DOCUMENT RESUME

ED 249 936 IR 011 376

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TITLE Analysis and Review of Courseware Evaluation Strategies.
PUB DATE 26 Apr 84
NOTE 30p.; Paper presented at the Annual Conference of the National Society for Performance and Instruction (Atlanta, GA, April 26, 1984).
PUB TYPE Reports - Research/Technical (143) -- Speeches/Conference Papers (150)

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS Check Lists; *Courseware; *Educational Media; *Evaluation Criteria; Literature Reviews; *Models; Purchasing; Surveys
IDENTIFIERS Computer Users; *Courseware Evaluation; Instructional Effectiveness

ABSTRACT

This study examined current approaches to computer courseware evaluation and evaluated published models on courseware evaluation from the perspectives of end-user/project proposers, the commercial vendor, and the academic or non-aligned consultant. First, a list of primary sources of computer courseware evaluation were located and analyzed. From this analysis, a list of criteria or criterion elements was derived; grouped into the global categories of use, quality, and efficiency; and cross-referenced with the primary sources. A checklist of the resulting criterion elements was formulated and mailed to a sample of 14 end-users (contract agencies), vendors (courseware developers), and academic-based educators or faculty, who were asked to rate the criteria on their importance in software evaluation. The respondents--five vendors, four users, and three academics--generally rated the information provided on both hardware and software, including documentation, as very important for doing an adequate courseware evaluation. No global category dominated, and no major differences were noted among vendors, users, and academics. In general, it was found that users were less rigorous than vendors or academics. Eleven general articles are listed, as well as the sources of courseware evaluation models used in designing this project, and charts showing participant responses. (LMM)

ANALYSIS AND REVIEW OF COURSEWARE EVALUATION STRATEGIES

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Paper Presented at The 1984 National Society for Performance and Instruction Conference, Atlanta, Georgia, April 26, 1984.

Analysis and Review of Courseware Evaluation Strategies

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Introduction

The genesis of this presentation can be linked directly to a paper delivered by Dr. Suzanne Sax of AT&T Business Service Education group at the 1983 NSPI Conference. Dr. Sax's presentation on a computer courseware Vendor Selection Model drew considerable audience interest and reaction -- not all of it positive. As I sat in the audience, I observed at least three reactions. First, end-users (project proposers) saw her model as a way to demystify the process of getting quality computer courseware for their applications. Second, commercial vendors (courseware developers) wanted to know how they could get on AT&T's list of potential bidders. On the other hand, in my role as a small trade association representative, I wondered about the potential affect of such vendor selection strategies on future developments in computer-based training--namely, whether sound development procedures would be compromised in order to fulfill contracts.

On a parallel front, there exists a general consensus that Computer-Based Training (CBT) will be big business in the future (e.g., Training magazine's Computer Literacy Week, September 1983 in New York), and the field is attracting many entrepreneurs (e.g., August 1983 issue of Training: "How to Make it Big in the Computer-Literacy Training Biz"). However, this proliferation is not without its problems in a business populated by individual consultants, small firms and a few major publishers. For example, the publisher of the authoring system chosen for AT&T's vendor demonstration, WICAT Systems, went public with a common

stock offering on July 1, 1983. Since its initial price of $18 per share, the price as of this writing is $3.50 (due primarily to significant projected losses). Thus, a "shakeout" may be occurring in CBT industry before real growth comes to fruition.

Concurrent with the above developments, one can rarely find a popular computing magazine, an issue of Training or an issue of Performance and Instruction, without some expert's opinion on how to evaluate instructional computing software. Just as the CBT business proliferates, so do models on courseware evaluation strategies. One purpose of this presentation is to examine a number of published models from three perspectives in light of the current CBT industry situation. Two of these perspectives were alluded to in the previous discussion--the end-user/project proposer and the commercial vendor. A third perspective, that of the academic (or non-aligned consultant), is added to provide overall balance.

The Present Context

I would be remiss in my primary occupation as an educational evaluator and researcher, if I did not relate the current work on computer courseware evaluation to the evaluation of educational materials in general. After all, computer courseware is a specialized product in the overall realm of instructional products. If we think about instructional products, how is computer courseware different? What commonalities does it have? Does the evaluation of computer courseware require special expertise different from the evaluation of less technically sophisticated instructional materials?

While these questions are considered here, it is not the primary intent of this paper to provide definitive answers. Golas (1983) attempted

to describe major differences in the formative evaluation of print materials and CAI. She pointed out three differences: hardware, its associated components and their reliability; the management of evaluation especially in collecting detailed formative data; and the target group's familiarity and ease of interaction with a computer. Considering these aspects certainly implies that expertise associated with computer hardware interacts with the evaluation process. A more general statement on this issue was provided by Scriven (1980, p. 11), "The medium modifies the message." In his discussion of the evaluation and effects of current word processing capabilities on instructional research, Scriven (1980, p. 12) talked about the difficulty of selecting software:

> ". . . And they must decide whether and which ones to purchase for their own or their employees use. This is a formidable task. The field is functionally and technologically more complex than any consumer goods area. Being an informed purchaser here is perhaps two or three times harder than in the automobile field, for example . . ." (emphasis added)

Even Robert Stake, whose writings have changed the course of evaluation toward the humane and "responsive", is swayed by the potential changes to be brought by computers in education when he states that many educators "are quite insensitive to the revolutionary changes in the nature of knowledge [to come]. There is little appreciation for the upcoming replacement of print media by electronic media and how much that will change what is considered 'knowledge'", (Stake, 1981).

Possibly the differences between traditional media and electronic media are more profound considering our rather limited history with CBT.

The implications for evaluation of media of both types should parallel these differences. Except for special emphasis on technical features, however, present evaluation strategies have not tended to make such distinctions. I shall examine our current status in the rest of this paper.

Method of Investigation

While this investigation has as its focus on the current approaches to computer courseware evaluation, there are probably three levels of courseware that may be considered: program, course or lesson. It was decided that course level was most appropriate, i.e., a big enough project to assume substantial commitment on the part of potential users. However, the majority of literature reviewed for this study did not make this distinction. The extent and intensity of review would seem to depend upon the level targeted for analysis. For the most part, I have chosen to stay at the course level, but the consulted documents vary across levels.

A three-stage process was utilized in this investigation. First, a list of "primary" sources of computer courseware evaluation were located and analyzed. From this analysis, a list of criteria (or criterion elements, e.g. human factors operation) was derived and cross-referenced with the primary sources. Thirdly, a checklist of the resulting criterion elements was formulated and mailed to select samples of end-users (contract-agencies), vendors (courseware developers) and academic based educators or faculty.

The list of criterion elements was grouped into three main or global categories: Use, Quality and Efficiency. These global categories were chosen mainly as a means for separating the individual elements. As a secondary consideration, it was hypothesized that certain criterion

elements would receive greater importance depending upon the perspective of the evaluator. For example, Quality might be assumed of greatest concern to the Academics.

RESULTS

Source Documents and Criteria Identification

The twelve sources reviewed for this study are listed in Exhibit 1. Documents with particular emphasis on computer courseware evaluation are listed as numbers 3 through 11. Most of these nine documents were suggested by colleagues, cited in other literature or selected on the basis of current or potential impact. Four of these nine are directly related to computer-based training (CBT); others were primarily designed for educational or academic audiences, although generalizations and transfer to CBT can be assumed on many topics.

The first two documents (numbers 1 and 2) represent evaluative strategies for educational products in general. Both Scriven's checklist and Dick's chapters are highly regarded sources, and they are cited often in other literature. The last reference (number 12), on some special application software, was chosen to represent the software field in general. The quite extensive guidelines used by Hsu and Mitko (reference #12) were based upon criteria originally published in InfoWorld.

The objective of the review of evaluation strategies as described or imbedded within these sources was to identify a set of criteria comprehensive enough to include most of what was discussed yet short enough to be manageable. Obviously some sources emphasized some topics over others; however, most authors made some claim to state that their ideas were comprehensive. Results of this review are given in Exhibit 2

where sources are cross-classified with the content analyzed criteria. These criteria are purposely phrased in short description terms. With some exceptions, most can be applied to educational products generally.

Another step in the process was to classify the specific criteria according to three general or global criteria--Use, Quality and Efficiency. In Exhibit 2, an 'X' indicates that either a discussion or some mention of a particular criterion element was given in that source. Two exceptions to this are a more detailed list of Instructional Strategies (B9) and Demonstrated performance effectiveness (B11) where a number indicates how many subtopics were considered (each out of a possible eight).

The data in Exhibit 2 provide only a general indication whether or not a given criterion element was discussed. Certain authors were obviously interested in some topics more than others, and their guides were not necessarily complete for a comprehensive courseware evaluation. For example, the IRS CBT Starter Kit was developed to provide new or potential CBT users with guidelines to be considered. These authors placed more emphasis on examining use and cost, and they were less concerned about the particular quality of a product. For thoroughness on the topic of Use, the CBT Starter Kit and the Kearsley book are recommended to decide whether or not CBT is a feasible alternative to present training delivery.

With regard to the examination of Quality, the sources recommended include the Steinberg book, the EPIE Guidelines, and the Reeves and Lent paper. A thorough discussion of the category titled Demonstrated performance effectiveness is given in the Scriven document. No other reference cited was as thorough in this area as his checklist.

The discussions on Efficiency or cost is sketchier in the literature than discussions of Use or Quality. The Kearsley book mentions a large number of facets with regard to Efficiency, but better guidelines in terms of implementation and use are provided in the IRS publication and the Reeves and Lent paper. Because of present limited information, future research might be concentrated in this area. It seems reasonable to conclude that Vendors, Users and Academics would all be interested in better studies on the cost and efficiency in using CBT, if its projected future is at all consistent with many of the current claims being made.

Checklist and Survey Results

The criteria list of Exhibit 2 was translated into a checklist and mailed to a small, select, sample of reactors. The individuals contacted were asked to provide their opinions based upon their perspective as a computer courseware vendor, end-user (contract agent), or academic evaluator/developer. Of the fourteen individuals contacted, twelve responded, and the ten who allowed use of their names are listed in Exhibit 3. Two academic respondents refused permission. This sample (five Vendors, four Users and three Academics) is not claimed to be representative of all such individuals included in each group. Instead, the purpose of the survey was to provide expert opinion on the initial validity and utility of the criteria list.

For each criterion element, each respondent was asked whether or not it should be required in the evaluation of a given computer courseware product. Secondly, they were asked to rate the importance of each element on a five-point scale of high to low. The checklist contained the same labels as in Exhibit 2 including the subcategories of Instructional strategies (B9) and Demonstrated performance effectiveness (B11). Results

for the total group and for Vendors, Users and Academics are displaved in Exhibit 4.

The total sample results (n=12) are provided in the first two column sets at the left. As an illustration, the first element under Use should be read as "Should a Basic description of the courseware be required." Elever respondents indicated it as required, and one indicated as not required. Under Importance, a five-point scale of high to low, nine gave it a rating of highest importance, one in the next highest category, one for the middle category and none in the lowest two (also one person did not respond to importance). To the right, these responses are broken down by group where the 'R' column shows how many indicated as required (e.g., 4/5 means 4 out of 5 who responded). Similarly, the 'I' column shows importance ratings where the five response category results are given in descending order from most important.

A criterion element that appeared near the top of the importance list for Vendors, Users and Academics for the general category of Use was Required equipment (6). The next two highly rated elements were Documentation (8) and Basic description (1) of the course. Although Target groups specifications (2) was indicated as required, its importance compared to the above three elements was lower. The least important elements, on the other hand, were Match to needs in general (5), Dissimination/availability (7), and Longevity (13). In making comparisons across the three groups, Academics were more concerned than Vendors and Users about the Reliability of operation (10), Human factors operation (12) and User organization support (14). Vendors were more interested than Users in Reliability of operations (10). In no case were Users more interested than Vendors or Academics for any of the Use categories. For

Use in general, there was very little differentiation among the groups. It would remain to be seen whether or not these results would hold true across larger samples.

The most important category under the heading Quality was Content accuracy (1). Another consistent component across all three groups was the Overall instructional effectiveness of the courseware, a subcategory under Demonstrative performance effectiveness (11). Least important categories across all three included the Description of rationale (3) and surprisingly for Vendors and Users, the Specific match to target needs (4). Also of lesser importance to Vendors and Users was the specific categories of performance effectiveness (11). Looking at the differences across groups, Users were more interested than Vendors or Academics in a Manual for operation of courseware (8) and Lesson and course management (12). Vendors, on the other hand, were more interested than Users in Content (skills and adequacy) (2), Learning objectives (5) and Technical features (10). Academics were more interested than Vendors and Users in a specific Match to target needs (4), Instructional strategies (9) and specific elements of performance effectiveness (11).

The general ratings for the third part of the questionnaire on Efficiency indicated lower importance than many Use or Quality areas. This may have been somewhat surprising. For required components, the last four categories received fairly high proportions; importance, however, was generally low. The most important category across the three groups was Cost of acquisition or development (1). Criteria of lesser importance were Cost effectiveness results(3) and Cost benefit detailed analysis (4) across all three groups. It appeared, in general, that Vendors were more concerned with potential cost factors than were either Users or Academics.

Vendors were more interested in Cost effectiveness results, Cost benefit analysis and Management resources needed than were Users. In none of the eight categories did Users rate an element more important then did Vendors.

DISCUSSION

Earlier in this paper, the question was raised as to whether or not computer courseware evaluation was sufficiently different from the evaluation of other media-based training. Information relating to that question may be derived by looking at the top five criteria across categories for the total sample:

		Adjusted Score
1.	Content Accuracy (B1)	100
2.	Required Equipment (A6)	95
3.	Documentation (A8)	92
4.	Basic Description (A1)	87
5.	Cost of Acquisition/Development (C1)	82

The adjusted score is an importance rating weighted by the number of responses checked as "required".* A score of 100 means that all respondents checked the element as "required" and all assigned it the highest importance rating. Only two of these five are media dependent--Required equipment and Documentation--and one may reasonably argue that they are more critical with computers than with other media. For comparison, here are the next six:

		Adjusted Score
6.	Service (training to operate) (C6)	76
7.	Content (prerequisite skills, topic adequacy) (B2)	75
8.	Overall instructional effectiveness (B11b)	73
9.	Maintainability (Extended support) (C7)	73
10.	Equipment compatibility (A9)	70
11.	Learning objectives described (B5)	70

Three of these--Service, Maintainability and Equipment compatibility--are much more specific to computers than to other media. It appears that the "medium modifies the evaluation", to paraphrase an earlier quote. Thus, knowledge of computer hardware and software (including documentation) are important aspects for doing an adequate evaluation of courseware. This should be no surprise to any readers.

A second point to be gleaned from the above data is that no global category dominates, i.e., Use, Quality and Efficiency are all well represented. Additionally, comments from respondents indicated only minor revision of the checklist. Most revisions were associated with clarity of some terms, very little on the comprehensiveness or completeness of what was presented.

Finally, it was expected that Vendors, Users and Academics would differ considerably on one or two global categories (Use, Quality or Efficiency). Major differences were not noted, and this may in part be due to the small size of the present sample. In general, it was found that Users were easier to please, i.e., less rigorous than Vendors or Academics. Academics were predictably more concerned with specific instructional strategies and effectiveness than were others. Generally, Vendors were more like the Academics in their preferences for criteria.

Perhaps this study could be expanded to wider representation to confirm or discount a number of present conclusions. Such an expansion would serve at least two purposes. First, the results would provide good

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* $$\text{Adj. Scr.} = \frac{\text{Importance Rating Mean}}{\text{5.0 (Maximum rating)}} \times \frac{\text{\# Checked Required}}{\text{12 (Total sample)}} \times 100$$

market research data on competitors (if you're a vendor), what other Users are looking at and how to please Users with products. Secondly, the training of future computer courseware developers may be shaped according to industry demands and standards. At least, attention should be paid to those elements viewed as important considerations, including research on those criteria less understood or used.

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EXHIBIT 2 (PART A - USE)

CRITERION ELEMENTS vs. DOCUMENTS MATRIX

CRITERIA	SCRIVEN CHECKLIST, GENERAL EDUCATIONAL PRODUCT	DICK GENERAL FORMATIVE AND SUMMATIVE	KEARSLEY BOOK	STEINBERG BOOK	SAX NSPI PAPER & ARTICLE	NCTM GUIDELINES	MICRO SIFT EVALUATORS GUIDE	BLUM EPIE PAPER	IRS CBT STARTER KIT	REEVES AND LENT PAPER	YEAGER CBT WORKSHOP	HSU AND NITKO SPECIAL APPLICATION SOFTWARE
USE (Is It Useful For My Needs?)												
1. BASIC DESCRIPTION	X	X		X	X	X	X	X	X		X	X
2. TARGET GROUP	X	X	X	X	X	X	X	X	X		X	X
3. GENERAL CONTEXT	X	X		X		X	X	X	X		X	X
4. GENERAL PURPOSE/APPLICATION	X	X	X	X			X	X	X	X	X	X
5. MATCH TO NEEDS	X	X		X	X				X		X	X
6. REQUIRED EQUIPMENT		X	X	X		X	X	X	X			X
7. MARKET/DISSEMINATION (AVAILABILITY)	X		X									X
8. DOCUMENTATION	X	X	X	X	X	X	X	X		X		X
9. EQUIPMENT COMPATIBILITY			X			X			X			X
10. RELIABILITY OF OPERATION	X		X	X		X	X		X	X	X	X
11. SCHEDULING/DELIVERY		X	X			X			X	X	X	X
12. HUMAN FACTORS OPERATION			X	X		X	X		X	X		X
13. LONGEVITY (SHELF LIFE)			X						X			
14. USER ORGANIZATIONAL SUPPORT			X						X			

EXHIBIT 2 (PART B - QUALITY)

CRITERION ELEMENTS vs. DOCUMENTS MATRIX

CRITERIA	SCRIVEN CHECKLIST, GENERAL EDUCATIONAL PRODUCT	DICK GENERAL FORMATIVE AND SUMMATIVE	KEARSLEY BOOK	STEINBERG BOOK	SAX MSPI PAPER & ARTICLE	NCTM GUIDELINES	MICRO SIFT EVALUATORS GUIDE	BLUM EPIE PAPER	IRS CBT STARTER KIT	REEVES AND LENT PAPER	YEAGER CBT WORKSHOP	HSU AND NITKO SPECIAL APPLICATION SOFTWARE
QUALITY (Is It Any Good?)												
1. CONTENT ACCURACY	X	X		X		X	X			X	X	X
2. CONTENT (PRE-SKILLS, TOPIC ADEQUACY)	X	X		X		X	X	X			X	X
3. RATIONALE		X	X	X	X	X		X		X		
4. SPECIFIC MATCH TO TARGET NEEDS	X	X	X	X	X				X	X		X
5. LEARNING OBJECTIVES	X	X	X	X	X	X	X	X		X	X	
6. INSTRUCTIONAL TECHNIQUE		X	X	X	X	X	X	X	X		X	
7. CONSISTENCY: TECHNIQUE TO OBJECTIVES	X	X		X	X		X	X			X	
8. MANUAL		X	X				X	X				X
*9. INSTRUCTIONAL STRATEGIES (8)		6		7	5	4	4	6	2	8	6	5
10. TECHNICAL FEATURES (GRAPHICS, TOUCH)		X	X	X	X	X	X	X	X	X	X	X
11. DEMONSTRATED PERFORMANCE EFFECTIVENESS (8)	8	4	4	3	3	2	2	4	6	7		2
12. LESSON AND COURSE MANAGEMENT		X	X	X				X	X	X		X

* = SEE ADDENDUM

EXHIBIT 2 (PART C - EFFICIENCY)
CRITERION ELEMENTS vs. DOCUMENTS MATRIX

CRITERIA	SCRIVEN CHECKLIST, GENERAL EDUCATIONAL PRODUCT	DICK GENERAL FORMATIVE AND SUMMATIVE	KEARSLEY BOOK	STEINBERG BOOK	SAX NSPI PAPER & ARTICLE	NCTM GUIDELINES	MICRO SIFT EVALUATORS GUIDE	BLUM EPIE PAPER	IRS CBT STARTER KIT	REEVES AND LENT PAPER	YEAGER CBT WORKSHOP	HSU AND NITKO SPECIAL APPLICATION SOFTWARE
C. EFFICIENCY (WHAT DOES IT COST?)												
1. COST OF ACQUISITION/DEVELOPMENT	X	X	X						X	X	X	X
2. COMPONENT RESOURCES		X	X			X			X	X	X	
3. COST EFFECTIVENSS RESULTS	X		X						X	X		
4. COST-BENEFIT DETAILED ANALYSIS	X		X						X	X		
5. COST OF IMPLEMENTATION	X	X	X						X	X		
6. SERVICE (TRAINING)	X		X	X			X		X			
7. MAINTAINABILITY - EXTENDED SUPPORT	X	X	X			X	X		X			
8. MANAGEMENT RESOURCES NEEDED	X		X		X		X	X	X	X		

EXHIBIT 2 - ADDENDUM

CRITERION ELEMENT

B 9 INSTRUCTIONAL STRATEGIES

A. PRESENTATION

B. LOCUS OF CONTROL

C. INTERFACE WITH RELATED MATERIAL

D. QUESTIONS

E. RESPONSES

F. FEEDBACK

G. BRANCHING

H. REMEDIATION

CRITERION ELEMENT

B 11 DEMONSTRATED PERFORMANCE EFFECTIVENESS

A. TRUE FIELD TRIALS WITH TARGET GROUP

B. CRITICAL COMPARISONS WITH ALTERNATIVES

C. LONG TERM RESULTS

D. SIDE EFFECTS

E. ASSOCIATION OF CAUSE TO TREATMENT

F. RISKS, MORAL QUESTIONS

G. STATISTICAL SIGNIFICANCE

H. OVERALL INSTRUCTIONAL EFFECTIVENESS

EXHIBIT 3

RESPONDENTS TO CHECKLIST

VENDORS

BEV COSKUNOGLU - - - -DUOSOFT CORPORATION
SAVOY, ILLINOIS

ANDY GILBERT - - - - -DUOSOFT CORPORATION
SAVOY, ILLINOIS

RICHARD LENT - - - - -DIGITAL EQUIPMENT CORPORATION
BURLINGTON, MASSACHUSETTS

TONY PHELAN- - - - - -GLOBAL INFORMATION SYSTEMS TECHNOLOGY
CHAMPAIGN, ILLINOIS

TOM SCHAEFGES - - - -COURSEWARE APPLICATIONS
SAVOY, ILLINOIS

USERS

ROBERT BODINE- - - - -SAFEGUARD BUSINESS SYSTEMS
BLUE BELL, PENNSYLVANIA

CHUCK GEIGNER- - - - -STATE FARM INSURANCE COMPANIES
BLOOMINGTON, ILLINOIS

LES MAY- - - - - - - -DIGITAL EQUIPMENT CORPORATION
BEDFORD, MASSACHUSETTS

GREG SHARP - - - - - -SOUTHEAST BANK CORPORATION
MIAMI, FLORIDA

ACADEMIC (TO ACKNOWLEDGE ONLY)

R. ALLAN AVNER - - - -COMPUTER-BASED EDUCATION RESEARCH LABORATORY (CERL)
UNIVERSITY OF ILLINOIS
URBANA, ILLINOIS

EXHIBIT 4

RESPONDENT RESULTS

PART A. USE (IS THIS COURSE/LESSON USEFUL FOR MY NEEDS?)

CRITERION ELEMENT	TOTAL REQUIRED	TOTAL NOT REQUIRED	IMPORTANCE (HIGH-LOW)	VENDORS (5) R	VENDORS (5) I	USERS (4) R	USERS (4) I	ACADEMICS (3) R	ACADEMICS (3) I
1. BASIC DESCRIPTION	11	1	9 1 1 - -	5/5	4 1 - - -	3/4	3 - - -	3/3	2 - 1 - -
2. TARGET GROUP SPECIFICATION	11	1	4 3 2 1 1	5/5	1 2 1 - 1	3/4	1 1 1 1 -	2/3	2 - - - -
3. GENERAL CONTEXT FOR USE	7	4	3 - 6 - -	4/5	1 - 4 - -	2/4	- - 2 - -	2/3	2 - - - -
4. GENERAL PURPOSE/APPLICATION	7	5	3 2 3 - 1	3/5	1 - 3 - 1	2/4	1 1 - - -	2/3	1 1 - - -
5. MATCH TO NEEDS IN GENERAL	2	9	1 1 - 2 2	1/5	- 1 - 1 1	0/3	- - - 1 1	1/3	1 - - - -
6. REQUIRED EQUIPMENT	12	-	9 3 - - -	5/5	3 2 - - -	4/4	3 1 - - -	3/3	3 - - - -
7. MARKET/DISSEMINATION (AVAILABILITY)	3	8	1 - 2 2 3	1/5	- - 1 - 3	0/3	- - - 2 -	2/3	1 - 1 - -
8. DOCUMENTATION	11	-	9 1 - 1 -	5/5	4 1 - - -	3/3	2 - - 1 -	3/3	3 - - - -
9. EQUIPMENT COMPATIBILITY	10	2	5 2 3 - -	4/5	2 1 1 - -	4/4	2 1 1 - -	2/3	1 - 1 - -
10. RELIABILITY OF OPERATION	9	3	7 1 - 1 1	4/5	3 - - - 1	2/4	1 1 - 1 -	3/3	3 - - - -
11. SCHEDULING/DELIVERY	4	7	2 3 - 2 -	2/5	1 1 - 1 -	1/3	- 2 - 1 -	1/3	1 - - - -
12. HUMAN FACTORS OPERATION	7	5	3 1 3 1 2	2/5	- - 1 1 2	2/4	1 1 1 - -	3/3	2 - 1 - -
13. LONGEVITY (SHELF LIFE)	4	7	- 1 3 1 3	2/5	- - 2 1 1	2/3	- 1 1 - 1	0/3	- - - - 1
14. USER ORGANIZATION SUPPORT	8	3	2 2 3 2 2	2/5	- 1 2 - 2	3/4	- 1 1 2 -	3/3	2 - - - -

EXHIBIT 4 (CONT'.)

(IS THIS COURSE/LESSON ANY GOOD?)

PART B. QUALITY CRITERION ELEMENT	TOTAL REQUIRED	TOTAL NOT REQUIRED	IMPORTANCE (HIGH-LOW)	VENDORS (5) R	VENDORS (5) I	USERS (4) R	USERS (4) I	ACADEMICS (3) R	ACADEMICS (3) I
1. CONTENT ACCURACY	12	-	12 - - - -	5/5	5 - - -	4/4	4 - - -	3/3	3 - - -
2. CONTENT (PREREQUISITE SKILLS, TOPIC ADEQUACY)	11	1	4 5 1 1 -	5/5	2 2 1 - -	3/4	- 2 - 1 -	3/3	2 1 - -
3. RATIONALE DESCRIPTION	5	6	1 1 1 3 2	3/5	- 1 - 2 1	1/3	1 - 1 -	1/3	- - - 1 1
4. SPECIFIC MATCH TO TARGET NEEDS	8	4	2 3 2 1 1	3/5	1 1 1 - 1	2/4	- 2 - 1 -	3/3	1 - 1 -
5. LEARNING OBJECTIVES DESCRIBED	10	2	5 3 1 1 -	5/5	2 3 - - -	3/4	2 - 1 1 -	2/3	1 - - -
6. INSTRUCTIONAL TECHNIQUE	10	1	1 5 4 - 1	5/5	- 1 3 - 1	3/4	1 3 - -	2/2	- 1 1 -
7. CONSISTENCY: TECHNIQUE TO OBJECTIVES	8	3	3 3 4 1 -	4/5	2 1 2 - -	2/4	- 1 2 1 -	2/2	1 1 - -
8. MANUAL FOR OPERATION	10	2	2 2 6 - -	4/5	- 1 4 - -	4/4	2 1 1 - -	2/3	- - 1 - -
9. INSTRUCTIONAL STRATEGIES (8 COMPONENTS)	71	23	/43/21/14/10/ -	30/40	15 15 2 7 -	19/31	10 6 8 4 -	22/23	18 - 4 - -
10. TECHNICAL FEATURES (GRAPHICS, SOUND, TOUCH, ETC.)	9	3	3 2 5 - -	4/5	2 1 2 - -	2/4	- 1 2 - -	2/2	1 - 1 - -
11. A. DEMONSTRATED PERFORMANCE EFFECTIVENESS	34	50	/ 9/23/19/10/ 2	10/35	3 11 12 2 -	7/28	2 8 2 5 1	17/21	4 4 5 3 1
B. OVERALL INSTRUCTIONAL EFFECTIVENESS	10	2	6 3 2 - -	4/5	2 2 1 - -	4/4	3 1 - - -	2/2	1 - 1 - -
12. LESSON AND COURSE MANAGEMENT	10	2	3 2 5 1 -	4/5	1 2 2 - -	4/4	2 - 2 - -	2/3	- - 1 1 -

EXHIBIT 4 (CONT'.)

PART C. EFFICIENCY

(WHAT DOES LESSON/COURSE REALLY COST?)

CRITERION ELEMENT	REQUIRED	NOT REQUIRED	IMPORTANCE (HIGH-LOW)	VENDORS (5) R	VENDORS (5) I	USERS (4) R	USERS (4) I	ACADEMICS (3) R	ACADEMICS (3) I
1. COST OF ACQUISITION/DEVELOPMENT	9	2	7 2 1 - -	4/5	3 1 1 - -	4/4	3 1 - - -	1/2	1 - - - -
2. COMPONENT RESOURCES NEEDED	8	3	6 2 1 - -	4/5	3 1 1 - -	3/4	2 1 - - -	1/2	1 - - - -
3. COST EFFECTIVENESS RESULTS	5	7	4 1 2 1 -	3/5	4 - 1 - -	0/4	- 1 - 1 -	2/3	- - 1 - -
4. COST/BENEFIT DETAILED ANALYSIS	5	6	3 1 2 1 -	3/5	3 1 1 - -	1/4	1 - - 1 -	1/2	- - 1 - -
5. COST OF IMPLEMENTATION	10	2	3 5 2 - -	5/5	- 3 2 - -	3/4	2 1 - - -	2/3	1 1 - - -
6. SERVICE (TRAINING TO OPERATE)	11	-	4 4 1 1 1	5/5	1 3 - - 1	4/4	2 1 1 - -	2/2	1 - - 1 -
7. MAINTAINABILITY-EXTENDED SUPPORT	11	1	5 4 2 - 1	4/5	2 2 - - 1	4/4	1 2 1 - -	3/3	2 - 1 - -
8. MANAGEMENT RESOURCES NEEDED	10	2	2 4 1 1 1	5/5	- 4 - - 1	2/4	1 - 1 - -	3/3	2 - - 1 -