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Techniques for Teaching Procedures

Brent G. Wilson
LEPS-GA 279
Northern Illinois University
Dekalb, IL 60115

Abstract. Procedures are among the most common kinds of content taught in many training programs. Complex procedures can be difficult to teach effectively. Several analytic methods for simplifying procedures for initial presentation are discussed. Most of the methods do not require analysis as thorough as an information processing task analysis, but they can still be useful to the practicing designer with limited time and resources.

Instructional designers and trainers face the problem of how best to teach different kinds of instructional content. In particular, procedures are commonly found in 'how to' and technical courses. A procedure is a set of steps or performances to be carried out with the purpose of obtaining a predetermined outcome. Related terms include rule, algorithm, heuristic, and performance routine. Procedures may be tightly-defined or loosely-defined, simple or complex, certain or simply helpful in obtaining the desired outcome.

Elaboration theory (Reigeluth & Rodgers, 1980; Reigeluth, Merrill, Wilson & Spiller, 1980) recommends teaching procedures through the use of an epitome which shows the key steps of a procedure, and allows the student to complete the simplest case in the first lesson of instruction. It is reasonable to suspect that since so many kinds of procedures exist, there may also exist a number of ways of formulating epitomes for those procedures. The purpose of this paper is to suggest several ways procedures can be introduced to students, depending on the kind of procedure and the purposes of instruction.

Path Analysis: An Obvious Parallel

P. F. Merrill (1976, 1978) and others (Scandura, 1973; Landa, 1976) have recommended that information-processing principles be used in the analysis of instructional tasks. To do this, the task is analyzed to reveal the sequence of steps, including decisions and branches, carried out in its performance. A useful representation of this analysis is the flowchart, typically using boxes and arrows to designate different procedural steps and the order of their performance. An information processing (IP) task analysis represents an instructional task as a procedure.

According to P.F. Merrill (1978), a complete IP task analysis includes these general steps:

1. Identify the processing requirements of the task (the result is a precisely ordered series of operations and decisions, usually represented by a flowchart);
2. Identify the possible paths through the procedure; and
3. Order the paths according to difficulty (a path containing all operations of another path and then some can be said to be more difficult).

Figure 1 is an example of an IP task analysis. The flowchart representation is the product of the first step of analysis. The paths through the procedure (in this case a subtraction algorithm) show the different ways a student could perform the task. These paths are then ordered according to difficulty. Note that the number of operations contained in a path is not the criterion for difficulty; rather, difficulty is determined on the basis of one path's operations being included within another path's operations. It has been argued elsewhere (P. F. Merrill & Wilson, 1979) that IP task analysis identifies what elaboration theory intends by "epitome" for branching algorithms. Path analysis provides an efficient technique for carefully specifying what the core of the procedure is, that is, the simplest path through the algorithm. Following the path analysis from simplest path through more complex paths until the entire procedure is learned is consistent with the elaboration approach that starts with an epitome and gradually adds levels of elaboration (Reigeluth & Rodgers, 1980).

For more detailed exposition of the information processing approach to task analysis, see other sources (Reigeluth, 1983; Cagne, 1977). Path analysis is clearly an effective technique for sequencing procedures in instruction. It is important, however, to recognize the limits of path analysis as well as its strengths. Path analysis is only effective in prescribing instructional sequences when the procedure being used is (a) well defined (i.e., actually representing the processing requirements for performance) and (b) branching (i.e., containing decision points). When a procedure fails to meet either of these two conditions, path analysis techniques will be largely ineffective in determining how to teach the procedure. For example, some procedures are so grossly formulated that a single box of a flowchart may contain several sub-operations. Although path analysis may not apply, such "non-performable" procedures may still serve a useful instructional role. Take another case using a linear procedure, that is, a procedure without any decision points. Since only one path exists through the procedure, path analysis will be of no help in prescribing how to go about teaching the procedure. In the remaining portion of the paper, several techniques are presented for analyzing procedures.

1. Perform a path analysis. As described above, path analysis is assumed to be a first choice for designers and is performed whenever possible on a defined procedure.
2. Simplify the initial case. For branching algorithms such as that represented in Figure 1, path analysis can provide a partial ordering of the
paths and suggest a possible epitome and sequencing of instruction. For algorithms or heuristics not so precisely formulated, it may be useful to simplify the procedure by choosing a simple first case. For example, the common variety of the “systems model” of instructional design usually contains no decision points but rather is intended as a general heuristic. A first attempt to actually use the model would be more successful if the development project were simple (e.g., a ten minute mini-lesson) than if the project were more complex (e.g., a six semester sequence of courses). The basic steps of instructional design could be carried out on a highly simplified task and thus provide students with an epitome for later elaborations.

Figure 2 illustrates a rather loosely constructed heuristic for literary criticism. There are several ways of simplifying this procedure for teaching.

Reigeluth (1979) notes that one can simplify this procedure by using a short poem as the first case rather than a complex novel or play. The representation of the procedure remains unchanged, but the cases for which the procedure is used are kept simple for initial instruction.

3. Provide output for difficult steps. Another useful way of simplifying a complex procedure is to provide the output of steps that would otherwise have to be performed. This allows the student to perform critical parts of the procedure early on, as well as provide a meaningful context for the whole process. For example, statistics teachers often provide the values of sum of squares during tests, allowing the students to work with certain data as “given.” This approach conceivably could be used before the student even knows how to calculate these values, if other parts of the procedure are considered more central or structurally important. The student can be taught these “subroutines” in subsequent instruction. This is similar to Gilbert’s notion of “backward chaining” (Gilbert, 1962). In both cases, instruction allows the student to perform only part of the steps in a procedure, yet still benefit from seeing the logic of the entire procedure. In backward chaining, the student always completes the task; in our view, the student performs that part of the procedure that will highlight the logical structure of the procedure.

To take an example from office training, novices who first approach a word processing system will frequently be provided with a sample text file, thus avoiding the work required to enter, save, and load a body of text. The saving and loading of documents can be learned at a later time; with a text file in computer memory, students can master editing commands and functions.
There are four major stages in the multidimensional analysis and interpretation of creative literature:
1. Identify elements of dramatic framework—character, plot, setting, perspective, and language.
2. Combine the elements into composites appropriate for analysis of their literal meaning—(1) analysis of character, plot, and setting, (2) analysis of perspective, character, and plot, and (3) analysis of language.
3. Interpret the elements figuratively—symbolism through character, mood, and tone.
4. Make a judgement of work—personal relevance, universality.

**Figure 2. Heuristic for analyzing literature (adapted from Reigeluth, 1979.)**

4. Delete steps of the procedure. Another way to simplify the heuristic in Figure 2 would be to drop out or "prune" certain steps. Reigeluth (1979) suggests omitting consideration of "setting, perspective, and language" from the first stage of analysis ("identifying the elements of the dramatic framework") and only using "character and plot." This "pruning" technique can be carried on at all stages of this particular heuristic, resulting in a greatly simplified epitome that can be taught in a much shorter time. Of course, steps essential to the meaningfulness of the procedure cannot be deleted: the remaining procedure must still be sensible and suitable to the purposes of instruction. Whenever possible, a path analysis should be performed as an input to this strategy.

5. "Chunk" or summarize the steps. In some cases it may be profitable to teach a simplified heuristic as a conceptual overview rather than as a procedure to be performed by the student. As an introduction to a statistics course, for example, the teacher may want to show the general process of PROBLEM ANALYSIS—DATA ANALYSIS—CONCLUSIONS. Although this heuristic may not be operable in the first lesson, it may offer, nonetheless, a useful advance organizer for the course. This type of simplification is not a legitimate procedural epitome since it is not designed to be executed by the student.

The ways of simplifying procedures for instruction listed above should indicate the complexity of the problems of teaching procedures and the need for design flexibility in solving the problem. The challenge, of course, is deciding which technique to use and how to use it in a given situation. A heuristic to guide the designer's use of strategies is presented in Figure 3. This decision table lists conditions that may require different design strategies. The decision table takes into account procedures of varying complexity and varying purposes for presenting procedures. Path analysis is recommended when possible. Also note that "Use a simplified initial case" is recommended for all performable procedures, while "Delete steps for easier presentation" is recommended only for procedures too complex to present clearly in the first lesson.

6. Teach the principle(s) underlying the procedure. A final technique to be considered relates closely to M. D. Merrill's (1977) recommendation: "Identify the underlying principle" (p. 11). Elaboration theory suggests that the principle underlying a procedure should be used in deriving the epitome, but it does not specify how this is done. Bruner (1964) and Resnick (1976) have suggested that it may be important to teach the underlying principle as well as the efficient procedure, especially when the procedure is quite unrelated to the underlying principle (e.g., long division). Perhaps on occasion it would be helpful to the student if two separate procedures were taught, one that clearly illustrates the underlying principle, and another that offers an efficient procedure routine. As a general rule, the greater the need for the student to be able to transfer the procedure to a variety of tasks and conditions, the greater the need to include some kind of "theory" in instruction. Where transfer is not an issue, there is less need to understand the underlying "whys" of a given procedure. Clearly the effort to make procedures meaningful is an area requiring further investigation.

**Summary**

A number of techniques for simplifying procedures for initial presentation have been described:
1. Path analysis. The different paths through a branching procedure are ordered according to difficulty. The simplest path through the procedure is taught first to the student, followed by increasingly difficult paths until the entire procedure is presented.
2. Simplify the initial case. Although the representation of the procedure and its steps may remain the same, a simple case may be used to demonstrate performance of the procedure in the first lesson.
3. Provide output for difficult steps. Rather than require that all steps of a procedure be performed, the teacher can provide the output of some steps for use in later operations.
4. Delete steps of the procedure. For some procedures, steps can be "pruned" while still preserving the meaningfulness of the procedure.
5. "Chunk" or summarize the steps. A complex procedure can be summarized and used as a synthesizer even in the first lesson. Presenting the procedure in this fashion, however, does not allow the student to perform the procedure immediately.
6. Teach the principle(s) underlying the procedure. This should be done as a supplement to teaching a specific performance routine. Understanding why a procedure works may improve the retention and transfer value of the procedure.

Most of the methods presented above are not nearly as clear-cut as path analysis. They have a practical value, however, to the designer whose resources may not always allow the expense of a thorough information processing analysis. It is helpful to know that a wide variety of techniques may be utilized in teaching procedures, all depending on the goals of instruction and the individual characteristics of the procedure and the students who must learn it.

**Author Note.** I wish to thank Harvey Black and Norm Higgins for helpful comments on earlier drafts of the manuscript, and to LuAnn Beasley for preparation of the manuscript.
<table>
<thead>
<tr>
<th>SELECTING STRATEGIES FOR TEACHING PROCEDURES</th>
</tr>
</thead>
<tbody>
<tr>
<td>WHENEVER POSSIBLE:</td>
</tr>
<tr>
<td>1. Do a Data analysis.</td>
</tr>
<tr>
<td>IF, in the first lesson, the whole procedure:</td>
</tr>
<tr>
<td>THEN:</td>
</tr>
<tr>
<td>A. can be clearly presented and performed</td>
</tr>
<tr>
<td>2. use a simplified task as a first case</td>
</tr>
<tr>
<td>(present whole procedure)</td>
</tr>
<tr>
<td>B. can be clearly presented but not performed</td>
</tr>
<tr>
<td>2. use a simplified task as a first case</td>
</tr>
<tr>
<td>3. provide output for difficult steps</td>
</tr>
<tr>
<td>(present whole procedure)</td>
</tr>
<tr>
<td>AND IF performance of the procedure is,</td>
</tr>
<tr>
<td>intended</td>
</tr>
<tr>
<td>2. use a simplified task as a first case</td>
</tr>
<tr>
<td>3. provide output for difficult steps (if needed)</td>
</tr>
<tr>
<td>4. &quot;prune&quot; or delete steps for easier presentation</td>
</tr>
<tr>
<td>not intended</td>
</tr>
<tr>
<td>5. &quot;chunk&quot; or summarize steps for easier presentation</td>
</tr>
<tr>
<td>(do not require performance of procedure)</td>
</tr>
</tbody>
</table>

Figure 3. Decision table to aid in selecting strategies for teaching procedures.

References


Selecting Media for Instruction: An Exploratory Study

Norman Higgins
Department of Educational Technology
Arizona State University
Tempe, AZ 85287

and

Robert A. Reiser
Department of Educational Research
Florida State University
Tallahassee, FL 32306

Abstract. The purpose of this study was to compare the media selection decisions novice instructional developers make when they use an intuitive approach versus the decisions they make when they use a formal media selection procedure. The subjects, who were beginning graduate students enrolled in a media design course, were first asked to identify, on an intuitive basis, the appropriate medium to employ in a given instructional situation. After studying the media selection procedures described by Reiser and Gagne (1982), the subjects were asked to use those procedures to select the appropriate medium to use in another situation. Results indicated that more than twice as many subjects made the "correct" media selection decision when they used the formal selection procedures. The number of factors the subjects considered when they made their decisions also increased when they used the formal procedures. The implications of these findings and suggestions for further research are discussed.

At some point in every instructional development project, decisions must be made about the media that will be used to deliver instruction. Media selection is a major component of most comprehensive instructional systems development models (e.g., Branson et al., 1975; Department of the Air Force, 1978). It is also the subject of two recent books (Anderson, 1983; Reiser & Gagne, 1983) and numerous journal articles. With so much attention being devoted to media selection procedures in the instructional development literature, it is surprising to find so little attention devoted to the study of their effectiveness or usefulness.

Reiser and Gagne (1982) reviewed ten media selection procedures and identified two major differences among the procedures which were likely to influence media selection decisions: the physical form used to display the procedures and the selection factors employed in them. The procedures reviewed were displayed in flowcharts, in two-dimensional matrices, and in workbooks. The flowchart form was considered easier for those with minimal experience to use. The selection factors employed in the procedures included characteristics of the learning task, the instructional setting, the learner, the events of instruction, the capabilities of media, and practical concerns.

Although formal media selection procedures have been developed to aid instructional developers in selecting appropriate media for instruction, it is difficult to find information about their effectiveness. We have been able to locate only two studies in which the effectiveness of media selection procedures has been evaluated.

Romiszowski (1974) studied the effectiveness of lesson planning algorithms and checklists which included media selection procedures. He had 32 experienced teachers and 38 inexperienced teacher trainees develop lesson plans for teaching four instructional objectives. The inexperienced trainees were given a lesson planning job-aide to use when planning their lessons. A team of educational technologists rated the 440 lesson plans (110 teachers x 4 objectives) as ideal, acceptable, or poor. The experienced teachers produced more lesson plans classified as ideal (72%) and fewer classified as poor (less than 1%) than did the experienced teachers, who had fewer plans classified as ideal (37%) and more classified as poor (15%). The results of Romiszowski's study indicated that teacher trainees were able to use a job-aide that included media selection to prepare lesson plans which met judges' criteria for ideal or acceptable plans.

In another study, Braby (1973) trained six instructional designers to use nine different formal media selection procedures. He then had them use each of the nine formal procedures plus an informal intuitive procedure to select media for seven training objectives. Two experts in training systems design then rated each of the 420 media choices (6 designers x 10 procedures x 7 objectives) on a five point scale for its ability to meet the training objectives. The experts' ratings were then combined and the relative utility of each selection procedure was determined. The experts' mean ratings for the 10 procedures ranged from 2.18 to 3.6. The procedures that received the highest ratings were a procedure developed by the Training Analysis and Evaluation Group (1972), an informal intuitive approach, and Briggs' (1970) procedure.

Does the use of formal media selection procedures result in better media selection decisions? Braby (1973) did not find this to be the case. Romiszowski (1974) demonstrated that novice teachers who used a formal planning procedure, which included a media selection component, could prepare lesson plans which were judged to be "ideal" or "acceptable" by a team of educational technologists. He did not, however, demonstrate that the lesson plans were superior to those which the novices would have produced, had they not used a formal planning procedure.

This study was designed to compare the media selection decisions novice instructional developers make when they use an intuitive approach versus the decisions they make when they use a formal media selection procedure, in this case the procedure described by Reiser and Gagne (1983). Two aspects of the media selection decision process were examined: the appropriateness of the media selected for given instructional
design problems and the factors considered when selecting media. These two aspects of the selection process were studied under conditions in which novice instructional developers used their experience and intuition to select media and in which they used a formal systematic procedure to select media. In previous studies of media selection, subjects were given sets of instructional objectives for which to select media. In this study the subjects were given descriptions of instructional design problems that included information about five factors commonly employed in formal media selection procedures: learning tasks, learners, instructional settings, instructional events, and practical considerations. Unlike previous studies, the design problems used in this study were designed to elicit a single appropriate instructional medium (though it may be part of a multi-media presentation).

Method

Subjects
The subjects in this study were 22 graduate students enrolled in a media design course at Arizona State University. The students had completed from 3-9 semester hours of graduate courses in Educational Technology. Some were part-time students who worked in training departments in local businesses. None had used formal or systematic procedures for selecting media for instruction. Four students who did not participate in both phases of the study were dropped from the analysis. Data are presented for the 18 students who participated in both phases of the study.

Materials
Four media design problems were prepared for use in this study. The problems were written descriptions of various instructional situations for which instructional presentations had to be developed. Each problem involved a different content area, a different type of learning task, and a different instructional setting. The problems were titled Personnel Interviewing, Aircraft Instrument Comprehension, Instructional Objectives, and C.T. Scan. Each title designating the instructional content covered in the situation described. The Personal Interviewing Problem is presented in Figure 1.

Each problem description included a statement of the general purpose of the instruction and specific instructional objectives. The problems also included brief descriptions of the characteristics of the intended learners, the nature of the setting in which the instruction was to take place, the media production budget that was available, and the intended instructional functions of the media that were to be selected.

Procedures
During the first phase of the study, one of the four media design problems was randomly assigned to each of the students enrolled in the media design course. The students were directed to read the media design problem given to them, and then use their knowledge and experience in order to select the most appropriate medium or media to use in the situation described in the problem. They were also asked to write a brief rationale for their media selection. Students received no feedback on the correctness of their media selections or on the adequacy of their rationales. This phase of the study represents the informal intuitive approach to media selection.
Table 1

Percentage of Students Making Correct and Incorrect Media Selections

<table>
<thead>
<tr>
<th>Media Selection Problem</th>
<th>Correct Medium</th>
<th></th>
<th>Correct Medium and Other Media</th>
<th></th>
<th>Incorrect Medium</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Informal</td>
<td>Formal</td>
<td>Informal</td>
<td>Formal</td>
<td>Informal</td>
<td>Formal</td>
</tr>
<tr>
<td>Personnel Interviewing</td>
<td>00</td>
<td>00</td>
<td>100</td>
<td>100</td>
<td>00</td>
<td>00</td>
</tr>
<tr>
<td>Aircraft Instrument Comprehension</td>
<td>20</td>
<td>25</td>
<td>00</td>
<td>00</td>
<td>80</td>
<td>75</td>
</tr>
<tr>
<td>Instructional Objectives</td>
<td>25</td>
<td>60</td>
<td>50</td>
<td>0</td>
<td>25</td>
<td>40</td>
</tr>
<tr>
<td>C.T. Scan</td>
<td>20</td>
<td>50</td>
<td>40</td>
<td>33</td>
<td>40</td>
<td>17</td>
</tr>
<tr>
<td>Mean</td>
<td>17</td>
<td>39</td>
<td>44</td>
<td>28</td>
<td>39</td>
<td>33</td>
</tr>
</tbody>
</table>

Table 2

Mean Number of Selection Factors Reported and Percentage of Students Reporting Factors by Factor Category

<table>
<thead>
<tr>
<th>Factor Category</th>
<th>Pretest</th>
<th></th>
<th>Posttest</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean Number of Factors Reported</td>
<td>Percentage of Subjects Reporting These Factors</td>
<td>Mean Number of Factors Reported</td>
<td>Percentage of Subjects Reporting These Factors</td>
</tr>
<tr>
<td>Learning Task</td>
<td>1.0</td>
<td>78</td>
<td>1.9</td>
<td>92</td>
</tr>
<tr>
<td>Learners</td>
<td>0.5</td>
<td>33</td>
<td>1.0</td>
<td>67</td>
</tr>
<tr>
<td>Instructional Setting</td>
<td>0.9</td>
<td>72</td>
<td>1.5</td>
<td>75</td>
</tr>
<tr>
<td>Instructional Events</td>
<td>1.3</td>
<td>78</td>
<td>1.7</td>
<td>79</td>
</tr>
<tr>
<td>Practical Concerns</td>
<td>0.8</td>
<td>50</td>
<td>1.2</td>
<td>71</td>
</tr>
</tbody>
</table>
During the following week, the students were assigned to read a review of the characteristics of media selection models (Reiser & Gagne. 1982) and the portion of the text by Reiser and Gagne (1983) in which they describe how to use their media selection flowchart.

One week after the first phase of the study, one of the four media design problems was again randomly assigned to each student. The students were directed to read their assigned problem, then to use the Reiser-Gagne media selection flowchart to select the most appropriate medium or media, and to write a brief rationale for their media selections. This phase of the study represents the formal or systematic approach to media selection.

Results

The students' responses were analyzed to determine if they selected the "correct" medium for their assigned problems and to determine the number and type of selection factors reported in their rationale statements. The percentage of students making correct and incorrect media selections is reported in Table 1.

There were three types of responses to the media selection aspect of the study: responses that included the most appropriate medium and no other media, responses that included the correct medium as well as other media, and responses that did not include the most appropriate medium.

The most common response was the selection of only the correct medium, followed by the selection of the correct medium as well as other media.

Discussion

The results of this study suggest that when novice instructional developers use a formal media selection procedure, rather than an intuitive procedure, the choices they make are more likely to match the choices made by experienced instructional developers who use the same procedure. The novices are also more likely to consider a greater number of selection factors when they have received instruction on the rationale for a formal media selection process.

Do these results indicate that the media selection model examined in this study is superior to an intuitive method to media selection? Not necessarily. Judging the relative value of various media selection procedures is a very difficult task. There are several criteria that can be used in making such judgments. The criteria we employed are certainly not the only ones that can be considered. For example, rather than judging the novices' media choices as correct or incorrect, we could have had experienced designers rate the choices, as Braby

Novices are more likely to consider a greater number of selection factors when they have received instruction on the rationale for a formal media selection process.

The fewest number of factors was reported in the learner category (mean of .5) by the smallest percentage of students (33 percent) when the informal intuitive procedure was used. The largest number of factors was reported in the learning task category (mean 1.9) by the largest percentage of students (92 percent) when the formal flowchart procedure was used. The mean number of factors reported, and the percentage of students reporting factors from each category, increased across all categories when the formal flowchart procedure was used.

(1973) did in his study. In addition, we could have examined other variables such as the time required to orient the users to the selection procedures, the time users took to make media selection decisions, and the users' attitudes toward the two procedures.

In future studies, it may be advisable to adopt techniques to ensure that subjects fully understand how to use a media selection procedure before they are required to employ it. The assigned readings and the use of the formal media selection procedure did result in a greater percentage of correct media
selection decisions and in a larger number of selection factors being considered. However, the relatively low mean percentage of students making correct media selections (39%) using the formal flowchart raises questions about the adequacy of the the students' orientation to the formal media selection procedure. Apparently, just reading about how to use the formal selection procedure is not adequate to insure that novice instructional developers can use the procedures effectively. In future studies, students might be given practice and feedback in the use of a formal selection procedure before they are required to employ it.

Most instructional development models include a component labeled "Select Appropriate Media." Although there have been several attempts to elaborate upon that component by describing formal procedures for making informed systematic media selection decisions, there have been few attempts to assess the usefulness of those procedures. It is hoped that our study will help lay the groundwork for more research in this important area.

References


Results indicate that more than twice as many subjects made the correct media selection decision when they used a formal selection procedure.


Author Note. The development of the media design problems used in this study was supported by the sabbatical program at Arizona State University. The authors express their appreciation to Marice Coleman and Sharon Shrock for their comments on an earlier draft of the manuscript.
Comparison of Three Algorithms for Analyzing Questionnaire-Type Needs Assessment Data to Establish Need Priorities

Oliver W. Cummings
Arthur Anderson & Co.
Center for Professional Education
1405 North Fifth Avenue
St. Charles, IL 60174

Needs assessment has been recognized as an important part of curriculum planning for many years. Commonly, need assessments are conducted to identify discrepancies between an existing state of affairs and a desired or ideal state (Kauffman, 1977; Witkin, 1977). Kaufman (1976) and Kaufman and English (1979) define needs assessment as a method for identifying gaps between present and desired outcomes. They present the overall process as one in which three major steps are taken:

1. Identifying all the relevant gaps.
2. Prioritizing the gaps that are identified.
3. Selecting the highest priority gaps for closure.

Under this model there are different ways to gather data, and different data collection techniques imply different analysis approaches. Needs assessment data collected via a nominal group technique (e.g., see Harrison, Peirce & Moore, 1985; or Scott & Deadrick, 1982) would be generated and analyzed differently from data collected via a large-scale survey in which ratings of desired states are compared to an assessment of the existing state of affairs (e.g., see Lane, Crofton, & Hall, 1983; Misanchuk, 1982, 1984). Further, different data analysis approaches may be applied to data collected using a single technique.

In this paper three approaches to identifying "gaps" and establishing priorities will be explored. These approaches are applied to the analysis of data collected to identify the level of knowledge, skill, or attitude that "SHOULD" exist and the level that "DOES" exist. (For the remainder of the paper, knowledge will be used alone, so repeating skills, attitudes, and other learner characteristics will not be necessary.) Discrepancies between SHOULD and DOES are usually identified through analyzing responses to similar rating scales for the two dimensions and are presumed to identify gaps between the desired state and the current state. Prioritization of needs is accomplished by comparing the magnitude of the discrepancy measure between the ratings on the two dimensions. How the discrepancy is defined may be key to the outcome of the prioritization.

Three Ways to Quantify the Gap

For the purposes of the following discussion, a discrepancy-column questionnaire-type needs assessment instrument is assumed. The discrepancy-column format has been shown to be superior to single-column constructions for needs assessment (Johnson & Dixon, 1984). During instrument development, key content areas would have been identified for assessment. A response pattern of two five-option scales—one to assess a level of knowledge that SHOULD exist and one to assess the level of knowledge perceived to (i.e., DOES exist—are assumed (see Figure 1). For each content area, respondents mark their rating for the two dimensions. Typically, an opportunity would be afforded for respondents to note additional areas in an "Other" category. The analysis of these added categories is not considered here.

Mean Difference Analysis

The simplest way to analyze data such as these is to sum the ratings for a category by dimension and divide by the number of responses. Thus, a mean for each category is derived for the level that SHOULD exist and for the level that DOES exist. The difference of interest between these two means can be determined by $\bar{X}_S - \bar{X}_D$; where $\bar{X}_S =$ average rating on the SHOULD dimension and $\bar{X}_D =$ average rating on the DOES dimension. A positive difference is indicative of a greater knowledge level needed than currently exists (i.e., a gap). The greater the magnitude of this gap, the higher is the priority of the need.

Multi-Component Data Analysis

Misanchuk (1982, 1984) proposed an application of the statistic del for the analysis of needs assessment data when two or more dimensions are considered simultaneously. While Misanchuk applied the statistic to dimensions of relevance and competence, his logic for using it applies equally well to the somewhat different SHOULD and DOES dimensions. Borrowing from Misanchuk (1984, p. 29): One need only postulate that a high educational need exists when the respondents collectively indicate a high knowledge level SHOULD exist with a concomitant low knowledge that DOES exist. In essence, this statistical approach can be used to identify properties of need by summarizing the discrepancies in response patterns on the SHOULD/DOES continuum, taking into account the magnitude of the rating on the SHOULD dimension. The implicit contention in this approach is that differences of the same magnitude between what SHOULD exist and what DOES exist have different meaning, depending on whether there is a high or low level indicated on the SHOULD dimension.

In Misanchuk's application, two key theoretical assumptions were made by the needs analyst:

1. That the marginal probabilities of the rows and columns of a matrix of SHOULD x DOES ratings are known (or can be reasonably assigned) by the analyst, and


2. That a systematic cell weighting scheme, related to a proportionate reduction in error approach to the data analysis can be defined.

These assumptions are explained below.

Data collected for a single content area in an approach as shown in Figure 1 could be displayed in a 5 x 5 matrix as indicated in Figure 2.

Following this scheme the cell probability assumed for a combination of responses indicating that an extremely high level of knowledge SHOULD exist (5) and an extremely low level of knowledge DOES exist (1) would be 0 (.4 x .0 = 0). The probability for a cell representing moderate levels on both dimensions (e.g., 4 on SHOULD and 3 on DOES) would be .06 (.3 x .2 = .06), and so on.

In regard to assumption 2 above, Misanchuk (1982) makes an argument for a cell weighting scheme assuming a "more-or-less linear progression based on a unit diagonal length" (p. 20). In other words, the cell weight for cell (1,3) (low level of knowledge DOES exist and high level of knowledge SHOULD exist) is 0.0000 and a cell weight for cell (5,1) (high DOES and low SHOULD) is 1.0000. Cell (3,3) is weighted .0000, and so on. Each cell is weighted, working off of this unit-diagonal scheme (see Appendix A for complete table of cell weights).

The weights can be conceptually understood as the individual cell contribution to an indication of no need for training. That is, if a person’s response appears in cell (5,1), it is assumed that there is absolutely no need for training (weight = 1.0000). If, on the other hand, the person’s response places them in cell (4,2), it is assumed there may be some, but very little need (weight = .7500). In still another example, for cell (2,5), it is assumed that there is little contribution to the need conclusion, thus there is a low weight for the cell (weight = .1768).

Employing Misanchuk’s (1982) proposed cell weighting scheme and assumption of monotonically increasing proportions for the marginals, the formula actually employed in this study (using $\Delta N$ to denote the needs assessment del was:

$$\nabla N = 1 - \frac{\sum_{i=1}^{R} \sum_{j=1}^{C} W_{ij} P_{ij}}{.5729}$$

Where: $W_{ij}$ is the weight for cell (i,j) (see Appendix A for weights used); $P_{ij}$ is the probability of a randomly sampled observation falling into cell (i,j); .5729 is a constant derived from the noted assumptions.

The value of $\Delta N$ as computed can range from approximately -1.75 to 0, with any negative value indicating no need. The values of del ranging from 0.00 to 0.1 can be interpreted as carrying magnitudes of need and can be used to prioritize the needs. This method of analysis gives heavier emphasis in the prioritization process to areas which many respondents feel there SHOULD be high levels of knowledge, but for which lower levels of knowledge exist.

### Weighted Needs Index

When an organization considers building training programs to benefit its long-term success, the training should be developed only for critical skills, knowledge, or attitudes and for severe deficiencies. This implies a threshold of relevancy, importance or "SHOULD" below which no training would be economically justified even though a discrepancy exists. Further, it implies a threshold above which the level of competence or existing knowledge is deemed to be adequate (i.e., not worth the cost to refine or hone through formal training programs). Within the thresholds it is important to be able to prioritize content areas according to the severity of the need.

In addition, the needs assessment analyst must sometimes communicate with an audience that is neither wellversed in nor impressed with statistics. This audience may be skeptical of assumptions about "monotonically increasing marginal probability" or "unit diagonal linear progression." but might embrace the logic which suggest that small discrepancies for important skills may need to be addressed, whereas relatively larger discrepancies for less important skills may not require attention.
The weighted needs index (WNI) was developed to incorporate the threshold concept into an easy to communicate and directly intuitive data analysis approach. The WNI uses a cell-weighted scheme to transform frequency data into a single, important-weighted score for each content area assessed. This value is then used to prioritize the areas according to the magnitude of need.

The WNI focuses on those areas receiving a SHOULD rating of 3 or higher and a DOES rating of 3 or lower. The implicit assumptions in the algorithm is that the relative ratings of SHOULD and DOES show no need for training development (from an organizational point of view) if there is no discrepancy in rating or if the SHOULD rating fails to meet a test of “moderate to high” in conjunction with “moderate to low” DOES. The weighting value assignment scheme is shown in Figure 3. The higher values here indicate a greater need for training development.

Where: \( f_{ij} = \) frequency of responses in a given cell \((i=rows, j=columns)\), and \( V_{ij} = \) the assigned value for the given cell

\[ N = \text{total number of people responding to the item.} \]

This index value can be viewed simply as an average, importance-weighted rating of need. Index values can range from 0 to 5, and the higher the value the greater the implied need for training.

A Comparison Study

Each of the three data analysis techniques has claimed advantages and disadvantages. The mean difference approach is the simplest to calculate and easiest to describe to an audience that is not well versed in or is even skeptical of statistical analyses. On the other hand, it requires an assumption that the rating scales yield interval data and fails to take into account differences in the absolute importance level of the variable. The data user under mean difference analysis must attend to both the rating for “SHOULD” (i.e., importance) and to the difference between “SHOULD” and “DOES” in interpreting the results, an increasing problem as the number of discrepancies to be prioritized increases.

The multi-component data analysis takes into account the importance level and the difference between “SHOULD” and “DOES,” and represents the results in a single number. This reduces the interpretation complexity, since the user has to attend to only one number, a distinct advantage when several areas are assessed in one questionnaire. It, however, is conceptually and computationally complex and therefore more difficult to “sell” to some audiences. It also includes results that are additive across the entire distribution of responses, and does not treat responses above or below any given threshold differently. (This is not entirely the case since “errorless” cells in the computation may be designated.) This latter characteristic is a key advantage of the multi-component approach, when there is a prior assumption that justifiable benefits exist in providing training at any level of importance or competence if the discrepancy is significant.

Finally, the weighted needs index is an approach somewhat different from the other two approaches in some significant respects. It is computationally less complex and requires fewer theoretical assumptions than multi-component analysis. It accounts for threshold levels of knowledge that SHOULD and DOES exist in the analysis and represents the need hierarchy in a single number.

This study was undertaken to assess the relative effects of these three data analysis approaches on prioritizing needs, when resources are a significant constraint on training development. A needs assessment was undertaken to define the training curriculum to increase competence of management and professional staff working with construction industry clients of a large accounting/auditing firm. A core group of industry experts, with specialties in accounting/auditing, tax consulting, and management information systems consulting, was used to develop a list of content areas for which training was deemed to be potentially very important. The content areas identified included 19 business issues and seven accounting/audit issues uniquely related to construction industry work. These 25 issues were included as part of a more comprehensive survey administered to managers and professional staff.

Sample

Two hundred forty-seven surveys were distributed to industry managers and professional staff actively engaged in construction industry work. One hundred sixty-three of the surveys (86 from managers and 77 from professional staff) were returned after two follow-up reminders to nonrespondents. The usable return rate was approximately 66 percent. The sample was distributed throughout the United States, with a small representation from outside the U.S.

Survey

On the survey instrument, respondents were asked to answer the following questions for each content area.

1. “Indicate the knowledge level that should exist for individuals who are working with construction industry clients. Please rate each issue for persons at your personnel classification.”

2. “Indicate the knowledge level that does exist for individuals who are working with construction industry clients. Please rate YOUR own knowledge level.”

The instrument was set up in the format shown in Figure 1 above. Respondents indicated their assessments by circling...
the number most closely corresponding to their judgments for each issue listed. Responses were coded and keypunched. The data analyses were conducted using the Statistical Analysis System (SAS).

Data Analyses
The data analyses were conducted separately for managers and professional staff. First, means were computed using all available responses for each issue on the two dimensions (knowledge level that SHOULD exist, and knowledge level that DOES exist). The difference between means was computed for each issue, and the results were ranked according to the magnitude of the mean difference.

In a second analysis, ΔN as described above was computed for each issue. This analysis made use of SAS to output the 5x5 cell matrices illustrated in Figure 2, then through additional programming, computations of ΔN were accomplished. The resulting values served as the basis for a second ranking of the issues into priority order.

In the third analysis the weighted needs index was used to produce a score for each issue. Again SAS with additional user programming was used. The issues were prioritized according to the weighted needs index.

Results and Discussion
In a strict sense, the results of the needs assessment were influenced by the data analysis technique applied. If content areas were selected for training development solely on the basis of questionnaire results, the differences that would have occurred in the two samples used in this study are shown in Table 1. The table shows the percent of agreement between the data analysis techniques at the two personnel levels when constraints are placed on the number of content areas to be addressed. For example, if resources were available in the firm to address only five of the 25 content areas studied, there would be agreement on four of the five (80%) areas regardless of whether the mean difference analysis approach or the multi-component data analysis approach was used. There would be complete (100%) agreement between the mean difference approach and the weighted needs index, and consequently 80% agreement between the multi-component and weight needs approaches. As would be predictable from the computational approaches, there is generally better agreement between the mean difference and weighted needs approaches and between the multi-component and weighted needs approaches, than there is between the mean difference and multi-component approaches. Also, as the proportion of content areas to be addressed increases, there appears to be generally increasing agreement among the three approaches. This trend also is predictable, but might not have been intuitively expected to increase as rapidly as it appears in these samples. For example, by the time 40% of the content areas were included, there was uniformly 80% to 90% agreement among the three data analysis approaches.

In Table 2, the number of respondents to each issue (N) and the results of the data analyses for each of the three different approaches, by personnel level are shown. The content areas are labeled by letter, in the sequence they appeared on the original questionnaire.

Overall, the relationships between the various analysis approaches for the two personnel samples on the 25 content areas studied were quite high. Rank order correlations of .92, .94, and .96 were found for mean difference vs. multi-component, mean difference vs. weighted needs index, and multi-component vs. weighted needs index, respectively, for the manager group. The comparable correlations for the professional staff group were .85, .92, and .96.

The similarities in results of the three approaches are further evidenced in an analysis of the effects of the importance (SHOULD) ratings on the results. For each sample (managers and professional staff) an analysis was undertaken to assess whether differences in ranks obtained by the three approaches were systematic. The issues were ranked by magnitude of the SHOULD dimension. Then, the relative need was compared, based on ranks of issues analyzed by the three computational approaches. For example, the highest ranked issue on the SHOULD dimension for managers was content area “G,” but its respective ranks of need under the three analysis approaches were 13, 5, and 15. If the more important content areas are likely to be favored by the multi-component and the weighted needs models, as might be inferred from the earlier discussions, then differences in the rankings should be systematic with the mean difference approach yielding lower priority needs at the higher “SHOULD” levels and higher needs at the lower “SHOULD” levels than the other approaches. An analysis of the data, using the one sample runs test (Siegel, 1956) indicated that the order of the observed differences in both samples was randomly occurring. In other words, the rankings in these samples were not systematically related to the importance (SHOULD) ratings. It should be noted, however, that all of the 25 content areas studied here showed some positive level of need and all were judged relatively important (average ratings of SHOULD ranged from 3.42 to 4.63 in the two samples). A set of content areas or issues which yielded a wider range of reactions might have shown systematic relationships that were not apparent here.

| Table 1. Percent of Agreement among Data Analysis Results under Constrained Response to Needs. |
|---|---|---|---|
| # of areas to be addressed | Minimum Percent Agreement |  |
|  | MDA vs. ΔN | MDA vs. WNI | ΔN vs. WNI |
|  | Mgr. Staff | Mgr. Staff | Mgr. Staff |
| 2 | 100 | 50 | 100 | 50 | 100 | 50 |
| 3 | 87 | 67 | 87 | 67 | 87 | 67 |
| 5 | 80 | 80 | 100 | 100 | 80 | 80 |
| 10 | 90 | 80 | 90 | 80 | 90 | 90 |
| 15 | 93 | 87 | 100 | 93 | 93 | 93 |
| Average across various levels | 86 | 73 | 98 | 80 | 86 | 76 |

NOTE: ΔN = Needs assessment del MDA – Mean Difference Analysis WNI = Weighted Needs Index

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<th>DEL (Rank)</th>
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**Summary and Conclusions**

A study of training needs was undertaken, using a questionnaire to assess the level of knowledge that SHOULD exist and the level of knowledge that DOES exist for 25 content areas. The data were analyzed by three different approaches: mean difference analysis, multi-component data analysis, and weighted needs index.

The study included a relatively small sample of content areas and small samples of respondents. This, however, probably represents the "real world" of needs assessment. The results for these samples were fairly homogeneous. All 25 areas were identified as yielding a positive need for training development. Future research should focus on a broader range of needs and on larger and more diverse samples of respondents and content areas. It should also include exploration of the consequences of adopting a "threshold" approach as suggested by WNI and development of decision rules to guide the analyst in setting threshold levels realistically.

Two conclusions based on the foregoing discussion and the study results seem tentatively warranted. First, if a significant portion of the content areas considered in a needs assessment are likely to be addressed, and if each area individually represents a relatively harmless consequence if included or omitted in error, it appears that any of these approaches to the data analysis task would probably be adequate. If, however, a relatively small proportion of the areas can be addressed, analyses using $\Delta N$ or WNI should be conducted. Secondly, because of the different assumptions underlying $\Delta N$ and WNI, the selection of one over the other depends on the training intent. If the focus is one of providing training at any importance or competence level when there is an identified need, then $\Delta N$ may be preferred. On the other hand, if thresholds beyond which no training will be developed should be established, WNI may better serve the decisions to be made.

Author Note: The author acknowledges Kimball C. Kleist of Arthur Andersen & Company's Center for Professional Education for his contribution to the development of the weighted needs index and for his assistance with data analysis required for this research.

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Strategy Training: An Incidental Learning Model for CAI

Sharon J. Derry
Florida State University
Center for Educational Technology
413 EDU
Tallahassee, FL 32306

Abstract. Attempts to train learning strategies have not produced marked or lasting increases in academic achievement probably because current training models fail to recognize the evolutionary nature of strategies acquisition. Empirical and theoretical evidence is presented supporting an incidental learning model that engineers the instructional environment following study skills training, so that students are prompted to recall and use strategies during study. At onset of spontaneous strategies initiation, prompts are faded gradually, to produce automatic processing. The model can be implemented on a very large scale as CAI, or as a somewhat less promising paper curriculum.

My students and I began this work last year with a review of literature pertaining to the training of what Brown and Campione (1982) have called the "skills of academic intelligence"—learning strategies. Here the term learning strategy refers to the mental operations that a student employs in an instructional situation to acquire different kinds of knowledge and performance. Thus conceived, learning strategies lie within the domain of cognitive strategies (Bruner, Goodnow & Austin, 1956; Gagne, 1980a, 1980b), a broader family of capabilities that enables individuals to exercise control over their own intellectual processes.

Seven types of learning strategies that might be taught to adults with academic difficulties were identified: mood management, attentional management, memorization strategies, reading strategies, problem-solving strategies, test-taking strategies, and vocabulary learning strategies. A number of researchers (e.g., Dansereau, Collins, McDonald, Holley, Garland, Diekhoff, & Evans, 1979; McCombs & Dobrovolsky, 1982; Weinstein, 1978, 1979; Rood & Weinstein, 1983) have developed study skills courses offering direct training in these skills, and have reported modest improvements in students' abilities to learn, remember, and solve problems. However, study skills training has not yet produced marked or lasting increases in academic achievement, possibly because current training models do not recognize the evolutionary nature of strategies acquisition. Research and theory suggest that thinking skills must be developed gradually, as by-products of practice and experience.

Gagne (1980a) also has expressed doubt that strategic thinking can be "trained" in the usual sense of the word. He points out the enormous diversity of task-specific cognitive strategies, and the experiential aspects of their natural evolution. Thinking skills, he argues, are adaptive intellectual capabilities that evolve slowly through contact with many different learning situations. If this is true, then study skills training would not be likely to provide the rigorous and extended practice that is needed in order for learning skills to develop. To achieve training of strategies, an elaborate curriculum plan that recognizes and accommodates the evolutionary aspects of strategies acquisition must be devised.

This paper describes a strategies training model that attempts to "engineer" the instructional environment following study skills training, so that students are prompted to invoke and use previously taught learning strategies during study. My discussion here develops a rationale for our approach, which is consistent with research on incidental learning.
treatment, which could vary greatly, depending upon a student's entering competencies.

Strategies Initiation: Awareness and Control

One feature of JSEP that distinguishes it from previous basic skills curricula (e.g., McNell Gray, Science Research Associates) is that JSEP attempts to develop student awareness and control of strategic learning ability. Derry and Murphy (in press) have discussed how initiation and control of learning strategies may arise primarily from the student's own self-instructions (learner-controlled), or from an instructional system (lesson-controlled). Following Rigney (1978, 1980), they conceptualize a continuum ranging from conscious to subconscious processing, and point out how student awareness can vary along this continuum.

A conscious strategy is described independently of the subject matter; the student is aware of its existence in a "metacognitive" (Brown, 1978, 1980) sense. A subconscious strategy may be lesson-controlled if it is deliberately forced by the instructional design, or student-controlled if it is not. In either case, the learner is not spontaneously aware of its use. Suggested are the four conceptualizations of learner strategies presented in Figure 1.

Figure 1. Four Types of Learning Strategies

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<th>Learner Awareness of Strategy</th>
<th>Student Controlled</th>
<th>Lesson Controlled</th>
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<td>B</td>
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</tbody>
</table>

For example, consider a student attempting to learn the text material in a training manual. If the student consciously adopts the use of paraphrase, imagery, and self-generated questions, this would be an example of situation A. But, if the textbook directly instructs the student in the use of this strategy, this would exemplify B. Rigney's (1978, 1980) premise was that combination A of Figure 1 is desirable. He argued that when students have not naturally acquired appropriate strategies for learning, situation A might be realized through implementation of situation B. In early phases of training, instruction would explicitly point out that there are strategies that can be applied to facilitate learning of the subject content. As the student progresses and develops greater skill with the subject, strategy training can be phased out, leading ultimately to situation A.

Situation C is illustrated by the combination in which the student has evolved, through experience with a particular type of material, a processing method that is so spontaneous and automatic, there is no conscious awareness of its initiation and use. The widely accepted resource allocation model of attention (Norman & Bobrow, 1975) suggests that automaticity is a highly desirable long-range goal for strategies training. Automatic strategies initiation is believed to free attentional resources that can be devoted to processing of content based instruction.

Derry and Murphy (in press) point out that no training system has yet achieved combination C. Rigney (1980) suggested that extended practice of a newly acquired strategy, as in situation A, could help develop the type of automaticity that is a desirable characteristic of the subconscious student controlled strategy. Another theorist (Brown, 1980) also has proposed that one route to automatic processing is through initial training in "metacognitive awareness." JSEP will attempt to engineer spontaneous initiation of new strategies, by moving the student from conscious, lesson-controlled processing, through what might be termed the metacognitive phase, toward a smoother, more automatic form of processing. The success of this approach is an empirical issue that has not yet been resolved.

In contrast to the JSEP approach, most basic skills curricula represent situation D, the lesson-controlled counterpart to automatic processing. This instructional design methodology involves incorporating controls into a lesson, so that students are required to employ particular processing strategies in order to accomplish subject-matter orienting tasks. For example, inserted questions (Anderson & Biddle, 1973; Andre, 1979; Rickards, 1976) may be used to foster imaging and depth processing. Or, through explanation techniques based on metaphor and analogy (Or-
tory, 1975; Rumelhart & Norman, 1981), or the advance organizer (Ausubel, 1963: Ausubel, Novak & Hanesian, 1978), students might be required to encode new information in the context of a particular prior knowledge structure. In the field of instructional development, current standards are dominated by the methodologies of Gagne & Briggs (Briggs, 1977; Gagne, 1977; Gagne & Briggs, 1974), which rely on subconscious, lesson-controlled strategies supplied by the instructional designer as part of an event called “learning guidance.”

The effects of lesson-controlled strategies have now been documented by a substantial body of literature, yet our review of that literature reveals few, if any, totally dependable instructional techniques. With the possible exception of “forced” practice-and-feedback, no single, isolated instructional device that will greatly enhance instructional effectiveness is known. By contrast, some explicitly taught learner-controlled techniques, such as mnemonics and pegword systems, have significantly enhanced memory, at least for lists and paired associates (Bower, 1970).

Furthermore, Rigney (1978) has argued that hidden strategies do little to help the student cope with requirements for further independent learning of material that is not highly “designed,”—a technical manual accompanying electronic equipment, for example. Yet, the notion of subconscious, lesson-controlled strategies has strong intuitive and theoretical appeal. If thought control can totally be relinquished by the student to the instructional system, more of the learner’s activation resources presumably are available for concentrated processing of subject-matter material. Thus, it might be argued that situation D represents the most efficient form of instruction, when strategies acquisition is not an important instructional goal.

**Cognitive Strategies, Intellectual Skills, and Cognitive Style**

Gagne (1977) has defined five types of subject-matter for which a training curriculum can be developed:

1. cognitive strategies,
2. intellectual skills,
3. verbal information,
4. motor skills, and
5. attitudes.

In Gagne’s terminology, JSEP represents an intellectual skills curriculum. Soldiers enter JSEP to acquire the prerequisite math and verbal competencies that will enable them to learn their military tasks. However, it is necessary in this context to make an important distinction between Gagne’s conceptualization of intellectual skills training, and another well-known use of this same phrase, derived largely from theories of intelligence and popularized by Sternberg.

Gagne (1977) has identified five progressively complex classes of intellectual skills: discriminations, concrete concepts, defined concepts, rules, and higher-order rules. To acquire the skill of “making change,” for example, the student first must be able to distinguish coin types from one another, and to identify them by name and monetary value. The rules of addition, subtraction, and monetary equivalence also must be acquired. These concepts and

A serious shortcoming of study skills courses is that they are unable to supply a real world context for long term varied practice in strategies formulation.

Sternberg’s notion of the intellectual skill differs from Gagne’s, but is more than roughly equivalent to Gagne’s notion of “cognitive strategy.” (From Gagne’s point of view, one of Sternberg’s “component processes” would amount to no less than a prerequisite competency for acquiring a particular cognitive strategy.) Here we will follow Gagne’s (1977, 1980a) convention of distinguishing between cognitive strategy and intellectual skill as two distinctly different forms of human capability. This distinction already is well-established in the field of instructional design, and it helps clarify the nature of the JSEP model, which embeds cognitive strategies training within an intellectual skills curriculum.

The parallel between Gagne’s notion of cognitive strategy and Sternberg’s view of intelligence is emphasized, to make the point that in many respects the JSEP approach to strategies training
adheres to Sternberg's 1983 guidelines for training the intelligence. In this sense, it might be argued that JSEP represents a large-scale, programmatic effort to improve a form of processing intelligence — ability to learn from a particular type of training system.

We must note that currently there is a trend toward differentiating the concept of processing intelligence from that of cognitive style. Cognitive styles have been defined as non-evaluative individual differences in modes of conducting thinking processes such as perceiving, attending, storing, remembering, transforming, and utilizing information. The notion of intellectual ability concerns processing capacity, which can vary on an evaluative continuum from low to high (Federico, 1980).

Because the JSEP introductory course includes direct, step-by-step instruction, linkages between the processing skills that are being taught and real-world processing situations. Learners often are required to process, during training, the types of materials they will encounter in their daily experience. For example, Sternberg notes that one of his programs trains the set of skills individuals use to learn the meanings of previously unknown words. If a job-relevant vocabulary list were employed during training, then students not only would acquire the ability to figure out the meanings of new words, but also may acquire, as incidental learning, a vocabulary list that is personally relevant. As pointed out by Derry and Murphy (in press), this approach amounts to embedding, within a strategies training program, secondary objectives based on what is usually regarded as the primary subject-matter in a functional basic skills curriculum.

Improving a person's ability to function within a standardized instructional environment is a viable goal.

in processing mode, it could be argued that strategies training in JSEP is more appropriately described as an attempt to alter cognitive style rather than intelligence. We prefer the concept of cognitive strategy, and the idea that strategy can be taught as a means of obtaining more efficient and intelligent use of processing resources that may, in fact, be relatively limited. In this context, we draw no evaluative distinction between "intelligence" that results from efficient use of limited capacity resources, and that resulting from a larger resource allotment and less effective strategy.

Embedding a Strategies Training Program

Sternberg's (1983) guidelines for improving intelligence (as measured by standardized aptitude tests) emphasize the importance of providing appropriate curriculum.

These authors argue that learning strategies programs have usually treated academic subject-matter as practice material. The typical approach is represented by the adjunct study-skills courses developed by McCombs (1983), Dansereau et al. (1979), and Weinstein (1978, 1979). These programs are stand-alone curricula in which strategies acquisition, rather than subject-matter learning, is the primary aim. They teach and provide practice in using general processing and self-management schemes that are "detached" (Rigley, 1980) from any particular curriculum, but, presumably are applicable to a wide variety of learning situations. Study-skills courses have produced statistically significant (though modest) gains in student attitude, motivation, confidence, and in certain types of school performance measures (Vaughan, 1982). A serious shortcoming of study skills courses is that they are unable to supply a real-world context for long-term, varied practice in strategies formulation.

Jones (1983) has argued in favor of embedded strategies training, which offers instruction and practice in learning strategies totally within the context of a curriculum based on subject-matter learning goals. Her approach incorporates explicit instructions on text processing strategy into subject-matter instructional materials received by teachers and students. One advantage to this approach is that it can be implemented without extensive in-service teacher training. Four types of strategies instruction can be embedded:

2. Think Aloud Models, simulated dialogues of a model student processing a portion of text.
3. Adjunct Study Questions, which require particular thinking processes, and
4. Study Prompts, reminders to use specific information processing strategies that have been taught previously.

Jones and her associates have developed several large-scale embedded strategies curricula that rely heavily on the first three types of embedded instructions, especially the step-by-step prompts. Jones' approach can be contrasted with that taken in JSEP, which is based on a less obtrusive prompting method.

When nonobtrusive study prompts are employed, step-by-step strategies training occurs outside the actual learning event rather than in conjunction with subject-matter instruction. Brief reminders to use previously learned strategies are inserted, at appropriate points, into lessons based on more traditional subject-matter material. This prompting method is unique in that it encourages practice in the recall, as well as the use, of previously acquired learning strategies. Thus, it is more likely to encourage the development of independent processing.

Furthermore, since step-by-step strategies training is provided outside the actual learning event rather than in conjunction with subject-matter instruction, study prompts are less likely to disrupt concentration. Nonobtrusive prompts are a feature of the JSEP model, which treats strategies development as a form of incidental learning embedded within a functional basic skills curriculum. Empirical and theoretical justification for the incidental strategies
training approach is supplied in part by research based on the depth-of-processing paradigm (Craik & Lockhart, 1972; Craik & Tulving, 1975), which clearly has demonstrated that intention to learn is not a prerequisite for actually learning.

**Metastrategies and Component Strategies**

A learning strategy has been conceived by Dansereau (1978) as a mental construction that embodies both a situationally-relevant general metastrategic and component sub-strategies that are associated with the metastrategy. To initiate a strategy for learning, an individual must not only access an available library of component processing skills, but also select particular component processes, organize them into a metastrategy that matches a particular learning situation, and continuously monitor the success of the learning effort. The relationship between a metastrategy and its related sub-strategies parallels the link between what Sternberg (1983) has called “executive” and “nonexecutive” information processing routines. He argues that programs which attempt to train a form of intelligence “... should provide explicit training in both executive and nonexecutive information processing, as well as interactions between the two kinds of information processing” (Sternberg, 1983, p. 9).

We conclude that strategies training systems should teach not only essential component cognitive skills, but also a repertoire of metastrategies appropriate for frequently encountered learning situations. For example, Dansereau and his associates have taught college students to utilize MURDER, a mnemonic which stands for a sequence of steps in a general study strategy — set your mood, read for understanding, recall, digest information (correct recall, amplify and store), expand knowledge through self-inquiry, and review mistakes. A simple variation on this mnemonic is taught as a general heuristic for test-taking. Specific component processing skills associated with each step in these mnemonics also are taught. Mood-setting may involve positive self-talk and progressive relaxation, amplification could be accomplished through imaging or paraphrasing.

When considered alone, a metastrategy that is general enough to be used for many types of lessons and curricula amounts to what Newell (1980) has called a “weak” strategy. The method is weak because it trades power for generalization. However, when coordinated with embedded prompts to engage various specific processing techniques to accomplish a metastrategy, the technique becomes a model for training students in what Newell has called a “Weak to Strong Method Sequence.” “The weak methods can be taken to be just the tip of the iceberg, so that there exists an expanding cone of methods of ever greater specificity and power. This is a variant of the Big Switch hypothesis, for at the base of the cone are the multitude of specific expert procedures” (Newell, 1980, p. 186).

We hypothesize that acquisition of a metastrategy will provide learners with an important link insuring continued initiation of component strategies, even after explicit prompts are deleted. A well-established fact of memory research is that recall of high-order contextual combined in a CAI curriculum is illustrated, again with reference to JSEP. JSEP begins with an introductory learning strategies course consisting of two units: “Welcome to JSEP,” and “Learning Skills You Need for JSEP.” One lesson in the welcome unit, entitled “What JSEP Lessons are Like,” will suggest that students employ a general metastrategy for approaching every basic skills lesson. The metastrategy consists of five elements:

1. Control your mood,
2. Set your goal and pace,
3. Memorize when necessary,
4. Employ a reading strategy, and
5. Practice thoughtfully.

Each element of this metastrategy is introduced by a fictitious character whose image and name represents his or her particular concept. In further introductory lessons, specific component strategies that can be initiated by the

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**Strategies training should teach not only essential component skills, but also a repertoire of metastrategies appropriate for frequently encountered learning situations.**

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**The JSEP Strategies Training Program**

An example of how adjunct strategies training, the metastrategy technique, and nonobstrusive prompting can be learner to accomplish each metastrategy step are taught by the appropriate character. For example, problem solving strategies are introduced by a character modeled after Sherlock Holmes. In the final segment of the introductory course, entitled “Making Your Skills Work Together,” the characters are pictured in scenes together so that they will become associated with one another as members of a cooperating group. The intent of this device is to create an “imagery mnemonic” that will cue students when they attempt to recall elements in the metastrategy.

These characters also will appear often within the basic skills lessons that compose most of the JSEP curriculum. Within the lessons, they will function as part of a prompting system that analyzes student responses to determine whether or not the metastrategy is being utilized,
and encourages soldiers, when necessary, to consciously recall and employ their new learning skills. For example, students who are actively practicing the skill of comprehension monitoring will frequently use the review option for difficult-to-understand material. If results of a comprehension posttest indicate lack of understanding, but the review counter has posted few or no reviews for that student, then a prompting character would begin to appear, encouraging use of the review option. This prompting procedure is analogous to establishing, in a problem-solving situation, what Bower (1975) and Cagno (1980) have called a learner set. "The effect of the set is to activate a cognitive strategy that persists during the time the processes of problem solving are being employed" (Cagno, 1980, p. 15).

One important difference between the JSEP system and most other forms of instruction, reviews and prompts can be phased out, presumably in advanced stages of instruction.

The JSEP Taxonomy

The task of creating a strategies training program requires a taxonomy of curriculum-relevant component strategies. Cagno (1980) has argued that the universe of cognitive strategies is so diverse that it is virtually unteachable. However, when training of strategies is contextualized within the bounds of a metastrategy that has been chosen to fit a particular subject matter curriculum, the burden of identifying a relevant set of component strategies is substantially eased.

A taxonomy of component strategies was created specifically for JSEP. The JSEP taxonomy represents a synthesis of ideas borrowed from organizational frameworks created by D harvest and his colleagues (1978), McCambus (1983), strategies are behavioral self-management "tricks," including techniques for setting and meeting realistic goals, time scheduling, self-contracting and self-reinforcement. The goal of the self-pacing training is to enhance attentional processes by gradually increasing time on task within the learning center. Strategies in the self-pacing and mood-management categories are similar to those listed by D harvest and others as "support strategies." They are similar also to strategies incorporated by McCambus into her "motivational curriculum."

Strategies for reading, skilled memory, and problem solving are "primary information processing strategies" in D harvest's terminology, although his taxonomy does not include the problem-solving category. Reading strategies training in JSEP will be based on the ideas of Brown (1980), Cook and Mayer (1985), and Collins and Smith (1982). Students will be taught three types of reading techniques: how to select a strategy, how to monitor comprehension, and what remedial steps should be taken when comprehension failure occurs.

Over fifty percent of the strategies training in JSEP will be devoted to reading, memory, and problem-solving strategies. These categories raise controversial issues related to their role in skills acquisition, and have been discussed elsewhere in some detail (Derry & Murphy, in press). The memory module will teach the concepts of active memory and executive decision-making. In addition, three types of specific memory strategies (mnemonics) will be taught: strategies for learning single words and ideas, techniques for list-learning, and strategies for connected discourse. The problem-solving module will teach specific methods that can be used to help solve word problems involving arithmetic and mathematics operations. Students will learn to clarify a problem (schema training), to develop different solution methods, and to evaluate their answers by using "common sense" criteria. In a supplementary module, problem solving training will be generalized to cover test-taking situations.

Strategies development calls for a more programmatic training approach that supplies highly varied practice over an extended period of time. Strategies training, particularly study-skills courses, is the attention paid by the former to development of automaticity. Most strategies training programs begin by raising the student's metacognitive consciousness. But, the embedded model implemented in JSEP further attempts to logistically engineer the change from the laborious activity of the conscious level to the "normal rapid automatic pilot state . . . that distinguishes subconscious processing" (Brown, 1980).

Throughout the instructional program, students who need prompts are reminded to engage in the extensive and rigorous strategies practice that is known to be necessary for the development of automatic processing (Hirst, Spelke, Reaves, Cahirack and Neisser, 1980; Neisser, 1976; Rigney, 1980), or at least smooth performance. With the onset of spontaneous strategies initia-

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structurally compatible with one another and with the metastrategy. At the very least, lesson structures and the student’s metastrategy should not operate in conflict. Many JSEP lessons were designed according to methods advocated by Cagne and Briggs (Briggs, 1977; Cagne & Briggs, 1974). Thus, it was necessary to adopt a metastrategy that could be mapped upon the Cagne and Briggs events of instruction. The important point is that addition of student-controlled strategies to the instructional situation need not eliminate the use of instructional design principles that depend upon hidden controls.

JSEP students are taught strategies that should enhance the effectiveness of the instructional system. Consider, for example, the combined effectiveness of a designer’s use of color to highlight key ideas, and a student’s deliberate attempt to locate and encode key concepts. Whether or not the addition of an introductory course, metastrategies training, embedded prompts, or some combination of these significantly enhances learning over and above what is attained from well designed instruction alone is an important issue that should be addressed in future research.

It could be true that when strategies training is tied to a particular instructional system that has been thoughtfully sequenced and designed, learners will become system-dependent—unable to transfer learning skills into new situations that require them to deal with less adequate instructional conditions. Jones (1983) points out that strategies useful in one text design condition may be useless in another. However, training implemented within the context of a “text adequate” (Jones, 1983) curriculum may transfer to other learning situations that could be described as “text inadequate,” provided strategies for transfer into simulated real-world problem situations are taught and practiced during training.

The viability of this approach to transfer of strategies training also must be examined experimentally. But, even if transfer of strategies training proves to be limited, it is reasonable to assume that in many environments, instructional design is or could be standardized, at least for low-ability students. Improving a person’s ability to function within a standardized instructional environment, or with a standard design for training manuals, is a viable goal, and currently may be the best possible approach for basic skills training within military services, school districts, and industrial organizations with large-scale training needs.

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Linking Training To Organizational Impact

Roger Kaufman
Center for Needs Assessment and Planning
Florida State University
Tallahassee, FL 32306

Abstract. Organizations are successful to the extent to which they deliver things which are useful to clients. In order to run effectively and efficiently, many organizations spend large amounts of time and money in professional and technical training. If training is not linked to that which an organization uses, does, and delivers, the investment is better made elsewhere.

The ways in which training may be linked usefully to the various levels of organizational efforts, results, and impact are described. Also described are (a) an allocation of where various categories of personnel (Technical/Professional, Middle-Manager, Senior-Manager, and Executive Senior Manager) work relative to the Organizational Elements Model; (b) cases-in-point concerning responsibilities and activities; (c) tools and techniques usable by each category of organizational member, and (d) a training requirements identification and development cycle with an allocation of functions for determining who is concerned with each stage of the process. Finally, the relationship of the above with Needs Assessment and Needs Analysis is suggested.

Organizations succeed or fail on the basis of what they deliver. If their outputs are useful to clients and society, they will endure. If not, they will tend to falter and decline. Because that which goes on inside organizations determines what they can deliver, considerable concern is devoted to internal workings and results. Frequently, when an organization wants to survive, it invests in improving internal operations, and one way to accomplish this is to enhance human performance through training. The identification of what content should be trained, who should receive the training, and how these relate to organizational effectiveness and efficiency is the topic of this article.

The Organizational Elements Model (OEM) Provides the Basic Referent for Linking Training to Organizational Requirements.

Regardless of what an organization does or delivers, it may be seen as operating in the zones of organizational efforts, organizational results, and organizational impact. What an organization uses, does, completes, and delivers may be further subdivided into five “organizational elements” which relate to internal and external considerations (see Table 1).

Before embarking upon any training effort (or other intervention) requirements for what to change as well as what to continue should be obtained from policy and plans: one should determine where an organization is heading and why it wants to get there. In turn, these organizational intentions should be based upon documented gaps in results, ideally rooted in gaps in organizational impact in and for society—outcomes.

Planning for Useful Results

Any useful plan requires a strategy for linking organizational efforts, such as training and staff development, to the balance of that which an organization does and must deliver. To do this, one determines what has to be accomplished by the total organization, and then identify that which must be done to get from current skills, abilities, and products to those which are required. The reality of organizational life soon reveals:

1. Organizations are already set-up and running, with assignments, budgets, and territories already staked out, and
Table 1
Five Organizational Elements and How They Relate to Internal and External Considerations

<table>
<thead>
<tr>
<th>ELEMENT NAME</th>
<th>EXAMPLES</th>
<th>SCOPE</th>
<th>CLUSTER</th>
</tr>
</thead>
<tbody>
<tr>
<td>INPUTS—(raw materials)</td>
<td>Independence, existing human and physical resources, existing needs, goals, objectives, patients, users, money, rules, state-of-the-world.</td>
<td></td>
<td>Organizational Efforts</td>
</tr>
<tr>
<td>PROCESSES—(how-to-do-it)</td>
<td>Means, methods, procedures, how-to-do-it techniques, &quot;Japanese&quot; management training, manufacturing, organizational development any &quot;doing&quot; activity.</td>
<td>INTERIOR</td>
<td>(Organization)</td>
</tr>
<tr>
<td>PRODUCTS—(in route results)</td>
<td>Forms, systems, services offered, reports compiled, surgery completed, skill acquired, production unit net, sellers trained, disc drive addressed, etc.</td>
<td></td>
<td>Organizational Results</td>
</tr>
<tr>
<td>OUTPUTS—(the aggregated products of an organization which are delivered or deliverable to society)</td>
<td>Delivered automobile, delivered computer system, patients discharged, discharged finance package for municipal airport, etc.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>OUTCOMES—(the effects in and for society indicated by satisfactions, contributions)</td>
<td>Profit, net of welfare, no competitive relationships with others and/or society, having financial credit, contributing to self and society, customer satisfaction</td>
<td>EXTERNAL</td>
<td>(Societal)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Supported Resultal Impact</td>
</tr>
</tbody>
</table>

Note. (From Kaufman, 1983).

2. Most organizational goal-setting has been done "at the top" (usually in vague terms) and the definition downward for internal organizational action has usually been left to the good judgment of the supervisors in the chain of command. The net consequence of this is to have a set of tightly defined activities at each level of the organization with little or no formal linking of these efforts with required results at the same organizational level and with those building up to that which the organization is expected to deliver. We are usually missing an interrelated lattice of results at each organizational level.

In order to improve the effectiveness of any organization, there should be a shared vision by all employees as to where the organization is going, why it is going there, and what each person at each level can contribute to that individual and collective success (see Figure 1). Recent works dealing with "excellent" organizations and so-called "Japanese management" indicate a common characteristic: the existence of a shared vision of organizational purposes and a holistic (or unfragmented) focus for employees and management alike (cf. Drucker, 1973; Pascale & Athos, 1981; Peters & Waterman, 1982; Kaufman, 1982; Kantor, 1983; Peters & Austin, 1985).

Allocation of Function, the Organizational Community, and Organizational Success

Not everyone in the organization is capable of planning relative to Outcomes. Each person has her own assignment and responsibilities. But it is important that everyone's efforts and Products be complementary and symbiotic. Each of the Organizational Elements must fit together, and work interdependently with each other and the organization, not independently of the survival and self-sufficiency of society. A sensible allocation of functions to organizational personnel is practical and desirable if they are interrelated properly. Such a possible allocation follows.

Personnel assigned to Inputs. Some personnel are concerned with Inputs, such as the equipment and stores clerks and supervisors, auditors, accountants, compliance enforcers, and facilities and equipment managers.

Personnel assigned to Processes. Other personnel are "doers" who are responsible for correct and timely delivery of Processes, such as trainers, developers, planners, tellers, engineers, technicians, chemists, strategists, and administrators. Efforts, energies, and resources (Inputs) are used in Processes; anything that goes between Inputs and Products is a Process.

Training, for example, is a Process which is intended to measurable improve the effectiveness and efficiency of personnel. Training is a Means to accomplishing useful Products...results accomplished by people. If training is to be useful and worth the investment, it should allow people to achieve useful results, not just any result.

Personnel assigned to Products. Some personnel are responsible for the immediate effects of the Inputs and Processes upon results—the accomplishment of Products. Instructors and training personnel have to certify the acquisition of specific skills, knowledge, and attitudes (based upon a profound hope or data that the Objectives have been written correctly and are valid). Managers are interested in the Products of group accomplishment, such as setting up a field communication network according to specifications, assuring that customer accounts are credited without error, or delivering a successful advertising campaign. Most supervisors and middle-level managers are concerned with the linkages between Inputs and Process in terms of the Products they deliver.

Personnel assigned to Outputs. Senior managers, especially, are responsible for the overall effectiveness of a group, a division, or a major corporate action. They are concerned not only with the individual and collective fragmented Products, but they are concerned with the orchestration and integration of all of the Products taken together in delivering useful and timely Organizational Results.

Personnel assigned to Outcomes. Executive Senior Managers (and those who want to become one) are concerned with the cumulative effect of all of the Organizational Elements in terms of organizational survival, relevance, and societal contribution. To be concerned with less would mean that the organization could be a solution to nobody's problems. The most senior and successful managers are concerned first with Out-
Integrating All of the Assigned Personnel

In order for any one individual's assignment in the area of one of the Organizational Elements to be successful, that which they accomplish and deliver to the other Elements must be evaluated and found to be useful as well as compliant. Each Element must check, at least, with the Element next to it to assure that it is delivering things which are useful (see Box 1).

By each element level (actually the people responsible for doing it) checking with the one (or better yet, all of the others) adjacent to it, a consistency and coordination of efforts and results will be better assured. The general assignment and concern of organizational personnel to each Organizational Element is shown in Figure 2.

Each level operates to achieve a "fit" with the other levels to ensure total organizational effectiveness and efficiency. The frame of reference suggested here gives specifics on who is accountable for what, and provides a blueprint for the delegation of authority and responsibility. Training and management development for each of the levels should emphasize and clearly delineate the skills and abilities required of each, and state exactly how each level will be integrated and related. Managers at all levels tend to primarily supervise and coordinate that which is done and accomplished by the Technicians/Supervisors, orchestrating that which is delivered at increasingly higher management levels to assure that a correct linking and integration occurs. It is important to note that while an individual's work assignment might be at a given level, there should be a consistent and on-going commitment to that which their organization does, produces, delivers, and the impact of all of this external to the organization—a concern for all of the organizational elements. Following are some cases-in-point from a hypothetical project to implement a new computer-based teller operated accounting system which probably requires training.

Case-in-Point: Technician/Professional Level Contribution

If assigned the development of a self-paced teller training course for a new accounting system which is to be operational within six months, this level accepts the assignment, assuming management has come to the requirement by valid and useful needs assessment and analysis, planning, trade-offs, and allocation of resources and risks. They will be assigned the tasks of determining the trainees' entry skills, knowledge, and attitudes, determine the resources and funds available for such training (dollars, instructors, instructor competencies, location for training, appropriate regulations, etc.), and then will develop individual training courses and training materials using specific instructional design and development techniques (drawing upon such tools as front-end analysis, systematic approach, systems approach, individualization, self-pacing, television, multi-media, etc.) to meet specified objectives (usually supplied or approved by the Middle-Manager). The training course or instructional materials will be designed, developed, tested, and sent to middle-management for approval. This level is most concerned with Inputs and Processes (in order to deliver Products).

Case-in-Point: Middle-Manager Level Contributions

This level is required to assure quality and timeliness of the Products of the Technician/Professional. The Middle-Manager assumes the correctness and utility of her assignment, and is responsible for accomplishing it. If an internal auditing course is required for the new
bank accounting system, then she assures that it is completed according to specifications, and that it delivers the required skills, knowledge, and attitudes for completers of that course. As a supervisor of Technicians/Professionals and their results, there is a concern for and management of Inputs and Processes (e.g., approving the analysis of Input characteristics of trains, sites, methods—means—media trade-offs, etc.) and she will certify compliance with all requirements, rules, and regulations.

This level also develops or assures the performance specifications and objectives for any Product which will be developed and delivered. The responsibility for the objectives and the quality of the Technician/Professional's Products rests with the Middle-Manager.

The focus of attention for the Middle-Manager will usually be at course level, or course cluster level. The Middle-Manager should identify any potential problems in the Products she is to deliver in terms of their utility in the organization and in the field. The Middle-Manager is responsible for Inputs, Processes, and Products.

**Case-in-Point:**
**Senior Manager Contributions**
The Senior Manager has a wider perspective and associated responsibilities than those reporting to her. She must make certain that all completed Products meet their objectives. The Senior Manager must also be concerned that all of the Products "fit" together to achieve useful results for that management unit. For example, when developing the training courses for the new accounting system, she is responsible for all of the Inputs, Processes, and Products required to deliver a useful Output: to ensure that all which is designed, delivered, tested, and released will allow the computer assisted system to operate according to specification, including all human interactions with the hardware.

The Senior-Manager assumes that

The new computer-assisted system is useful, important, and is to be made user-ready. However, it is her responsibility to report to supervision any actual or potential problems in terms of possible inability to meet current and future marketing and user scenarios.

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She understands that all individual Products and Outputs might be in compliance with assigned specifications, but may NOT contribute to the marketing and profit potential required. (In sociological terms, she acts on the knowledge that "the whole is greater than the sum of the parts.") Not only do all of the parts have to work individually, but they must also integrate and coordinate, with everything the organization does, should do, and will do in operational situations.

The Executive Senior-Manager's concern and responsibility is with the TOTAL organization, while other managers are concerned with their assigned responsibilities. Thus, the Executive Senior-Manager is concerned with the "holistic" perspective, while the Senior-Manager and the Middle-Manager are concerned with individual pieces of an organization.

**Linking All Organizational Efforts and Results**
Any useful approach for an organization will define and accomplish interlinking of the five Organizational Elements. To do less may result in a possible inefficient, and worse, ineffective set of deliverables to the rest of the organization. Technician/Professionals and Middle-Managers are generally charged with "reaction" activities, since they assume the validity and utility of the assignments and charges made to them by the Senior-Managers.

Senior-Managers can assure the effectiveness of the organization. Middle-Managers and Technicians can only ensure compliance with assignments, and the efficiency of their assigned work. Executive Senior Managers may determine current and future impact, and affirm or change policy relative to organizational impact outside of the organization boundaries.
Case-in-Point:
Linking all levels
Using the hypothetical new computer-assisted accounting system example, the following are the areas of concern for each level:

Technician: uses resources and applies processes and tools in order to meet assigned specifications for courses.

Middle-Manager: assures compliance with regulations and assures that the assigned products for the course are delivered on time and will meet assigned requirements. Also, that other assigned, related training courses are completed as well, such as a central processor troubleshooting course, keyboard operation and input codes.

Senior-Manager: assures that all courses and technical support actions and products are delivered according to specification and on time, and that all of the elements of the program will allow the computer operators to meet all assigned objectives and will mesh with all other banking operations. The Senior-Manager will coordinate all products to assure that the entire accounting system will work when it is delivered and deployed.

Executive Senior-Manager: ensures that the entire system will work in customer environments, and makes organizational decisions concerning modifications and additions, and mandates and assigns new required thrusts.

Tools for Different Operational Levels
Each operation level, because it has a unique organizational purpose, tends to use tools which are most appropriate for their assigned jobs. Table 2 presents a listing of those tools which will most often be used by personnel operating at each level (using a training example, although the same approach may be used for any intervention). While each of the tools and techniques could be used by members at any operational level, they were assigned in Table 2 on the basis of frequent, usual, and primary concern with actual usage. Who applies these tools, and when do they get used?

The Training Development Cycle and Associated Responsibilities
In the operational reality of an organization, there will be a general training development cycle which will start first with the Executive Senior Manager identifying the organizational goals and direction, and from which any operational decisions, products, and deliverables will flow. Generally (but not always) the flow and responsibilities will be as presented in Table 3.

The foremost concern in the above general cycle is assuring that any intervention (such as training) will contribute to organizational impact. The data concerning where the organization is going, and why it is going there involves conducting a needs assessment. After completing a needs assessment and identifying and placing the gaps in results into priority order, a needs analysis will identify the roots of the needs. Applying needs assessment and needs analysis tools and techniques as presented below may help to get useful training efforts “off to the right start.”

Applying Needs Assessment and Needs Analysis Tools and Techniques
Following are some steps which each level of organizational training activity might follow to conduct a successful assessment and subsequent analysis of needs.

Middle-Manager Level and Technical/Professional Level
This will be a Needs Analysis effort. When assigned by the Middle-Manager, the Technician will:
• Identify current performance levels as measured by tests or comparison of current performance levels with existing performance standards and (but not or) determining perceptions of performance problems from experts or involved parties.
• Identify required levels of performance.
• Determine gaps in levels of performance, ideally by different types of learners.
• Identify skills, knowledge, and attitudes which should be changed.
• Identify skills, knowledge, and attitudes which should be continued.
• Identify the causes for performance discrepancies through analysis of the components of behavior (such as conducting a learning hierarchical analysis of required acquisition and comparing that with the actual, currently induced learning steps and levels).
Table 3
Steps for Training and Development

<table>
<thead>
<tr>
<th>Professionals/Technicians</th>
<th>Middle Managers</th>
<th>Senior Managers</th>
<th>Executive Senior Managers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Determine current organizational policy, goals, and strategies; determine outcome discrepancies</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Select outcomes discrepancies to be closed</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Identify document and select needs</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Assign front-end analyses</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Set measurable objectives</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Determine possible methods-means-media for meeting objectives</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Conduct front-end analysis</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conduct needs analysis</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conduct task analysis</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conduct quasi-needs assessment</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Identify, document, and select quasi-needs</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Determine cause-effect of alternative quasi-needs</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Obtain training requirements</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Assign training packages and programs</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Assign other human performance improvement programs</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Conduct methods-means-media analysis</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Select methods-means-media</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Approve methods-means-media</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evaluate and design methods-means-media</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plan and manage training system development and tests</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Field test methods-means-media</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Determine cost-effectiveness</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Determine cost-effectiveness</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Review as required</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Review completed training package (at course)</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Review program progress and on-course accomplishments</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Require and obtain revisions</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Require final training/human improvement development programs</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Install successful training programs</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Eliminate unrequired training programs</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Determine linkages with other organizational agencies to assure overall impact ability</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Integrate training requirements with overall system selection, design, delivery, and implementation</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Assess external evaluation</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Conduct external evaluation</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Require necessary revisions</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Assess organizational ability to neutralize any external threat</td>
<td>X</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Recommend methods-means-media for closing the gaps and maintaining the currently successful performances.

The Middle-Manager will approve the objectives, and allow the Technician/Professional to move ahead with course development. Data sources which could be used include current training test results, performance data, simulation exercises, specific testing by the Technician relating to current job results, expert opinion, supervisory judgments. (Note: these last two may be very unreliable sources of data and should be cross-related to performance data-based results.)

Senior-Manager Level

This will be a Needs Assessment accomplished at the Product and Output levels. Here the Senior-Manager will (or cause to be accomplished):

- Determine current performance levels of individuals and/or teams in operational situations.
- Determine required performance levels of individuals and/or teams in operational situations. (This is Needs Assessment-related since it deals with gaps in Products and Outputs.)
- Determine gaps in entry and exit levels for supposed enabling training courses and programs which "cause" the performance discrepancies. (This is a Needs Assessment at the Product level.)
- Determine possible ways and means of closing the gaps at the Product and Output levels based upon diagnosed causes. (This is Needs Analysis, for it is focusing on causes or origins of the Needs rather than upon identifying and documenting Needs.)

- Select the ways and means for closing the gaps in Products and Outputs.
- Assign the ways and means development to a Technician/Professional through a Middle-Manager.

Executive Senior-Manager Level

This effort will be a Needs Assessment since the identification of gaps in resources and causes should be accomplished at a lower level. The Executive Senior-Manager will (or cause to be accomplished):

- Identify current and future opportunities and threats to the organization.
- Identify current performance capabilities of the organization in each of the current and future organizational goals and objectives.
- Identify gaps in performance capability by major organization entities (such as divisions, departments, groups, etc.).
- Identify existing competing response and performance capability.
- Identify change requirements and continuation requirements to achieve required results. (These are External Needs Assessment-related issues, and they relate to survival and self-sufficiency—Outcomes—with delivery capability—Outputs—in order to determine Needs.)
- Identify causes for the Needs in terms of those Products which constitute each Output and Outcome. (This is a shift to Needs Analysis since it is seeking causes for Needs, not just identifying the Needs.)
- Identify causes which are changeable within the organization.
- Identify causes which are external to the organization.
- Recommend changes, both Internal and External to the organization and/or to the board of directors.

Needs Assessment and Needs Analysis are linked. Needs Assessment identifies, documents, and justifies the gaps in Outcomes, Outputs, and Products, while Needs Analysis identifies the causes and origins of the gaps in results. Both Needs Assessment and Needs Analysis are best data-based, and should include empirical data whenever possible. In actual practice, needs assessment and needs analysis may collect both performance and perception data and use those to
determine agreed-upon areas of needs. Both needs assessment and needs analysis are critical for linking organization training with effective future organizational results.

Relating Training, Needs Assessment, Needs Analysis and Organizational Impact

Training is one possible intervention which could be used to improve organizational results. Before embarking on the expense of training, management should be quite clear about where the organization is going (and why it is going there), and then relate the internal processes and results the organization produces to that common shared purpose.

Excellent companies usually have workers with a shared vision of purpose, especially about making a contribution to a better world. Implementing any training program without a clear definition of how its results will contribute to the total organization’s efforts and results (Figure 1) risks spending time and resources on improving organizational efficiency without contributing to organizational impact. Needs assessments will identify both internal and external gaps in results. Needs analysis will provide information about the roots of these performance gaps, from which specifications for possible training may be derived. Using the tools described and related in this article, one may link training and organizational impact.

Author Note. This article uses specific definitions presented at length elsewhere (Kaufman, 1983a and b).

References


Allison Rossett, Book Review Editor
Professor of Educational Technology
San Diego State University
San Diego, CA 92182-0311


The explosion of interest in using computers for education and training has been attended by a flood of books on the subject. There are many books about “computer literacy” and programming in BASIC, Logo, and Pascal, but until recently, few books on systematically developing instruction for delivery by computer. Computer-based instruction: Methods and development by Stephen M. Alessi and Stanley R. Trollip, helps alleviate the shortage.

Alessi and Trollip’s book is, on the whole, a good one, with many strengths and a few weaknesses. Since this is a textbook for beginners in CBI development, it presents little new information and few new perspectives. Instead, it concentrates on presenting the basic information that students need to begin to develop CBI. The strengths of the text outweigh the weaknesses enough for this reviewer to use it in a course on “Designing Interactive Courseware.”

The book is organized into three major sections: (1) “Computers and Their Applications”, (2) “Methods of Computer-based Instruction”, and (3) “Development of Computer-based Instruction.” There are 17 chapters in these sections, followed by three appendices.

The first section contains five chapters on the history of computers, hardware and software, current computer applica-

tions, and an overview of computers in education. These chapters are useful if students have had no previous exposure to concepts of “computer literacy” or to the hands-on use of various computer systems and applications. Otherwise, they may be skipped without impairing the students’ ability to benefit from the rest of the book. The exception might be Chapter Five—a quick overview of the history and current status of computers in education. Although it is limited, this chapter provides useful background information for almost anyone.

The second section of Computer-based Instruction focuses on the details of current instructional uses of computers in education. It begins with a useful discussion of the overall process of instruction—Chapter Six—which serves as an advance organizer for Chapters 7-11. These five chapters discuss tutorials, drills, simulations, games, and tests as specific types of CBI. Because of the earlier discussion, each of these categories can be understood in the context of the overall instructional process.

The five chapters on the types of CBI are generally good, giving a great deal of pertinent and up-to-date information along with relevant examples. At the end of each of these chapters there is a valuable summary of the major principles to be followed in developing that type of CBI. These summaries could be pinned over the desk (or terminal) as job aids for almost anyone who designs and develops CBI.

The instructional and programming strategies covered in the strategies are often quite sophisticated. For example, the chapter on drills goes into detail on how to design programs that represent “missed” items at the optimal times for enhancing learning. These strategies are beyond what one might expect in an introductory text, since they are often ignored even by experienced instructional designers. They are presented well in
Computer-based instruction and should prove valuable to all developers.

The third and last section of the book covers the process of developing CBI. It begins with a general 8-step instructional design model for CBI. The next five chapters discuss the model in detail. Overall, the model is reasonable, particularly for a beginner's course. It is not laden with jargon, and the process outlined is straightforward and sensible. Variations on it are possible, but they generally are not worth arguing too long about. The pragmatic approach the authors have taken to the development of computer-based courseware is useful.

They stress the importance of keeping one's eye on the overall goals. The model is especially good on the production phases. However, the discussion of the early design phases is less convincing. In particular, the model does little to ensure that one's instructional goals, rather than the medium of instruction, drive the process.

I do have a few quarrels with the book. First, I find the authors' treatment of learning objectives unsatisfactory. In the chapters on developing lessons they argue that specifying precise objectives inhibits creativity in developing instructional strategies. Therefore, they say, it is not important for students to specify objectives up-front when they are developing lessons. I disagree. Most of my students need the discipline imposed by setting objectives and sticking to them. Without objectives, these students are not noticeably (to me) more creative, but they are wildly unrealistic and unfocused. These traits can quickly be fatal to a CBI project. Also, my students and I have found it impossible to separate the specification of objectives from the creative development of instructional strategies to enable learners to meet those objectives.

The only other discussion of objectives in the book centers entirely around the question of whether learners should be told what the objectives are at the beginning of a lesson. This is really a side issue when you consider that objectives are primarily for the benefit of designers and developers. Any added benefit that can be gained by informing the student of the objectives (in whatever form seems appropriate) is secondary. Since the loose ID model presented in Computer-based instruction did not cover points like these, my class was told to read at least one more systematic and complete ID book, like Gagne and Briggs (1979) or Dick and Carey (1978).

Another quarrel I have concerns the authors' tendency to describe the virtues and shortcomings of various types of CBI more on the basis of popular beliefs than on good research. For example, they maintain that simulation is the best instructional strategy to teach problem solving skills. On its face, this is a plausible claim, one that is made incessantly in the popular computing literature. However, there is still very little evidence to support it (e.g., Reiser & Gerlach, 1977). By making claims like this, the book tends to lead students into believing that they have to use certain strategies when other less expensive or less time-consuming strategies (e.g., those of Landa, 1976) for teaching problem solving skills might also be relevant. The book also tends to oversell the instructional value of certain instructional strategies, leading to unrealistic expectations.

Finally, although the historical discussion early in the book is valuable, it is also quite incomplete. Can a student really understand the roots of CBI without looking at the programmed instruction movement and other noncomputer sources for CBI ideas? Many of the lessons learned in earlier movements are undoubtedly relevant as we explore the possibilities of computer-based instruction. Yet, by ignoring these issues, the book contributes to the general perception that anything from before the age of the microcomputer is irrelevant.

On the whole, however, in spite of these areas of disagreement, this has proven to be a useful textbook for getting budding developers started on the difficult road to developing effective CBI. Since it has few competitors, it should be considered seriously by anyone teaching a class on CBI. Such teachers should also explore the possibility of supplementing the text with some more systematic points of view as well. —Reviewed by Albert L. Ingram, Instructional Designer, Scientific Systems, Inc., Cambridge, MA 02140.

References
Landa, L. N. (1976). Instructional regulation and control: Cybernetics, algorithmization, and


This book is well organized. Its 46 chapters, excluding the Introduction and Summary, are divided into seven sections that indicate its diverse content: Strategies, Tactics, Logistics, Diffusion, Applications, Personnel, and Futures. The topic of the Introduction is instructional development as art and science. The Summary describes the status of instructional development as a profession.

Having not read the first volume, Instructional development: The State of the Art, 1978, this review does not treat this book as the complementary volume it is intended to be, but as a stand-alone volume. Like instructional materials, books are not always used the way they were intended.

Several initial reactions to this book are related to its design and publication quality. Since this is a complementary volume, a list of topics and authors from the first volume would lend some continuity without having to refer back to the first volume (which I couldn't do anyway since I don't have it). I would have liked better publication quality: larger type, even inking across the page without letter dropout, and fewer typographical errors. Undoubtedly, there are reasons why things are as they are, but whatever the reasons, they don't make it easier to read.

Like most edited books, it is suitable to read this book by skipping around, reading the chapters that you have a reason to read. Though its organization is logical, its ideas don't build on each other in a dependent way, so you don't have to read one chapter before you read any other chapter. Since it is so expansive and covers such a wide range of topics, you may never get around to reading certain chapters.

There seem to be two kinds of chapters: old ideas updated with current research, and new or not-so-well-known ideas. There are points made by some authors that could stimulate a good discussion or argument. For the most part, the chapters are credible and well-
written, some being more captivating than others. I suspect that this depends more on an author’s writing style than on a reader’s initial interest in a topic. The majority of my favorite chapters were in the “Tactics” section; those topics interest me most, and they were well written. The majority of my least favorite chapters were in the “Strategies” section. Your favorites and least favorites may be in other sections. The chapter with which I was most impressed and the one with which I was least impressed were also in the “Strategies” section. The most outstanding chapter is Roberts Braden’s “A Place in Space: ID’s Universe” because of its many elements of excellent writing style, including the visible building of ideas to effectively make a point. I suspect this is a meld of art and science.

There are assertions in the beginning and in chapters toward the end of this book that question whether ID is a profession. Though I find the idea that ID is not a profession somewhat incredible (perhaps I define profession loosely), it’s one of those ideas that can spark a discussion. It’s incongruent that in the same chapters in which ID as profession is questioned, ID is called a profession, perhaps it’s just for the lack of a better word, or perhaps it shows some diversity of thinking on the issue. Since some chapters question ID as a profession, and other chapters speak of ID as a profession, I wonder if I should take seriously the claim that ID is not a profession. Perhaps we could gain some insight from social work, a field of practice that has also questioned whether it is a profession (and, it even has certification and licensing). I liked the description of ID in the introduction, where ID is described as a profession which:

- is not a true science,
- deals with a specific area of human behavior,
- obtains most of its content from other sciences,
- is aimed at practical achievement,
- values knowledge inasmuch as it is useful, and
- is successful through planning, adherence to plans in implementation, and insight and creativity of implementors.

It would be helpful for the editors to discuss the value of questioning whether instructional development is a profession.

So, what is the state of the art in ID? The Summary section describes the status of our knowledge, activities, and beliefs. ID is:
- working to describe itself;
- analyzing training for IDs;
- legitimizing services provided by IDs;
- moving toward a universal orientation encompassing public school, military, business and industry, and the international scene in addition to higher education;
- examining evaluation of products/processes, though many continue to slight the role of evaluation in ID;
- delineating its scientific basis;
- evaluating its designs and techniques;
- improving interaction with ID clients;
- dealing somewhat with the cost-effectiveness of ID;
- lacking a unified underlying literature;
- gaining the interest of other training organizations, e.g., NSPI and ASTD;
- increasing services for military contracts;
- looking closer at individual differences;
- a field that (a) wants to become a profession; (b) needs investigation; (c) rejects much, e.g., behavior modification techniques, programmed instruction, microfiche as a teaching medium; (d) widely embraces some innovations, e.g., television, computers, behavioral objectives; (e) will meaningfully use brain research; (f) will better understand the textbook as a tool, and (g) is art with its basis in science.

Often when people use the term state of the art, they are referring to the latest advancement, the hottest innovation, rather than the complete status of things. Thus, when instructional developers talk about state of the art, they are usually talking about the latest instructional computer systems and the latest computer-aided design tools. In this book, the authors are talking about the current status of the instructional development process, theory, human relations, and applications—everything but computers. With the application of computer technology to the development and delivery of instruction has come the criticism that the technology of the hardware/software has advanced separately from the research on learning and the technology of instructional development. By such criticisms we accuse ourselves of being on the fringes of innovation, in an edge of the art position, not taking full advantage of technological developments. Isn’t the bringing together of ID process, theory, etc. with media part of the state of the art? Without bringing the two together aren’t we maintaining an edge of the art position?

The editors have compiled an extensive document. Its size and diverse contents tell us that instructional development is a broad field where a great deal of professional activity is occurring. If the contents of this book reflect the status of instructional development, it is a profession that is conscious of itself and conscientious about its processes and products. What is left out of this book may tell you something as well—that we are a technology not bound to educational media, and that we are edge of the art when it comes to integrating our art and science with computer technology. We will look forward to the next volume. —Reviewed by Jodi Bonner, Training Systems Consultant, Planning Research Corporation, 1500 Planning Research Drive, McLean, VA 22102.