picture composition. The concept of psychological closure, i.e. the practice of the human perceptual apparatus to fill in spaces not actually seen (for example, to imagine the whole performer although the camera reveals only a close-up of his face) is an interesting highlight in this chapter.

Without light, there would be no video image. Chapter Six covers incident and reflected light, directional or diffused illumination, color temperature, lighting equipment and objectives for lighting. As a complement to this, Chapter Seven, section I discusses the intricacies of lighting strategies (three-point lighting and lighting for continuous action/movement) with section II devoted to the particular challenges of lighting on remotes.

Audio pickup is the main topic of Chapter Eight. Types, operational characteristics and uses of various microphones are all included. Chapter Nine primarily concentrates on the various aspects of sound routing and control in a studio situation. Section II of this chapter deals with the aesthetic factors of sound recording as well as the new advances in digital recording and time compression systems. These systems allow sound to be amplified, modified and balanced without increasing noise.

Chapter Ten examines the six principal image recording modes (ENG style, film style, live-on-tape, segment style, isolated camera, multiple camera), types of video recorders (quadraplex, helical track and videodisc) and the detailed planning involved in video recording. Improvements in tape quality and recorders have prompted the broadcasting networks to change from 2" tape format to: a) 1" formats for regular programmes and b) 3/4" formats for news and sports inserts. Problems such as tracking, skew and synchronization which occur on these formats are now being corrected through such innovations as the time base corrector and frame store synchronizer. While electronically coordinating signals from a number of video sources, these devices help to stabilize the image, particularly on transfers from one format to another.

In Chapter Eleven, Zettl identifies the major editing functions and the principal editing modes (offline and online, assemble and insert editing). New address code systems provide an electronic signal for each frame on the videotape thereby speeding up the process of editing. Topics such as single and multiple source editing, basic transitional devices, the purpose of rough cuts and editing logs are all covered in the second part of this chapter. Chapter Twelve, section I focuses on instantaneous editing while section II details the special features of computer-assisted switchers and image enhancers.

Its capacity to create visual effects is one of the main reasons that television continues to captivate audiences of different ages. Chapter Thirteen subdivides visual effects into standard electronic, digital, optical and mechanical effects. An in-depth description of a variety of digital video effects (split-screen, echo, compression/expansion, changing the

aspect ratio, perspective, horizontal/vertical flips, posterization, mosaics, and motion) is provided in section II.

Chapter Fourteen covers the specifications, types and principal devices for generating graphics (hand-drawn/graphics cards, character-generated graphics and digital still store systems). Aspects of set design are also explained.

No television programme is complete without talent and this is exactly the subject of Chapter Fifteen. Section I spells out the differences between performers and actors as well as looks at the art of cueing talent and conducting auditions and rehearsals. Section II outlines the principles of make-up and wardrobe.

Finally, in Chapter Sixteen, Zettl returns to his principal theme of television production as a system. He delineates two approaches to television production: 1) the 'content' approach - content dictates how the programme will be produced; or 2) the 'effect to cause' approach - viewer need is the motivating force for the programme. It is in this chapter that he elaborates on such factors as needs assessment, viewer involvement, capabilities of the medium, audience feedback, product evaluation and the specific skills required of the producer in carrying out these tasks. To extend this systemic approach, Zettl could have established these two approaches as the focal points in the book. Then more detailed information on equipment, roles and functions could have evolved during the discussion of the different phases of programme or series planning.

Techniques of control room and film style directing as well as the various roles that a director must undertake are defined in Chapter Seventeen, section I. To Zettl's credit, he is careful not to identify roles in television production as belonging to one gender or another, thereby recognizing that both males and females are capable of taking on these positions. Visualization and sequencing (or the conversion of the script into ordered images), script formating and script preparation are all described in section II.

Finally, Chapter Eighteen highlights the features of and procedures for handling large ENG/EFP sports or performance remotes.

One of the most important qualities of this textbook is Zettl's sincere reminder to television practitioners of their responsibility towards audiences. In the epilogue to the book, he writes:

> You are now in command of one of the most powerful means of communication and persuasion. Use it wisely and responsibly. Treat your audience with respect and compassion. Whatever role you play in the production process -- pulling cables or directing a network show -- you influence many people. Because they cannot communicate back to you very readily, they must and do trust your professional skills and judgement. Do not betray that trust.

Perhaps a cybernetic perspective might have made this book more appealing to those involved in the fields of educational communications and technology. As well, Zettl could have been more articulate on the theme of media effects. Findings of studies which investigate the effects of camera motion, camera angles, lighting, photography, music and performance characteristics are all relevant to the television practitioner who needs to decide which formats, techniques and strategies work best for different audiences in specific programming contexts.

Nevertheless, any educational communicator, technologist or broadcaster, who is interested in how television impacts on learners, should have a full understanding of the workings of television production and for this, Zettl's *Television Production Handbook 4th, edition* is an excellent and valuable resource.

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Practical Guide to Computers in Education, Second Edition, by Peter Cobum, Peter Kelman, Nancy Roberts, Thomas F.F. Snyder, Daniel H. Watt, Cheryl Weiner. Addison-Wesley, 1985.

Reviewed by Arnold Keller

It's a commonplace that the computer will remain an ex-miracle until teachers genuinely know what to do with it. Regardless of what's spent on shiny hardware or slick software, not much useful in the classroom can happen until teachers see themselves as directing learning, instead of hanging on for dear life. How, then, to present the technology to give teachers a sense of what they can do, rather than have done to them? The second edition of the *Practical Guide to Computers in Education* sets out the basics of educational computing, from the chips and bolts of hardware to the attendant educational and ethical implications. No *mere* book, of course, can substitute for the sometimes exhilarating, sometimes frustrating, first-hand experience of learning about computers. But there's a place for good books, and this one is a solid effort from a solid group of writers.

The authors' experience, which ranges from academia to software design, produces a very comprehensive account of educational computing. The book begins -- too breathlessly, perhaps -- by announcing yet again that the computer revolution is here (or, as they say, "here!"). It then airs its version of how computers will affect schools through a series of anecdotes that outlines the experiences of various teachers. Since the book makes no pretense at academic journalese, the teachers are Samantha, Richard, Jean, Karen, and so on. That's not to imply that the anecdotes aren't well thought-out; it's merely to suggest that the rhetoric is a bit cozy.

The book really gets started with a survey of classroom computer applications that successfully negotiates its way between being comprehensive and being superficial. CAI is represented by examples of drill-and-practice and tutorial lessons (but unfortunately not by "intelligent CAI", where the future surely is). There are also examples of demonstrations, 'simulations, games, and of such adjunctive uses as word processing, number crunching, and data bases. Included too is a brief but clear introduction to LOGO to show the computer as a teacher of thinking. None of this, of course, can hope to make a reader anything more than vaguely aware of the range of computer applications; but that's a limitation inherent in any survey.

For some reason, the authors of many introductory texts feel a need to regaIe readers with hardware chatter. Here this results in a chapter predictably called "Bits and Bytes" (mercifully not "Bits 'n Bytes"), with much ado about CPUs, ASCII code, circuit boards, registers, RAMS, ROMs, PROMs, and the not to be forgotten EPROMs. It's easy to

imagine the numbed response such talk must evoke from computer novices. This is a chapter to be skipped.

Cooler heads prevail with basic advice on buying hardware and software. The authors ask the right question -- "What use do we intend to make of the computer?" -- which quite properly puts the focus on function, rather than on the sexiest piece of hardware that a salesman knows about or the amount of money that can be dislodged from a school's budget. There's some very hardheaded and useful advice here: the need for local service, for talking to people who actually own what you think you want to buy, for being wary of untested products and untested companies.

The chapter on choosing educational software is the books best. The writers have no illusions about the quality of most available stuff (which ranges from mediocre to awful, with a handful of exceptions). They neatly outline the process of getting and using educational software, with examples from the shark-infested waters. There are concise accounts on determining how suitable a program is for students, how it fits into the curriculum, the values it conveys, and its instructional design (of which only few programs seem to have more than a nodding acquaintance). The book here lives up to its title as a very practical guide, indeed.

The next chapters- do almost as well. There is more hardheaded discussion (without being cynical) on the politics of introducing computers into schools, including how decisions are made and where the money comes from. The authors give time to the problems of preparing teachers, students, and administrators for their new roles, along with the various conflicts that inevitably arise. There is also a useful section on integrating computers into schools, in the mundane but necessary terms of their physical placement and how they get used on a day-to-day basis. (Somewhat in the same spirit, an annotated list of resources appears at the back of the book; whether it can resist being dated is an open question.)

The book concludes not with practical advice on what to do but with the far deeper issue of educational computing in transition. Without too much polemic, the authors ask us to consider the sort of pedagogy we need from educational software, the sort of teacher training, the sort of social problems we can expect -- in short, the sort of questions that need thinking through. The problems are real enough, the discussion enlightened.

Training teachers for the computer miracle has turned out to be where we'd better have another miracle. Again, no book can substitute for the unavoidable and determined first-person hours of slogging we need to make the computer our own. That is not to say that teachers must themselves become programmers or courseware designers, any more than car drivers must become mechanics. but drivers who can protect themselves from incompetent or dishonest garages are clearly better off; so too for teachers and their computers. A purely literary sense of a technology, of course, won't do. Only time and trial will produce confident teachers who can make informed choices about what's right for their classrooms. But the *Practical Guide to Educational Computing* should help the miracle along.

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