In Search of a Better Way to Organize Instruction: The Elaboration Theory

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The *elaboration theory of instruction* is an alternative to the standard way of organizing instruction based on a hierarchical task analysis. The hierarchical organization results in an instructional sequence that begins with highly fragmented, small pieces of the subject-matter content. Many educators have found its fragmentation to be demotivating. Many educational psychologists have found its parts-to-whole sequence to be inconsistent with much knowledge about how learning occurs most effectively—namely schema theory and its predecessor, subsumption theory. And many instructional designers have found that "learning hierarchies" represent a very incomplete basis upon which to make decisions about sequencing the instruction, primarily because learning hierarchies are only one aspect of the structure of subject-matter content. All this is not to deny that learning prerequisites exist nor to say that they are not important—they do exist and they are important. Rather this affirms that learning prerequisites are not a sufficient basis for organizing a whole course: our knowledge must progress beyond the hierarchy. It is for these reasons that the elaboration theory is being developed.

Author Note

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Context

Before describing the elaboration theory, I would like to place it within the context of instructional design in general. Instructional design theory can be thought of as being concerned with four major aspects of instruction (see Figure 1): (1) ways of organizing instruction, which include such concerns as sequencing and formatting the subject-matter content, (2) ways of delivering instruction, which is usually a matter of media selection, (3) ways of motivating students, which may be intrinsic or extrinsic, and (4) ways of managing the student's use of the other three aspects of instruction (Reigeluth & Merrill, 1979).

As Figure 1 indicates, it is helpful to think of ways for organizing instruction as being of two types, based on their scope. Micro strategies are ways of organizing instruction on a single topic, such as on a single concept or on a single principle. They include such strategy components as generalities (or definitions), instances (or examples), and practice. Macro strategies are ways of organizing those aspects of instruction which relate to more than one topic, such as sequencing the topics, showing interrelationships among the topics, and previewing or reviewing the topics. Task analysis is done primarily, if not exclusively, to develop this last type of strategy—specifically sequencing strategy.

The elaboration theory of instruction is a partial theory of instruction—it does not deal with all aspects of instruction. As is shown in Figure 1, it deals primarily with macro strategies for organizing instruction; but it also includes many motivational strategies, and the other aspects of instruction will be integrated with elaboration theory in the forseeable future. Merrill has done excellent work on micro strategies for organizing instruction (Merrill, Reigeluth, & Faust, 1979; Merrill, Richards, Schmidt, & Wood, 1977), and Keller (1979) and Dodge (1979) are making some excellent progress in the development of a motivational theory of instructional design.

The Elaboration Theory

The elaboration theory of instruction states that if cognitive instruction is organized in a certain specified way, then that instruction will result in higher levels of learning, synthesis, retention, and affect. There is a limitation to this theory: the smaller the amount of interrelated subject-matter content, the less difference it will make. With a small enough number of topics, it doesn't make any difference how you sequence them, whether you show interrelationships among them, or whether you preview and review the topics (as long as there are no learning prerequisite relationships among them). The following is a description of that "certain specified way" of organizing instruction, which is called the elaboration model of instruction.

The Elaboration Model

A good introduction to the nature of the elaboration model of instruction is an analogy with a zoom lens. Taking a look at a subject matter "through" the elaboration model is similar in many respects to looking at a picture through a zoom lens on a movie camera.

A person starts with a wide-angle view, which allows one to see the major parts of the picture and the major relationships among those parts (e.g., the composition or balance of the picture), but without any detail.

The person then zooms in on a part of the picture. Assume that, instead of

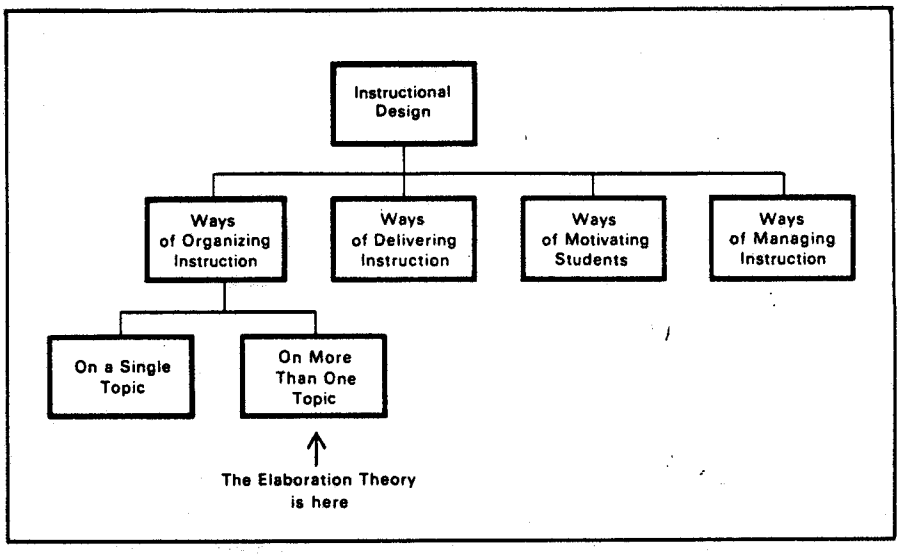

Figure 1. The context of the elaboration theory in relation to other aspects of instructional design theory.

being continuous, the zoom operates in steps or discrete levels. Zooming in one level on a given part of the picture allows the person to see the major subparts. After having studied those subparts and their interrelationships, the person could then zoom back out to the wide-angle view to review the other parts of the whole picture and to review the context of this part within the whole picture.

The person continues this pattern of zooming in one level to see the major subparts of a part and zooming back out for context and review, until the whole picture has been seen at the first level of detail. Then the person can follow the same zoom-in/zoom-out pattern for the second level of detail, the third level, and so on, until the desired level of detail is reached.

In a similar way the elaboration model of instruction starts the student with an overview of the major parts of the subject matter, it elaborates on one of those parts to a certain level of detail (called the first level of elaboration), it reviews the overview and shows the context of that part within the overview (an expanded overview), it continues this pattern of elaboration/expanded overview for each part of the overview until all parts have been elaborated one level, and it follows the same pattern for further levels of elaboration. Of course, it must be remembered that the zoom-lens analogy is just an analogy and therefore that it has nonanalogous aspects. One such dissimilarity is that all the detail of the picture is actually present (although usually not noticed) in the wide-angle view, whereas the detail is not there at all in the overview of the subject matter.

Now, some people ask, "don't you have to go through a lot of learning prerequisites to teach the overview?" The answer is a definite "no." In fact few unmastered learning prerequisites (if any) exist at the level of the overview. As a learner works to deeper levels of detail, increasingly complex prerequisites will need to be introduced. But if they are introduced only at the level of detail at which they are necessary, there will be only a few prerequisites at each level; and the learner will want to learn those prerequisites because he or she will see their importance for learning at the level of detail that now interests him or her.

The general-to-detailed organization prescribed by the elaboration model helps to ensure that the learner is always aware of the context and importance of the different topics that are being taught. It allows the learner to learn at the level of detail that is most appropriate and meaningful to him or her at any given state in the development of one's knowledge. And the learner never has to struggle through a series of learning prerequisites that are on too deep a level of detail to be interesting or meaningful at the initial stages of instruction.

Unfortunately, the zoom-lens approach has not been used much in instruction, in spite of its fundamental simplicity and intuitive rationale. Many textbooks begin with the "lens" zoomed in to the level of detail deemed appropriate for the intended student population, and they proceed—with the "lens" locked on that level of detail—to pan across the entire subject matter. This has had unfortunate consequences for synthesis, retention, and motivation. Many instructional developers begin with the lens zoomed all the way in and proceed in a highly fragmented manner to pan across a small part and zoom out a bit on that part, pan across another small part and zoom out a bit on it, and so on until the whole scene has been covered and to some limited degree integrated. This has also had unfortunate consequences for synthesis, retention, and motivation. And some educators have intuitively groped for an elaboration-type approach with no guidelines on how to do it. This has resulted in a good deal less effectiveness than is possible for maximizing synthesis, retention, and motivation.

The major reason for the lack of utilization of the zoom-lens approach in instruction is probably that the hierarchical approach was well-articulated and was a natural outgrowth of a strong behavioral orientation in educational psychology. This in effect put "blinders" on most of the few people who were working on instructional design strategies and methodology.

To summarize, the elaboration model of instruction starts by presenting knowledge at a very general or simplified level—in the form of a special kind of overview. Then it proceeds to add detail or complexity in "layers" across the entire breadth of the content of the course (or curriculum), one layer at a time, until the desired level of detail or complexity is reached. It is important to emphasize, though, that the elaboration model prescribes a special kind of overview, and it prescribes a special way in which the elaboration is to occur. The following is as close as we can come (without sacrificing clarity) to a nontechnical introduction to these special aspects of the elaboration model.

The Epitome

We do not like to use the word "overview" because its meaning is very vague—it means different things to different people. Also, we believe that a certain specific kind of overview is superior to other kinds. Among other

things, our overview must epitomize the subject matter that is to be taught, rather than summarizing it. Hence, we have named it the *epitome*. An epitome has two "critical characteristics" that distinguish it from other types of overviews: (1) it epitomizes the subject matter of the course (or curriculum) rather than summarizing it, and (2) it has a single "orientation"—which means that it emphasizes a single type of content.

With respect to epitomizing the subject matter of the course (or curriculum), an epitome is formed by "boiling down" the course content to its essence. It does not preview all of the course content; rather it presents a few fundamental topics that convey the essence of the entire content. Those topics are chosen or derived in such a way that all the remaining course content provides more detail or more complex knowledge about the epitome. Although an epitome is very general, it is not purely abstract. Since "general" and "abstract" are often confused, this distinction will be discussed in greater detail shortly.

With respect to having an orientation, the epitome emphasizes any one of three types of content: concepts, procedures, or principles. A concept is a set of objects, events, or ideas that have certain characteristics in common. Knowing a concept entails being able to identify, recognize, classify, or describe what something is. A procedure is a set of actions that are intended to achieve an end. It is often referred to as a skill, a technique, or a method. Knowing a procedure entails knowing how to do something. A principle is a change relationship—it indicates the relationship between a change in one thing and a change in something else. It describes causes or effects by identifying what will happen as a result of a given change (the effect) or why something happens (the cause). These three different emphases are referred to respectively as a conceptual orientation, a procedural orientation, and a theoretical orientation; and the orientation is selected on the basis of the general goals or purpose of the course (or curriculum). All three types of content may appear in the epitome, but one type receives primary emphasis; and the epitome is formed by epitomizing the orientation type of content, and then introducing whatever of the other two types of content are highly relevant. More will be said about this below.

I mentioned above that an epitome is very general but is not purely abstract. The terms "general" and "abstract" are often confused. It is helpful to think of three continua: (1) general to detailed, (2) simple to complex, and (3) abstract to concrete. These three continua are illustrated in Figure 2. The first two are very similar to each other, but the third is very different.

The general-to-detailed continuum refers primarily to a continuum formed by subdividing things (concepts or procedures) or by lumping things (concepts or subprocedures) together. "General" has breadth (things lumped together), while "detailed" is usually narrow (subdivisions). In Figure 2(a) "polar bear" is a more detailed concept than "animal." The simple-to-complex continuum refers primarily to a continuum formed by adding or removing things (principles or procedures). "Simple" has few things, while "complex" has many things. In Figure 2(b), the procedure for subtracting multidigit numbers is more complex than the procedure for subtracting single-digit numbers. Additional complexity can be added by introducing subprocedures for "borrowing" when the top number is smaller than the bottom number. The abstract-to-concrete continuum refers to tangi-

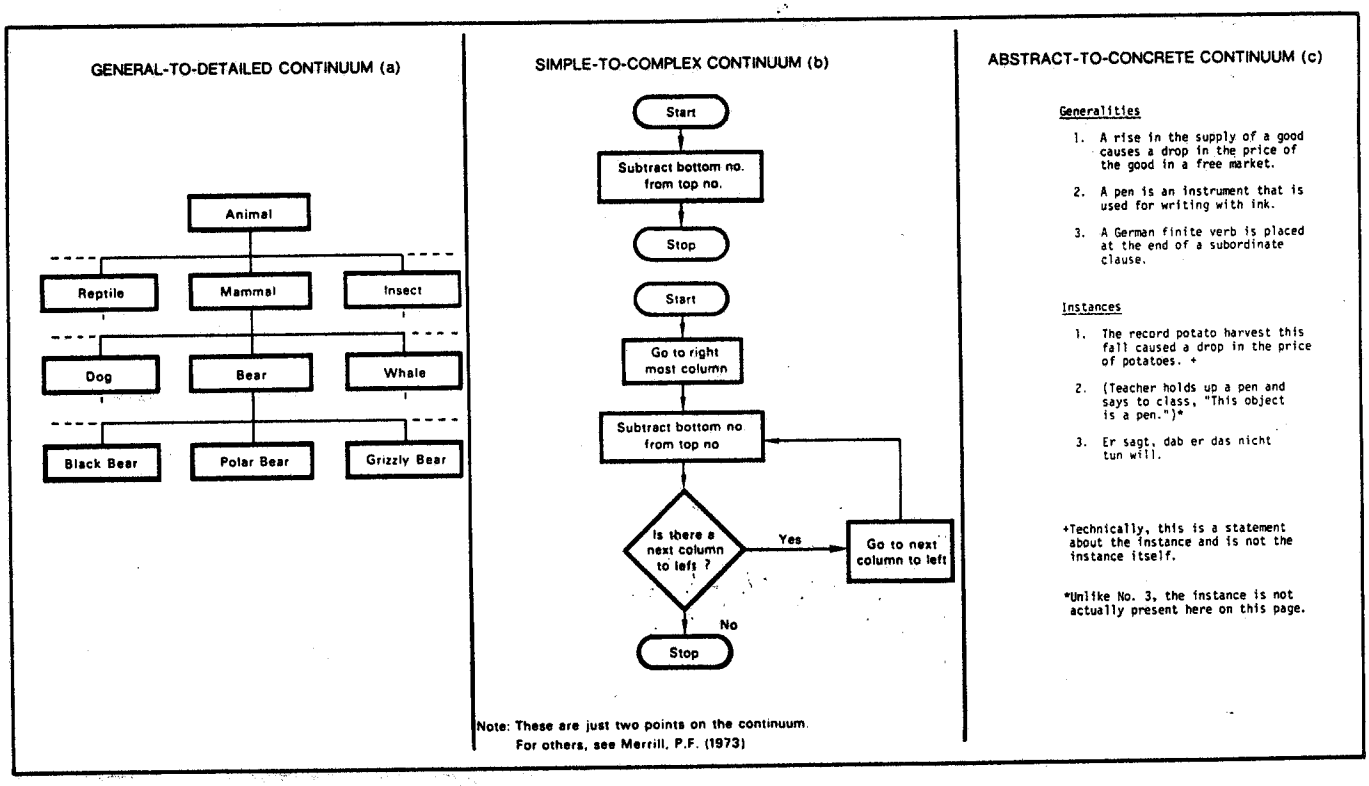

Figure 2. Illustrations of three continua that are often confused.

bility, and there are two major types of tangibility. First, generalities are abstract, and instances are usually concrete—the definition of a tree is abstract, while a specific tree (an object) is concrete. This is the most important abstract-to-concrete continuum for instructional theory. Second, some concepts are considered abstract because their instances are not tangible. "Intelligence" is a good example of an abstract concept. This second abstract-to-concrete continuum is largely irrelevant for our purposes.

On the basis of these distinctions, an epitome is always either very general or very simple—it must be, to epitomize the instructional content. But it should never be purely abstract. According to Merrill's Component Display Theory (Merrill, Reigeluth, & Faust, 1979) it should contain the following for each topic it presents: a generality (e.g., the definition of a concept), some instances of that generality (e.g., examples of the concept), and some practice for the student in applying the generality to new instances. As a rough guide, an epitome usually contains about six (plus or minus three) topics—that is, about six different generalities, along with some instances and practice items for each. These topics may be any combination of concepts, procedures, and/or principles. Figures 3 and 4 illustrate the nature of each of the three kinds of epitomes: conceptual, theoretical, and procedural.

A Level-1 Elaboration

A level-1 elaboration is a part of the instruction that provides some more detailed or complex knowledge on an aspect of the epitome. It should not include all of the more detailed or complex knowledge on that aspect. Rather, a level-1 elaboration should itself be an epitome of all of the more detailed or complex knowledge on that aspect, just as zooming in one level provides a slightly more detailed wide-angle view of one part of the whole picture. There is usually a level-1 elaboration for each aspect of the epitome, but an aspect is not the same thing as a topic. It is possible that a level-1 elaboration may elaborate to some extent on all of the topics in the epitome or perhaps even on a relationship among those topics.

The depth to which a level-1 elabora-

Theoretical Epitome

1. The law (principle) of supply and demand.
   a. The principle of what causes changes to occur in the quantity demanded and the quantity supplied (price changes).
   b. The principle of why prices change in a free market economy.
2. The principle of why changes occur in supply schedules or demand schedules.
3. The concepts of supply, supply schedule, and supply curve.
4. The concepts of demand, demand schedule, and demand curve.
5. The concept of changes in quantity supplied or demanded.
6. The concept of changes in supply schedules or demand schedules.
7. The concept of equilibrium price.

Practically all principles of economics can be viewed as elaborations on the law of supply and demand, including those that relate to monopoly, regulation, price fixing, and planned economies.

Conceptual Epitome

1. Definition of economics
2. Definitions of subdivisions of economics:
   a. Definition of macro economics
   b. Definition of micro economics
   c. Definition of comparative economics
   d. Definition of international economics
   e. Definition of labor economics
   f. Definition of managerial economics.

Practically all concepts in economics can be viewed as elaborations on these concepts (i.e., as further subdivisions—either parts or kinds—of these concepts).

Figure 3. The instructional contents for a theoretical epitome and for a conceptual epitome for an introductory course in economics.

1. There are four major stages in the multidimensional analysis and interpretation of creative literature:
   a. Identifying elements of the dramatic framework—character and plot.
   b. Combining the elements into composites appropriate for analysis of their literal meaning—analysis of character in terms of plot.
   c. Figuratively interpreting the elements—symbolism through character, mood, tone.
   d. Making a judgment of worth—personal relevance, universality.

(This procedure is simplified by introducing only *two* elements for the analyses in a and b, *three* in c, and *two* in d. It is further simplified by introducing only those procedures and concepts necessary for the analysis and interpretation of a *short poem*. Complexity is added later by increasing the number of elements used in each stage of analysis or interpretation and by introducing procedures and concepts needed for analyzing and interpreting more complicated types of creative literature.)

2. Concepts necessary for performing the procedure in 1.
   a. Character
   b. Plot
   c. Symbolism
   d. Mood
   e. Tone
   f. Universality

Figure 4. The instructional content for a procedural epitome for an introductory course in literature. (I appreciate the help of Faith Stein in the preparation of this figure.)

tion should elaborate on an aspect of the epitome is somewhat variable (i.e., the discrete levels on the zoom lens are variable, not always constant and equal in the amount of detail added). The most important factor for deciding on the depth of a given level-1 elaboration is student learning load. It is important that the student learning load be neither too large nor too small, for either will impede the instruction's efficiency, effectiveness (especially for retention), and appeal. The number of topics that represent the optimal student learning load will vary with such factors as student ability, the complexity of the subject-matter topics, and student prefamiliarity with the topics. The breadth of a level-1 elaboration will usually be fairly difficult to adjust. Hence optimizing the student learning load in a given elaboration can often be done mainly by varying the depth of that elaboration.

Figure 5 illustrates the nature of a level-1 elaboration on the theoretical epitome in Figure 3, and Figure 6 illustrates the nature of a level-1 elaboration on the procedural epitome in Figure 4.

1. Principle of increasing marginal costs as an explanation for the shape of the supply curve.
2. Principle of profit maximization for individual firms.
3. Procedure of marginal analysis to arrive at profit maximization.
4. Concepts of fixed and variable costs.
5. Concepts of total, average, and marginal costs.
6. Concepts of break-even point and shut-down point.

Figure 5. The instructional content for a level-1 elaboration on the theoretical epitome in Figure 3. This level-1 elaboration elaborates on the supply aspect of the law of supply and demand by presenting more complex principles that relate to supply.

1. How to identify other elements of the dramatic framework—setting, perspective, and language.
2. How to 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. Concepts of setting, perspective, and language.
4. Concepts of types and patterns of imagery (in language).
5. Procedure for analyzing imagery.
6. Concept of prosody.
7. Procedure for analyzing prosody.

Figure 6. The instructional content for a level-1 elaboration on the procedural epitome in Figure 4. This level-1 elaboration elaborates just on stages a and b—which must be elaborated at the same time because of their interrelatedness. It elaborates on these two stages by adding elements that need to be identified (in stage a of Figure 4) and analyzed in combination (in stage b of Figure 4). (I appreciate the help of Faith Stein in the preparation of this figure.)

Other Elaborations

A level-2 elaboration is identical to a level-1 elaboration except that it elaborates on an aspect of a level-1 elaboration rather than on an aspect of the epitome. In a similar manner, a level-3 elaboration provides more detail or complexity on an aspect of a level-2 elaboration, and so on for elaborations at deeper levels of detail/complexity. In all cases, an elaboration at one level of detail/complexity should be an epitome for all the lower level elaborations that elaborate on it.

According to this kind of organization, elaborations that are on the same level are very different from each other with respect to the instructional content they contain (i.e., their topics are very different from each other); but elaborations that are on different levels are very similar to each other with respect to their instructional content (i.e., their topics are very similar), because each level has the same content as the previous levels, only at a level of greater detail/complexity. This provides an important systematic review mechanism—more will be said about this shortly.

Expanded Epitome

After each elaboration, the instruction presents a summarizer and an expanded epitome, equivalent to the zoom-out-for-context-and-review activity in the zoom-lens analogy. The summarizer is comprised of a concise generality for each topic presented in the elaboration. The expanded epitome does two things. (1) it synthesizes the topics presented within the elaboration (internal synthesis) and (2) it shows the relationship of those topics (and relationships) to the rest of the topics (and relationships) that have been taught (external synthesis).

Summary of the Elaboration Model

In summary, the elaboration model is as follows (see Figure 7). First, the epitome is presented to the student. Then a level-1 elaboration is presented to provide more detail on an aspect of the orientation content in the epitome (that aspect which is most important or contributes most to an understanding of the whole orientation structure). Next a summarizer and an expanded epitome are presented. Another level-1 elaboration and its summarizer and expanded epitome are presented. This pattern of level-1 elaboration followed by its summarizer and expanded epitome continues until all aspects of the orientation content that were presented in the epitome have been elaborated one level. Then a level-2 elaboration is presented to provide more detail on an aspect of the orientation content that was presented in one of the level-1 elaborations. As always, this elaboration is followed by a summarizer and an expanded epitome. This pattern continues until all of the aspects of the orientation content presented in all of the level-1 elaborations have been elaborated one

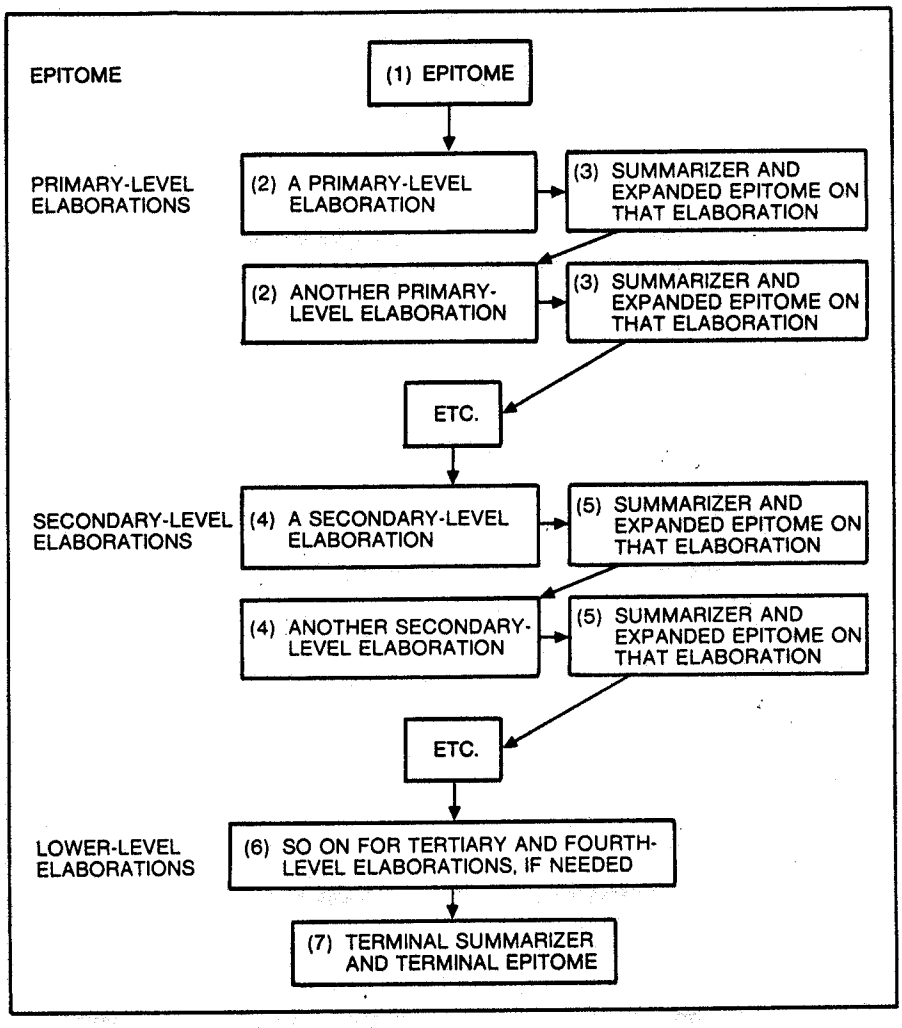

Figure 7. A diagramatic representation of the elaboration model of instruction.

level (unless the objectives of the course or the nature of the subject matter exempt a level-1 elaboration from being further elaborated). Additional levels of elaboration are provided in the same manner—an elaboration followed by a summarizer and an expanded epitome—until the level of detail/complexity specified by the objectives is attained in all aspects of the orientation content of the course.

It should be noted that there are three ways in which systematic review takes place. First, each level of elaboration covers content similar to that in the previous level (only with some additional detail and related topics). Learning this more detailed version of the same content stimulates or incorporates review of that earlier part of the course content. Second, the summarizer at the end of each elaboration reviews the content that was just presented in that elaboration. It does this by providing a concise generality for each topic. And third, the expanded epitome at the end of each elaboration constantly reviews the major content that was presented in earlier elaborations.

Using the Elaboration Model

We have developed a fairly detailed set of procedures for designing instruction according to the elaboration model (Reigeluth, Merrill, Wilson & Spiller, 1978). A major part of those procedures is analyzing the instructional content as to four different types of subject-matter structures. A subject-matter structure is something which shows a single kind of relationship that exists within a subject matter. Figure 2(a) shows part of a subject-matter structure. The four different types of subject-matter structures are: conceptual, procedural, theoretical, and learning structures. (Learning structures show learning prerequisite relations within the subject matter.) It is beyond the scope of this paper to describe and illustrate each of these four types of structures. The interested reader is referred to Reigeluth, Merrill, & Bunderson, 1978.

There are six major steps for designing instruction according to the elaboration model (see Figure 8). First, one must select an orientation—either conceptual, procedural, or theoretical—on the basis of the goals or purpose of the instruction. Second, one must develop an orientation structure for that orientation. It depicts the orientation content (either concepts, procedures, or principles) in the most detailed/complex version that the student needs to learn. This is a form of content analysis or task description. Then the orientation structure is analyzed in a systematic manner to determine which aspect(s) of the orientation content will be presented in the epitome and which aspects will be presented in each level of elaboration. In this way the "skeleton" of the instruction is developed on the basis of epitomizing and elaborating on a single type of content.

The fourth major step is to embellish the "skeleton" by adding the other two types of content at the lowest appropriate levels of detail. This is usually done by "nesting" the remaining subject-matter structures within different parts of the skeleton. Learning prerequisites are one of the considerations that enter in at this point.

Having allocated all of the instructional content to the different levels of elaboration, it is now important to establish the scope and depth of each individual elaboration that will comprise each level. The scope is usually predetermined by the orientation topic and its necessary supporting topics. The depth is then determined on the basis of achieving an optimal student learning load, as described above.

Sixth and finally, some of the internal structure of each elaboration within each level can be planned. The sequence of topics within an elaboration is decided on the basis of contribution to an understanding of the whole orientation structure (but of course within the constraints of learning prerequisites),

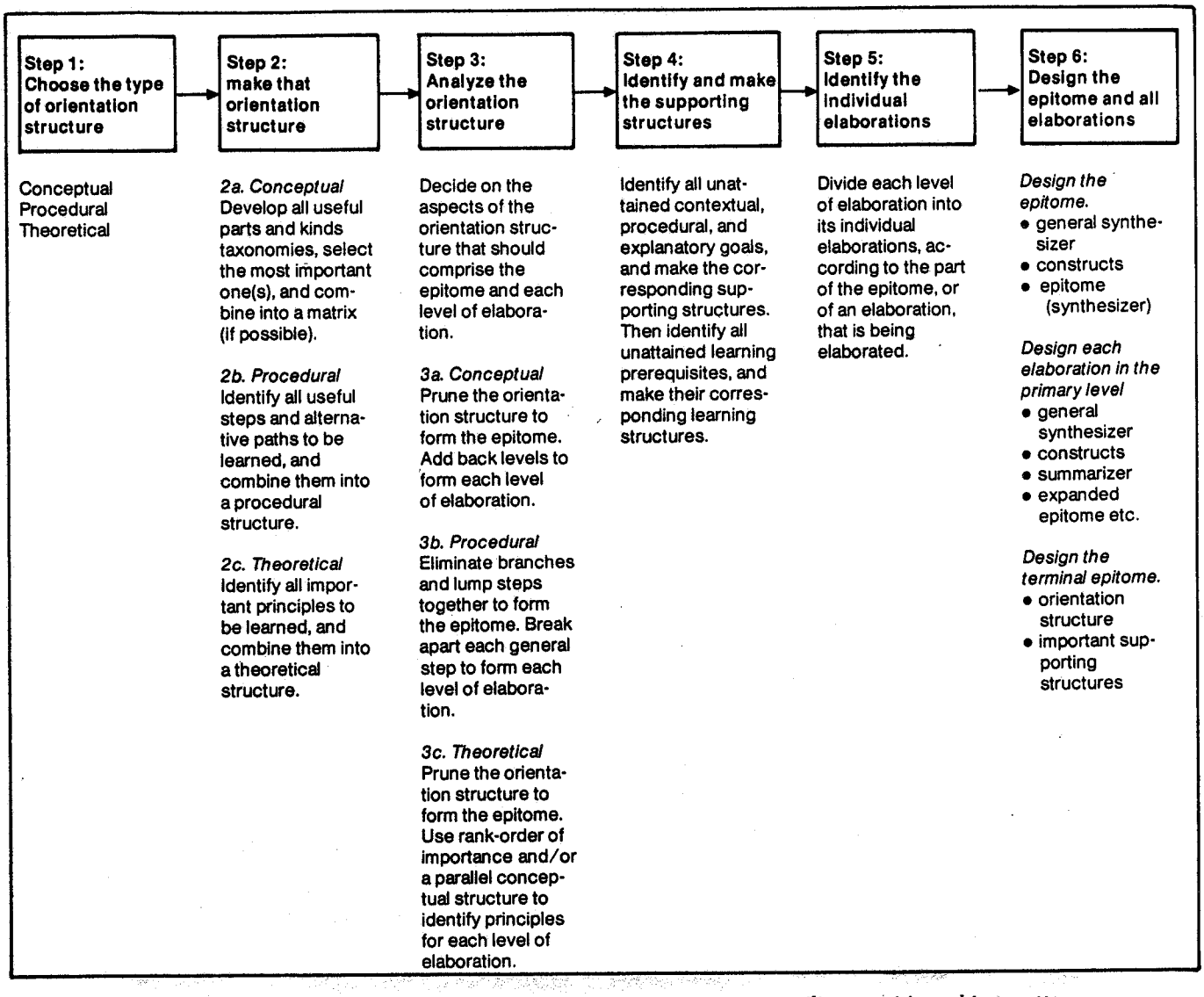

Figure 8. The six-step design procedure for structuring the instruction in any course entailing cognitive subject matter.

and the locations of synthesizers and summarizers are also determined.

This concludes the "macro" design process, at which point the "micro" design process begins—decisions as to how to organize the instruction on a single topic. We have spelled out these procedures for designing instruction in much greater detail elsewhere (Reigeluth, Merrill, Wilson, & Spiller, 1978).

The Need for Research

The model and procedures as described above have undergone very limited field-testing and virtually no research. It may turn out that having a complete expanded epitome after every single elaboration is inefficient and unnecessary (especially after lower-level elaborations). It may also turn out that it is unnecessary for a student to study all level-1 elaborations before proceeding to a level-2 elaboration. This would have important implications for learner-controlled selection and sequencing of topics—a student could now truly follow his or her interests in approaching a subject matter. This would be particularly valuable in adult and continuing education contexts.

It is also likely that a large, full-scale field test of the design procedures will reveal more effective and efficient ways to design instruction according to the model.

The elaboration model as developed to date is a tentative move in a much-needed direction. It does not yet have the maturity and validation of the currently used approaches to instructional design, but the need for alternatives should be clear. And there is great potential for the elaboration model to meet that need.

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The Instructional Quality Profile: A Curriculum Evaluation and Design Tool[1]

M. DAVID MERRILL, CHARLES M. REIGELUTH, and GERALD W. FAUST

The Instructional Quality Profile provides a set of detailed procedures for analyzing the quality of instruction in relation to different kinds of objectives and test items. *Instructional quality* refers to the degree to which instruction is effective, efficient, and appealing—that is, the degree to which it works in cost-effectively promoting student performance on a posttest and student affect toward learning. Educators have developed detailed procedures for making reliable tests and for writing well-stated objectives. However, very little attention has been devoted to detailed procedures for analyzing instruction. The Instructional Quality Profile is an analytic tool for diagnosing specific weaknesses and correcting those weaknesses in existing instruction and for providing prescriptions for avoiding such weaknesses in the design of new instruction.

[1] Previous publications on the Instructional Quality Profile referred to it as the Instructional Strategy Diagnostic Profile (Merrill, Richards, Schmidt, & Wood, 1977) and the Instructional Quality Inventory (Ellis & Wulfeck, 1978). The authors gratefully acknowledge support from the following institutions (in alphabetical order) for the development of the ideas presented herein: Brigham Young University, The Church of Jesus Christ of the Latter Day Saints (Education System), Courseware Incorporated, and the Navy Personnel Research and Development Center (San Diego) and Advanced Research Project Agency. The ideas expressed herein are those of the authors and should not be interpreted as necessarily representing the official policies, either expressed or implied, of any of the funding institutions.

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WHERE DOES IT FIT?

Clearly, there are many different aspects of instruction that influence its quality. We believe it is helpful to classify those aspects as to three kinds: (*a*) ways for *organizing* the instruction, such as the choice of words, diagrams, format, and student responses; (*b*) ways for *delivering* the instruction to the student and for receiving responses from the student, such as textbooks, class lectures, homework assignments, television, and discussion groups; and (*c*) ways for *managing* the interaction between the student and the instruction, such as scheduling, motivation, record keeping, and strategy selection. (See Reigeluth and Merrill [1978a] for a more detailed description of these three aspects of the quality of instruction.)

Within this scheme, the Instructional Quality Profile analyzes only Class 1: ways for organizing the instruction. But it is also helpful to divide this class into two categories: (*a*) ways for organizing the instruction on a **single** concept, principle, or procedure, such as the use of examples, and mnemonics; and (*b*) ways for organizing aspects of instruction that relate to **more than one** concept, principle, or procedure, such as the use of overviews, advance organizers, and various kinds of sequencing (Reigeluth & Merrill, 1978b). The profile analyzes only Category 1: ways for organizing the instruction on a **single** concept, principle, or procedure (see Figure 6.2). However, work is currently in progress to expand the scope of the profile to the second category (Reigeluth, Merrill, & Bunderson, 1978; Reigeluth, Merrill, Wilson, & Spiller, in press) and the profile will eventually be expanded to include the other two classes: the aspects of the quality of instruction that relate to delivery and management.

WHAT DOES IT DO?

The Instructional Quality Profile is a tool for analyzing the quality of instruction in the six areas shown in Figure 6.1: (*a*) purpose-objective

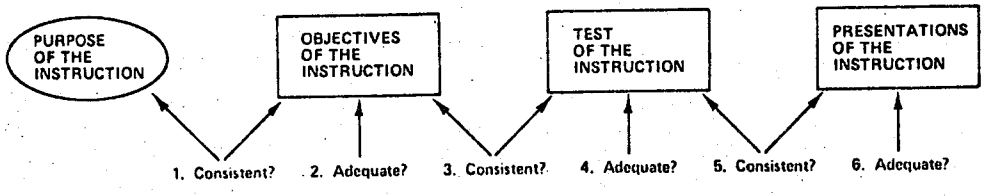

Figure 6.1 The context of the Instructional Quality Profile with respect to the major aspects of instructional quality.

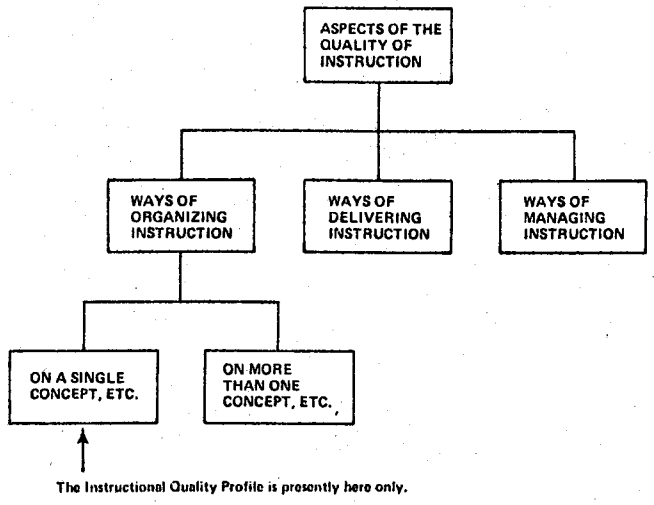

Figure 6.2 The six areas of instructional quality analyzed by the Instructional Quality Profile.

consistency; (*b*) objective adequacy; (*c*) objective–test consistency; (*d*) test adequacy; (*e*) test–presentation consistency; and (*f*) presentation adequacy. The following is a general introduction to what the profile does in each of these six areas.

Purpose–Objective Consistency

The educational literature contains a considerable amount of material about the importance of instructional objectives and about how to write them (Logan, 1978). Though knowing how to write correctly stated objectives is important, there has been relatively little guidance in how to decide whether the objectives that have been written are the objectives that should be taught. There have been no adequate guidelines for justifying the substance of one's objectives. As a consequence, many of the objectives that have been written are either unnecessary or trivial. They often stress memory-level behavior when rule using or problem solving is more appropriate. Though some memory-level objectives are certainly justified, many more are not. Merely stating objectives correctly cannot compensate for inappropriate substance.

The first set of profile prescriptions addresses the question, Is the objective justified? In other words, is the substance of the objective consistent with the purpose of the course?

Objective Adequacy

Knowing that the substance of an objective is consistent with the purpose of the course is very important, but it is not enough. In order to be an effective guide for writing both test items and instructional presentations, an objective must be stated adequately. The educational literature contains many prescriptions for writing objectives in a useful form. Perhaps the classic is Robert Mager's book (1962). Although the profile does not make any new contributions to objective adequacy, it emphasizes the importance of this area of instructional quality.

The second set of profile prescriptions addresses the question, Is the objective adequate? In other words, does the objective contain the characteristics that make it useful for guiding the design of test items and instructional presentations? (See Figure 6.1.)

Objective–Test Consistency

Much of educational psychology over the past 30 years has been directed toward testing. But most of this effort has been devoted to prescriptions for the construction of reliable tests and for the construction and use of good items of various kinds (e.g., multiple-choice and true–false). Although reliability and other aspects of test adequacy are important, validity is critical. If the test items measure the wrong thing, then the careful construction of the test items is of little value.

In spite of the extensive work on tests, relatively little effort has been devoted to correlating tests with objectives. Often the two activities are viewed separately and are not related. Consequently, most tests end up measuring memory, even though it might be more appropriate to measure the ability to use knowledge to solve problems. Some testing of memory is necessary and desirable, but too often we test memory and make inferences about ability to use the information remembered.

The third set of profile prescriptions addresses the question, Are the test items consistent with the justified objectives? In other words, are we measuring the real goals of our instruction?

Test Adequacy

Knowing that the substance of a test item is consistent with a justified objective is critical, but it is not enough. A test item must also be reliable, well-formatted, and in other ways adequately constructed. In the educational literature there are excellent prescriptions available for constructing reliable tests. There are also many guidelines for constructing a wide

variety of test formats, such as multiple-choice, matching, true–false, short-answer, and essay (Courseware, Inc., 1977). The profile emphasizes the importance of these aspects of test adequacy and includes them, but it does not contribute anything new to them. What the profile does contribute is the identification of other aspects of test adequacy that have been largely overlooked.

The fourth set of profile prescriptions addresses the question, Are the test items adequate? In other words, do the test items have the characteristics necessary to ensure that they will adequately test the objectives with which they are consistent?

Test–Presentation Consistency

Of the three components of instruction shown in Figure 6.1 (objectives, tests, and presentations), objectives and tests have received considerable attention, as previously described; but the prescription of appropriate instructional presentations has received much less attention in the educational literature. Most instructional presentations are based on tradition, intuition, or the modeling of others. Most of the texts in a given field are modeled after a given best seller. Most professors teach as they have seen others teach. There is almost no information available for judging the appropriateness of an instructional presentation for teaching what is required by an objective and its test item(s). As a consequence, many instructional presentations are inappropriate. Often the information needed to pass the test is not available anywhere in the presentation—either in the text or in the teacher's elaboration of the text.

The fifth set of profile prescriptions addresses the question, Are the instructional presentations consistent with their corresponding test items? In other words, do the instructional presentations provide the kind of information necessary for the student to learn how to perform as required by the test?

Presentation Adequacy

Even when the necessary information is present, it is often hidden in the elaboration or nice-to-know material; it is often inadequately illustrated with examples; and it is frequently unclear to the student. The necessary information may be present, but the student is unable to find it or to understand it if he does find it.

The sixth set of profile prescriptions addresses the question, Is the presentation adequate for effective and efficient learning to occur? In

other words, has the student been provided with a complete, concise, easily studied, adequately illustrated, and sufficiently elaborated presentation to enable him or her to acquire the desired performance efficiently?

HOW DOES IT WORK?

A distinction between descriptive and prescriptive principles (Reigeluth, Bunderson, & Merrill, 1978; Simon, 1969) is germane to an understanding of the profile. An experimental psychologist might attempt to describe *predictive relationships*, which are somewhat value-free. That is, under a given set of conditions a given event can be predicted to occur within some range of probability. It does not matter whether someone wants such an event to occur, or whether it is good for such an event to occur; it occurs.

An instructional psychologist, on the other hand, might attempt to state *prescriptive relationships*, which are based on values. Such prescriptions often take this form: "If you want such an event to occur, then do thus and so." In stating prescriptive principles it is important that the desired outcomes be clearly identified. Such specified outcomes enable one to consider the desirability or relative importance of the prescriptions with respect to one's own values and to decide if a given set of prescriptive principles is appropriate in a given situation.

The common goals of an instructional strategy are maximum effectiveness (i.e., the fewest errors and least time to perform), maximum efficiency (i.e., the least time to learn), maximum retention (i.e., continued low error rate and low performance time over time), maximum transfer (i.e., maximum effectiveness in new contexts), and maximum appeal (i.e., students perceive they are learning and seek additional opportunity to interact with the task or similar tasks).

Profile prescriptions are usually stated using the term *should*. This *should* implies that if the prescription is followed, one or more of the desired goals will be promoted. Instructional situations exist in which one or more of these common goals may be inappropriate, destructive of another goal, or impractical. The profile also provides prescriptions for these situations in which only some subset of the common goals is desired.

The following six sections describe how the profile works in each of the six areas of instructional quality shown in Figure 6.1. With the exception of the section on objective adequacy, all sections have three parts: (*a*) a description of concepts essential to the analysis of quality in that area; (*b*) a description of instructional principles that provide the basis for the analysis of quality; and (*c*) an outline of the procedures for performing each analysis.

Purpose–Objective Consistency

The first set of profile diagnoses is concerned with determining whether or not each objective is one which we really want to teach. This justification of the objectives requires four steps (see Figure 6.3). First, analyze the purpose of the lesson to be taught and classify it on the basis of important characteristics. Second, analyze the objectives and classify them on the basis of the same characteristics. Third, compare the classification of each objective with the classification of the purpose. If they are not the same, the objective should be revised to be consistent with the purpose. Finally, make sure that no important objectives have been left out.

Concepts

The most crucial requirement for estimating the quality of instruction in this area is the nature of the characteristic(s) for classifying the purpose and objectives. After much consideration and experimentation, it was concluded that just one characteristic was of great importance: the level of behavior expected of the student, which is referred to as *task level*. To be justified, an objective must be at an appropriate task level for the purpose of the lesson.

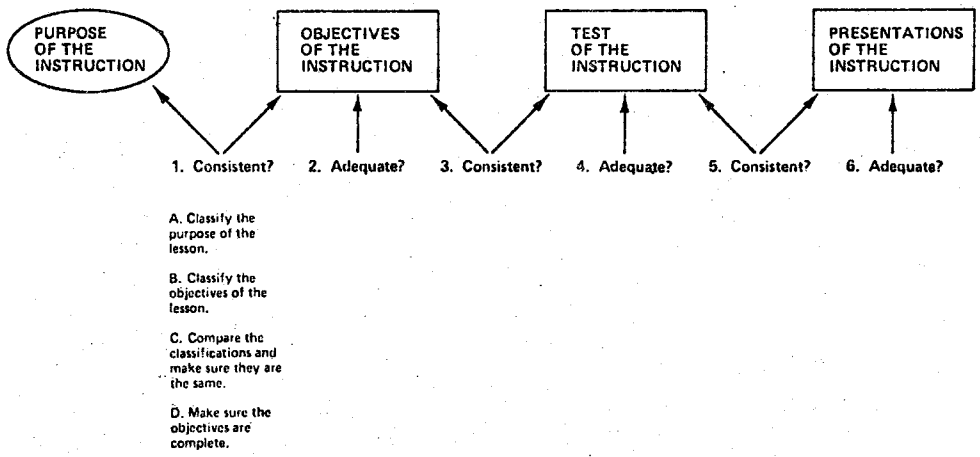

Figure 6.3 A summary of the aspects of instructional quality analyzed by the Instructional Quality Profile.

The profile identifies three major task levels: Remember an instance, remember a generality, and use a generality. A *generality* is an abstract or general statement that can be applied in a variety of specific situations, such as the definition of a concept or the statement of a procedure. An *instance* is a specific object, event, or symbol, such as an example of a concept or an application of a procedure. For every generality there are two or more instances associated with that generality. (See Merrill and Tennyson [1977] for a more detailed definition of generality and instance.)

Principles

The task level of the purpose of a lesson is based on two things: (*a*) the orientation of the lesson and (*b*) the degree of transfer required when the content–behaviors learned are used in a real-world setting. Transfer is the ability to use information in a new situation.

With respect to the orientation of the lesson, some lessons are application-oriented, which means that a major intention of the instruction is for the students to learn to **use** the content of the lesson in some way after completion of the lesson. Other lessons are non-application-oriented, which means that the intention of the lesson is just for the students to **know** the content (such as that the Declaration of Independence was signed in 1776), without any specific use for the content in mind.

With respect to the degree of transfer required after the lesson, some application purposes require no transfer, such as learning to use a procedure with specific, invariant inputs and conditions. Other purposes do require transfer, such as learning to use that procedure with a wide variety of different inputs and conditions. This is a greatly oversimplified notion of transfer, because there are qualitative differences (i.e., different types of transfer) as well as quantitative differences (i.e., different degrees of transfer). The profile itself deals more adequately with the true nature of transfer (see Merrill, Richards, Schmidt, & Wood, 1977), but this simplification allows a basic understanding without being overly technical.

To be consistent, the objectives of a lesson should reflect both the lesson's orientation and its transfer requirements.

Procedures

The profile uses the following procedure to analyze the consistency between the purpose of a course and its objectives.

Step 1. Determine the orientation and transfer requirements of the course on the basis of its purpose. Use this information and the flow diagram in Figure 6.4 to determine the appropriate task level for the major objectives of the course.

Step 2. Determine the task level of each objective by inspection.

Step 3. Compare the actual task level of each objective with its appropriate task level.

Step 4. Make sure that the objectives are complete—that is, that no important objectives have been left out.

Objective Adequacy

Once we have determined that the objectives for a lesson are consistent with the purpose of the lesson, the second set of profile diagoses is intended to determine whether or not each objective is adequate (see Figure 6.5). Because of the extensive treatment of this area of the quality of instruction in the educational literature, the profile has not attempted to contribute anything new. Nor will we discuss this area in terms of concepts, principles, and procedures.

Mager (1962) identified three important criteria of objective adequacy that must be clearly specified: (*a*) the desired student behavior; (*b*) the conditions under which the behavior is to be performed; and (*c*) the standards for the acceptable performance of the behavior. Gagné and Briggs (1974) extend these criteria to include (*d*) the object of the behavior; (*e*) the tools and constraints, and (*f*) the capability to be learned (which overlaps with standards). However, these last three criteria are usually parts of the first three. For an excellent summary of criteria for objective adequacy, see Davies (1976).

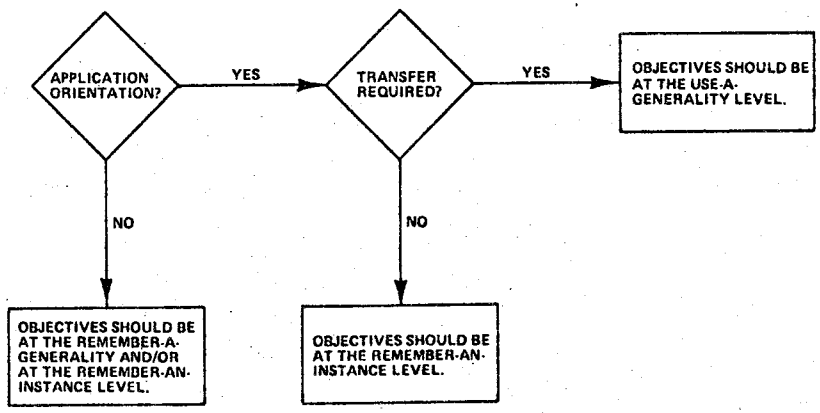

Figure 6.4 The procedure for determining the appropriate task level for the objectives of a course.

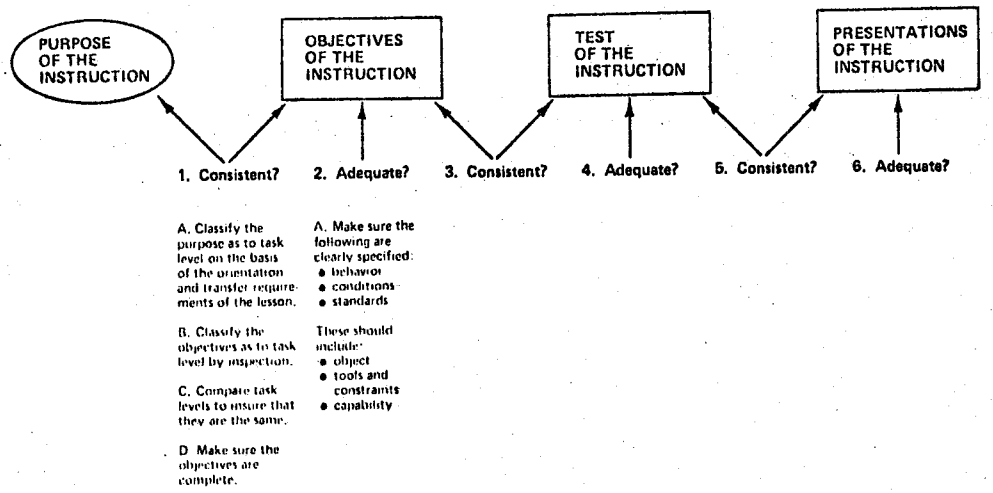

Figure 6.5 A summary of the aspects of instructional quality analyzed by the Instructional Quality Profile.

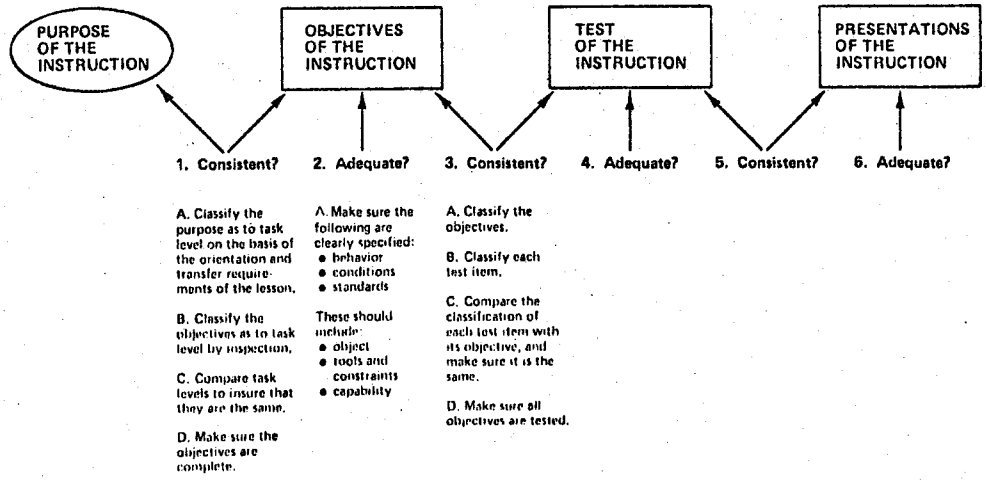

Figure 6.6 A summary of the aspects of instructional quality analyzed by the Instructional Quality Profile.

Objective–Test Consistency

Having determined that the objectives for a lesson are justified and adequate, the third set of profile diagnoses is intended to determine whether or not the test items are consistent with those objectives (see Figure 6.6). This analysis requires four steps. First, classify the objectives on the basis of important characteristics. Second, classify each test item on the basis of those same characteristics. Third, match each test item with the objective it tests (if any), compare their classifications, and (if necessary) revise the test item to be consistent with the objective. Finally, make sure all the objectives are tested.

Concepts

As with the justification of objectives (above), the most important requirement for estimating the quality of instruction in this area is the nature of the characteristics used for classifying the objectives and the test items. After much careful deliberation and experimentation, it was concluded that two characteristics were of great importance for assessing objective–test consistency: the level of behavior expected of the student (which is referred to as task level) and the type of content with which the student is expected to exhibit that behavior.

As indicated above, the profile identifies three major task levels: remember an instance, remember a generality, and use a generality. ("Find a generality" may also be included, but such problem-solving-type objectives are not yet adequately considered by the profile.) The profile also identifies four major content types: facts, concepts, procedures, and principles. A *fact* is a one-to-one association between objects, events, and/or symbols. A *concept* is a class of objects, events, or symbols that share critical attributes and have discriminably different individual members. A *procedure* is a series of steps required to produce an instance of an outcome class. Each step may involve (*a*) the temporal or spatial ordering of specific objects, events, or symbols, or (*b*) a branching decision based either on a fact or on the classification of an instance of a concept. A *principle* is a change relationship (between concepts) that explains why an instance of a particular concept is changed as a result of a particular change in an instance of another concept.

A fact cannot be represented by a generality, since there is not a class of objects, events, or symbols involved, but only a single specific object, event, or symbol. Hence, the task level for a fact is always the remember-an-instance level (see Figure 6.7).

A concept can be represented by (*a*) a generality (i.e., a statement identifying those critical attributes which determine class membership and the way in which those attributes are combined), or (*b*) an instance (i.e., the individual objects, events, or symbols comprising the class or their mediated representations). Therefore, a student can be asked to respond to a concept at any of the three basic task levels previously defined (see Figure 6.7).

A procedure is often characterized as how to do something (as con-

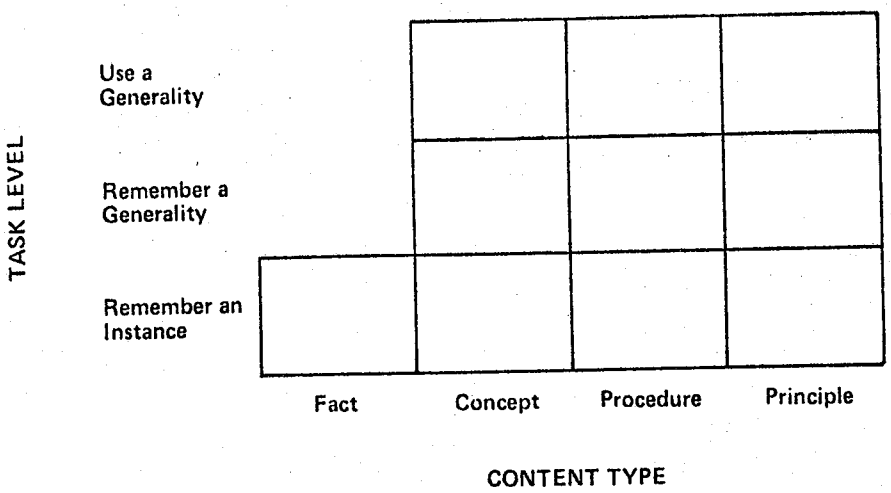

Figure 6.7 The profile's task–content classification table for analyzing objective–test consistency.

trasted with why it works, which characterizes a principle). A procedure can be represented by a generality (i.e., by a listing of the steps involved), or it can be represented by an instance (i.e., by an actual demonstration of the steps using particular objects, symbols, or events). Therefore, a student can be asked to respond to a procedure at any of the three task levels previously defined (see Figure 6.7).

A principle is often characterized as why something happens (as contrasted with how to do something, which is a procedure). Why a given procedure works can usually be explained by a single principle or set of related principles (a theory or model). However, a given principle or theory (model) can often give rise to a number of different procedures, each of which will produce the same outcome. A principle can be represented by a generality (i.e., by a statement of the relationships involved), or it can be represented by an instance (i.e., by its application to specific instances from each of the sets of concepts involved). Therefore, a student can also be asked to respond to a principle at any of the three task levels (see Figure 6.7).

The application of the task levels to the content types as described above results in the 10 classifications for comparing objective–test consistency shown in Figure 6.7. Every test item and every objective can be classified as one of these 10 classifications.

Principles

Adequate student evaluation depends on testing what we intend to teach. Hence determining and rating objective–test consistency is a critical part of good instructional evaluation. An objective and a test item are consistent if they both have the same type of content (fact, concept, procedure, principle) and the same task level (remember an instance, remember a generality, use a generality). Obviously, not only must the content be of the same type, but the subject matter topic stated in the objective and required by the test item must also be the same.

Procedures

The profile uses the following procedure to analyze the consistency between objectives and their respective test items.

Step 1. Classify the objectives with respect to the task–content table (shown in Figure 6.7).
Step 2. Find the test item(s) that correspond to the objective, and classify those test item(s) with respect to the task–content table.
Step 3. Compare the classifications for the objective and its corresponding test item(s). Are they the same? If not, revise the test item(s) to be consistent with the objective.
Step 4. Make sure that all the objectives of the lesson are tested. This may require the generation of additional test items.

Test Adequacy

Once we have determined that the test items for a lesson are consistent with the justified objectives, the fourth set of profile diagnoses is intended to detemine whether or not the test items are adequate. There are two important aspects of test adequacy that have received considerable attention: (*a*) the reliability of test items and (*b*) the technical correctness of the format of each test item. The profile calls for the analysis of these aspects of test adequacy (see Figure 6.8). But, because of their extensive treatment in literature, the profile does not attempt to contribute anything new to them.

There are some other aspects of test adequacy that have been largely overlooked or have received considerably less attention. These aspects are of two types: (*a*) those that apply to the adequacy of single test items, such as some characteristics of the information provided and of the behavior required, and (*b*) those that relate to sets of test items, such as item sampling, item sequencing, and criterion-level determination. These aspects of test adequacy will now be outlined.

Concepts

Response-level Option. A test item at the remember-an-instance task level or the remember-a-generality task level can require the student

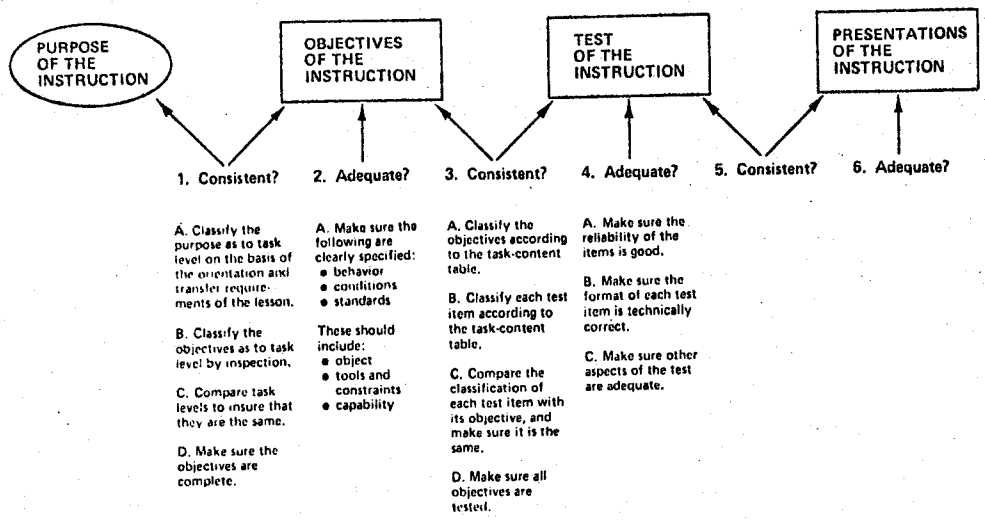

Figure 6.8 A summary of the aspects of instructional quality analyzed by the Instructional Quality Profile.

either to recognize or to recall the instance or the generality. And a test item at the use-a-generality task level can require the student either to identify or to produce the correct answer.

Input–Output Form. Every test item provides the student with some information: a generality name, a generality, or an instance. This is called the student's *input* because it is the information that the student uses. Every test item also asks the student for some information: a generality name, a generality, an instance (or part of an instance, such as a solution), or an explanation of an instance (e.g., telling why or why not it is an example of a concept). This is called the *output* because it is the information the student produces.

Response-time Criterion. On every test, students are allowed a certain amount of time to respond to the items. Response time may or may not be a criterion of acceptable performance specified by the objectives.

Feedback and Prompts. Sometimes feedback as to the correctness of a test response is provided before the test is over. And sometimes prompts are provided within the test itself. There are two basic kinds of prompts: *internal prompts*, such as attribute isolation[2] in the instance given as the input, and *extraneous prompts*, such as the answer to one question being

[2] *Attribute isolation* is the use of attention-focusing devices such as color, exploded drawings, arrows, or bold-faced type that enable the student to distinguish more easily the important characteristics of an instance.

facilitated by the wording of an earlier question or (assuming the student can go back and change an answer) by the wording of a later question.

Sampling. Many objectives have a variety of different representations or instances that can be used for testing them, whereas other objectives do not. One important question is the number of test items that should be used to test a given type of objective. And whenever more than one test item should be used, in what ways should the different representations of an instance, or the different instances of a generality, vary from each other with respect to divergence on variable attributes and with respect to item difficulty? *Divergence on variable attributes* refers to the differences between instances of the same generality (Merrill & Tennyson, 1977).

Sequencing. Test items can be sequenced randomly throughout the test, or they can be arranged in such nonrandom sequences as grouping by objective or arrangement in the same order as in the instructional presentation.

Criterion-level Determination. Every test should have a criterion level that indicates the minimum acceptable student performance with respect to an acceptable percentage of student errors.

Principles

Response-level Option. Unless justified, all test items should use the recall option for the remember levels and the produce option for the use levels, rather than the recognize and identify options, respectively.

Input–Output Form. The profile proposes that there is an optimal input form and an optimal output form for each task–content classification. Unless justified, all test items should have the input and output forms indicated in Figure 6.9.

Response-time Criterion. If response time is a criterion of acceptable performance specified by the objectives, then unless justified each test item should test for that criterion. If response time is not specified by the objective, then unless justified the following guidelines should be followed. The response-time criterion should be no delay if the student is to remember an instance or a generality verbatim; it should be short delay if the student is to remember an instance or a generality in a paraphrased form; and it should be untimed if the student is to use the generality.

Feedback and Prompts. Unless justified by the real-world task for which the student is being trained, feedback should be avoided before the student has finished the whole test, because it could influence performance either positively or negatively by such means as teaching something the student did not know or increasing anxiety. Both internal and extraneous prompts should also be avoided, unless justified by the real-

		FACT	CONCEPT	PROCEDURE	PRINCIPLE
Use a Generality	INPUT		Instance and Superordinate Name	Instance and Type of Solution	Instance
	OUTPUT		Name and Attribute Isolation	Solution and Algorithm	Name and Explanation or Name, Prediction and Explanation
Remember a Generality	INPUT		Name	Name	Name
	OUTPUT		Generality	Generality	Generality
Remember an Instance	INPUT	A	Instance	Instance	Instance
	OUTPUT	B	Name	Solution	Explanation

Figure 6.9 The profile's input–output table showing what kind of information should be used as the input and required as the output for each of the 10 task–content classifications. Two boxes are shaded because there are no task–content classifications for those two boxes (i.e., there is no generality for a fact).

world task, because they can allow an insufficiently knowledgeable student to given an "acceptable" performance on the test.

Sampling. The number of test items for an objective should be just one if the objective requires the student to remember an instance or a generality verbatim. For remembering an instance or a generality in a paraphrased form, a variety of representations is necessary, just as for using a generality a variety of instances is necessary. The minimum acceptable sample size for testing these kinds of objectives is estimated on the basis of such factors as the size of the entire population of items, the homogeneity of the population, and the frequency with which the student is likely to encounter different types of items from the population in postinstructional situations. Whenever there is more than one test item for a given objective, those items should be divergent with respect to the variable attributes on which the student is likely to encounter variations in postinstructional situations. Those items should also represent a range of difficulty appropriate for the types of "items" the student is likely to encounter after the instruction.

Sequencing. All test items should be randomly sequenced throughout the test. In addition to testing each objective at different places within a test, it is also preferable to test it at different points in time.

Criterion-level Determination. Unless justified, all tests should entail separate grading and scoring on each objective. The minimum acceptable percentage of student errors is usually specified by the objective. However, if it is not specified (which may particularly be the case for "enabling" objectives), then the following criteria are recommended: no errors for remembering an instance or a generality, and a *split criterion* for using a generality. A split criterion is something like the following: 100% of all "easy" problems correct, 80% of all "medium" problems correct, and 40% of all "hard" problems correct.

Procedures

The profile requires three separate procedures for analyzing the adequacy of a test. The order of their performance is not important.

1. Empirically determine the reliability of each test item, and improve it as necessary.
2. By inspection, analyze the technical correctness of the format of each test item, and improve it as necessary.
3. By inspection, ensure that each test item has the optimal response-level option (recall or produce), has the optimal input–output form (see Figure 6.9), has the appropriate response-time criterion, and has no prompts or premature feedback; and also ensure that the test as a whole samples the appropriate number, divergence, and difficulty of items for each objective, sequences the items randomly, and has the appropriate criterion for each objective.

Test–Presentation Consistency

Having determined that the test for a lesson is consistent with the justified objectives and is adequate with respect to reliability, item format, and other aspects of quality, the fifth set of profile diagnoses is intended to determine whether or not an instructional presentation is consistent with its test item(s)—that is, to determine whether or not the presentation contains the information necessary for the student to learn how to perform as required by the test (see Figure 6.10).

This analysis requires three steps. First, determine the task level of the test item(s) on an objective. Second, determine what the presentation needs to contain in order to be able to teach at that task level. And finally, analyze the presentation to see whether or not it contains those components and only those components. If it does, the presentation is consistent with its corresponding test item(s). If not, the presentation should be revised.

Concepts

One of the factors that has prevented much progress in the analysis of instruction has been the lack of an adequate description of a presentation.

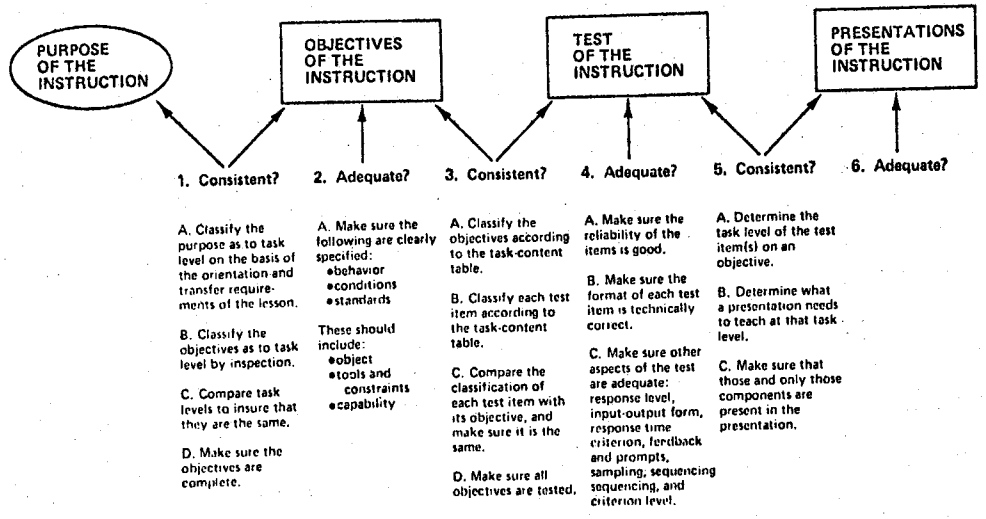

Figure 6.10 A summary of the aspects of instructional quality analyzed by the Instructional Quality Profile.

Concepts like *discussion, lecture,* etc., are far too ambiguous and have little correlation with student performance. A major contribution of the profile to the analysis of instructional quality is the notion that a presentation can be described as a series of *displays* (Merrill & Wood, 1974). A display is different from a frame in that a frame includes only that which is presented simultaneously via the delivery system in use (e.g., for printed materials a frame is synonymous with a page). A single frame may consist of one or more displays, or a single display may require more than one frame. For continuous-type delivery systems—such as lectures, audio tapes, video tapes, or motion pictures—the definition of a frame is somewhat more problematical, but the presentation can still be segmented into a sequence of instructional displays.

The kinds of displays of most importance to the profile's analysis of test–presentation consistency are those called *primary presentation forms* (Merrill & Boutwell, 1973; Merrill & Wood, 1974). Cognitive subject matter—such as concepts, procedures, and principles—can be presented as generalities or as instances (see above under objective–test consistency). Generalities and instances can be presented to the student in two ways: (*a*) The student can be told or shown, and (*b*) the student can be questioned or asked to demonstrate. The combination of these factors creates the four primary presentation forms: *generality, instance, generality practice,* and *instance practice* (see Figure 6.11). In order to analyze

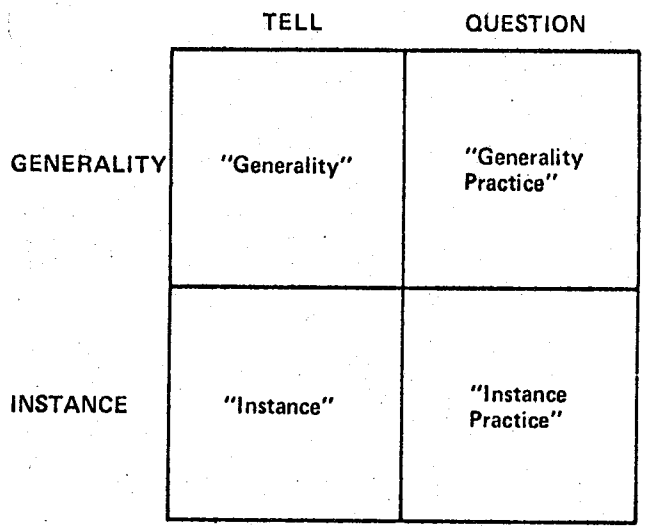

Figure 6.11 The four primary presentation forms.

the consistency between test items and instructional presentations, the profile indicates which primary presentation forms a presentation ought to contain in order to be able to teach the content at the desired task level.

A given presentation, regardless of delivery system, can be segmented into a series of displays, which consist of *primary presentation forms* (i.e., generality, instance, generality practice, and/or instance practice), *secondary presentation forms* (i.e., elaborated or "helped" primary presentation forms), *process displays* (which indicate to the student how he should process the information, such as "Repeat this in your mind"), and *procedure displays* (which indicate to the student how to manipulate the delivery system, such as, "Turn to page 47"). Other types of displays can also be defined but are not pertinent to the profile.

The differences among presentation strategies result largely from the different combinations of primary presentation forms used, the different secondary presentation forms used, and the variations in the characteristics (i.e., strategy components) of each primary and secondary presentation form. The first (i.e., the different combinations of primary presentation forms) is important for analyzing test–presentation consistency, and the latter two (i.e., the different secondary presentation forms and the variations in the characteristics of each presentation form) are important for analyzing presentation adequacy—the sixth set of profile diagnoses (see the discussion to follow).

Principles

Quality instruction depends on teaching what we intend to test. The profile hypothesizes that task level is very important for deciding which primary presentation forms should be presented to the student. For each task level there is an appropriate combination of primary presentation forms that should be used in the presentation. These combinations are as follows (see Figure 6.12).

1. For objectives and test items classified at the remember-an-instance task level, instance and instance practice are the primary presentation forms needed.
2. For objectives and test items classified at the remember-a-generality level, the generality and generality practice are often the primary presentation forms needed. However, it is usually helpful to provide a reference example if the generality is to be remembered in a paraphrased form, as opposed to being remembered verbatim.
3. For objectives and test items classified at the use-a-generality level, the generality, some instances, and some instance practice are the primary presentation forms needed.

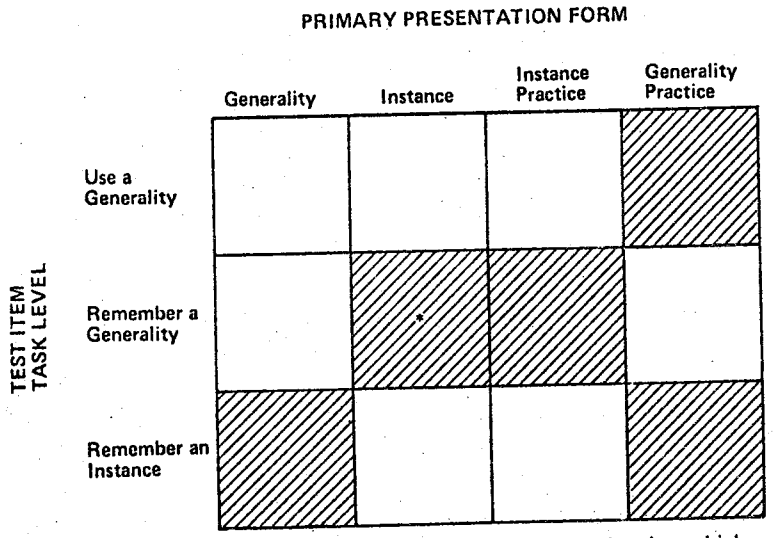

Figure 6.12 The profile's test–presentation consistency table, showing which primary presentation forms should comprise an instructional presentation in order for it to be consistent with its test item(s). The shaded boxes show which primary presentation forms should not be included in the instructional presentation for each task level. (*) It is usually helpful to provide a reference example if the generality is to be remembered in a paraphrased form, as opposed to being remembered verbatim.

It should be noted that instance and instance practice at the remember level are of a different nature from instance and instance practice at the use level. At the use level previously unencountered instances should always be used, whereas at the remember level the same instance is always used (sometimes with different representations). The nature of the cognitive processing required is also different at the remember and use levels.

Procedures

The profile uses the following procedure to analyze the consistency between a test item and the presentation intended to prepare the students for it.

Step 1. The test item(s) on an objective are classified as to task level (i.e., remember-an-instance, remember-a-generality, or use-a-generality). This has already been done in the procedure for analyzing objective–test consistency.

Step 2. The test–presentation consistency table (Figure 6.12) is used to determine which primary presentation forms should comprise the instructional presentation intended to prepare the students for the test item(s).

Step 3. The relevant presentation is analyzed to determine whether or not the appropriate primary presentation forms, and only those primary presentation forms, are present. If they are not, then the presentation should be revised to supply missing primary presentation forms. And if inappropriate primary presentation forms are present, they should be deleted. Then the presentation will be consistent with its corresponding test item(s). This step may be split into two parts:

a. Identify all the primary presentation forms in the presentation. Most presentations are composed of some material that cannot be classified as a relevant primary presentation form. Such extra material may be useful, but it is not relevant for rating test–presentation consistency. Therefore, rather than classifying all parts of a presentation, you should just identify the relevant primary presentation forms.

b. Analyze each relevant primary presentation form as to completeness. Often a presentation will have what appears to be a generality or an instance, but upon closer examination it will be found that the generality is incomplete or merely provides context for the concept, procedure, or principle being presented; or it will be found that the example does not contain the attributes necessary for the student to see why it is an illustration of the generality. Such primary presentation forms are not adequate and should not be counted when determining test–presentation consistency.

Presentation Adequacy

Having made sure that each instructional presentation contains the appropriate primary presentation forms for teaching at the desired task level (test–presentation consistency), one can go to the sixth and last set of profile diagnoses, which is intended to determine whether or not each primary presentation form is accompanied by the necessary secondary presentation forms and has the necessary strategy components and characteristics to teach well at the desired task level (presentation adequacy). (See Figure 6.13.) There are two major aspects of presentation adequacy: (*a*) what strategy components should be included in and with each primary presentation form and (*b*) what characteristics each of those strategy components should have.

Concepts

With respect to the inclusion of strategy components, some components should be included in or with all primary presentation forms regardless of the task level of the presentation in which those primary presentation forms appear, whereas the inclusion of other strategy components depends upon the task level of the presentation. Type of content does not influence decisions as to what strategy components should be included, but it does influence decisions as to what characteristics each of those strategy components should have. The next few paragraphs provide a

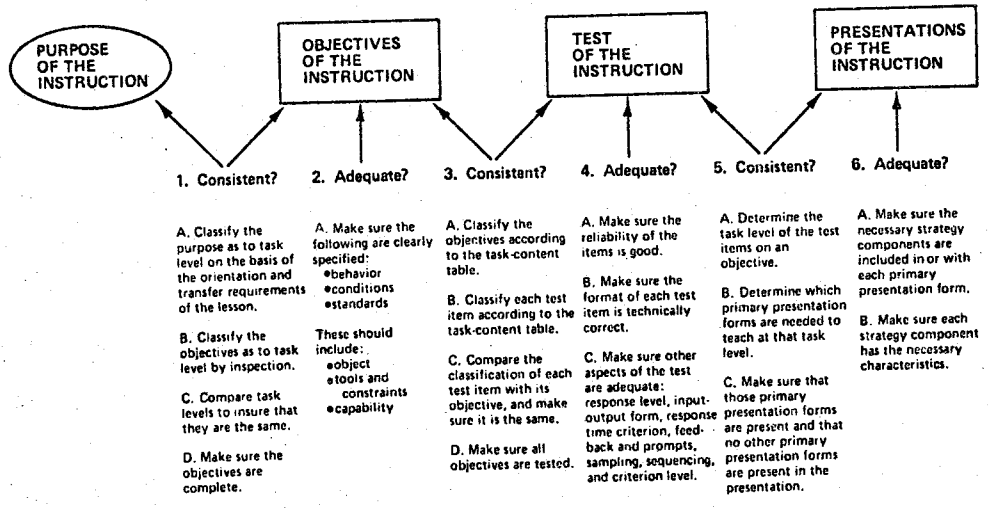

Figure 6.13 A summary of the aspects of instructional quality analyzed by the Instructional Quality Profile.

general description of the important strategy components of which we are aware.

Feedback. Often when practice is provided, the student receives no immediate feedback as to whether or not an answer is correct or (if the answer is not correct) as to what the correct answer is and why.

Isolation. Often a given presentation form (primary or secondary) will be buried in elaboration or in other types of presentation forms so that it is difficult for the students to know what represents the information that they will be required to remember or to use, as opposed to what represents information that is presented only to clarify or to help them see how to apply the ideas. This situation is characterized facetiously as "instructional hide-and-seek": the instructor hides the critical information and the students try to find it. Isolation of a presentation form refers to (*a*) separating it from other presentation forms and other kinds of displays and (*b*) clearly labeling it for the student so that there is no ambiguity as to what is the main idea and what is illustration, elaboration, or clarification.

Helps. Helps are various kinds of information that can be added to a presentation form to help the student to reach mastery. Descriptions of some kinds of helps follow.

A mnemonic help, which is a secondary presentation form, is a memory aid to help the student to remember the necessary information. Mnemonic help can include songs, rhymes, schematics, chunking devices, acronyms, and much more.

Attention-focusing help entails the use of various kinds of "flags" to focus the student's attention on critical aspects that are either especially important or are frequently overlooked by the student. Such flags include underlining, color, arrows, and other kinds of verbal or schematic highlighting.

An algorithm help, which is a secondary presentation form, gives the student a step-by-step description of what to do, whether it is for a concept-classification task (identification algorithm) or for a procedure-using or problem-solving task (transformation algorithm)—see Landa, 1974.

An alternative representation help, which is also a secondary presentation form, may be a graphic or schematic representation or even just a rewording of the generality or instance.

Sampling. There are various aspects of sampling instances and practice items that can greatly help a student to reach mastery. Some of them will now be described.

One of the most frequent problems of much instruction, second only to the too heavy use of memory-type test questions, is the lack of a sufficient number of instances. Somehow the notion seems to have been adopted

that instances are fine for grade school students, but that adult students should be able to grasp abstract ideas without any illustrative material. This problem is characterized as "generality-rich but example-poor" instruction. However, most advanced concepts and principles cannot be adequately understood without illustrative material. Closely related to example-poor instruction is the lack of a sufficient amount of practice. Most of us learn by doing, not merely by listening or looking. In the hard sciences—mathematics, physics, chemistry, etc.—there seems to be considerable use of practice problems. But in the humanities and social sciences there is usually an almost total absence of relevant practice. Students cannot learn to use ideas unless they have an opportunity to practice using those ideas, with guidance (i.e., feedback) on that practice.

Divergence. Instances and instance practice items can be fairly different, or divergent, with respect to variable attributes (for concepts) or contexts (for procedures and principles). To be different from each other, instances must be divergent in at least one way. The number of ways in which two instances are different is a measure of their divergence.

Difficulty Level. Because they can be divergent, instances and instance practice can usually be at a range of difficulty levels, from very easy to very hard. Even when there is only one instance to be learned (i.e., at the remember-an-instance task level), the various possible representations of that instance usually form a range of difficulty.

Matching. Instances and noninstances can be arranged as matched pairs, which means that an instance and a noninstance are as similar as possible. For example, a ketch and a yawl (types of sailboats) could be the same size, be the same color, and have the same type of hull.

These aspects of the adequacy of each presentation form do not vary with content type. But the optimal characteristics of many of these strategy components do vary with content type. Generalities, instances, practice items, and the various kinds of helps are usually written or arranged differently for each of the different types of content (to be discussed later).

Principles

Presentation adequacy is the sum of the adequacies of all of the required primary presentation forms (generality, instance, generality practice, and/or instance practice) in a presentation. The adequacy of each required primary presentation form is determined by its conformance to principles of presentation adequacy. Some of these principles are valid across all task levels and all content types, others vary with task level only, and still others vary with both task level and content type. The following is a brief description of the major principles that we have discovered or abstracted from the literature (see Figure 6.14 for a summary).

Feedback Principle. A presentation is of higher quality to the degree to which each instance practice or generality practice is followed by immediate feedback as to whether or not the response is correct, what the correct response is, and why it is the correct response. This principle applies to the two practice primary presentation forms at all task levels and for all content types. Practice alone does not make perfect; only

The following principles apply for the indicated primary presentation forms across all task levels and all content types.

PRINCIPLES:	Generality	Instance	Instance Practice: Question	Instance Practice: Feedback	Generality Practice: Question	Generality Practice: Feedback
Feedback				✓		✓
Isolation	✓	✓	✓	✓	✓	✓
Mnemonic help	✓	✓		✓		✓
Attention-focusing help	✓	✓		✓		✓

The following principles apply for the indicated primary presentation forms at the indicated task levels, across all content types.

PRINCIPLES:	Generality	Instance	Instance Practice: Question	Instance Practice: Feedback	Generality Practice: Question	Generality Practice: Feedback
Algorithm help	UG	UG		UG		UG
Alternative-representation help	UG,(RG)	UG,(RI)				
Number of items		UG	UG			
Divergence		UG	UG			
Difficulty level		UG	UG			
Matching		UG				

The following principles apply for the indicated content types at the indicated task levels.

PRINCIPLES:	Fact	Concept	Procedure	Principle
Make-up of generalities		RG,UG	RG,UG	RG,UG
Make-up of instances	RI	RI,UG	RI,UG	RI,UG
Make-up of instance practice	RI	RI,UG	RI,UG	RI,UG
Make-up of generality practice		RG	RG	RG
Make-up of helps: mnemonics	ALL	ALL	ALL	ALL
Make-up of helps: attention-focus	ALL	ALL	ALL	ALL
Make-up of helps: algorithm		UG	UG	UG
Make-up of helps: alternative-representation		UG,(RI)	UG,(RI)	UG,(RI)

Key: UG – Use-a-generality task level.
RG – Remember-a-generality task level.
RI – Remember-an-instance task level.
ALL – All three task levels.
( ) – In a paraphrased form only.

Figure 6.14 A summary of the areas of applicability of each principle of presentation adequacy.

practice with immediate feedback makes perfect. Too often the feedback is delayed long enough to be of questionable value; and too often it does not contain sufficient information—namely what the correct response is (if the student's response was wrong) and why it is the correct response.

Isolation Principle. A presentation is of higher quality to the degree to which the presentation forms are separated and labeled in such a way that the student can easily skip over or skip to each of these separate presentation forms. This principle applies to all primary and secondary presentation forms, including feedback for practice, alternative representations, and algorithms; and it applies across all task levels and content types. If such displays within a presentation are separated and labeled so that the student is told what is the main idea, then processing time can be spent on *encoding* the substance of the message instead of on trying to *find* the substance in a complex game of instructional hide and seek.

Help Principle. A presentation is of higher quality to the degree to which effective information is added to the presentation forms (both primary and secondary) to help the student to learn the information presented. More specific versions of the help principle are described below.

Mnemonic help. A presentation is of higher quality to the degree to which it provides the student with mnemonic aids to facilitate the ability to remember a generality or an instance accurately. This principle applies to all four primary presentation forms, except that mnemonics should only be presented on the feedback display of the practice items; and it applies across all task levels and content types (see Figure 6.14). One should be careful to use mnemonic aids that work well. If the mnemonic may interfere with subsequent performance, then it is better to omit it.

Attention-focusing help. A presentation is of higher quality to the degree to which it provides the student with attention-focusing help. This principle applies to all primary and secondary presentation forms, again with the qualification that attention-focusing aids should only be presented on the feedback display of the practice items; and it applies across all task levels and content types. If attention-focusing help is not provided, the student may miss important attributes or be forced to play another version of instructional hide-and-seek by guessing whether or not a given attribute is important. The student may end up processing a considerable amount of irrelevant information, which may interfere with learning what was important.

Algorithm help. A presentation at the use-a-generality task level is of higher quality to the degree to which it provides the student with algorithm help. This principle applies to all four primary presentation forms, again with the exception of only the feedback on practice items; it applies across all content types; but it applies only to the use-a-generality task level (see Figure 6.14). Most generalities require, at the use level, a series of ordered operations. The algorithm should identify all the important component operations and the order in which those operations should be performed.

Alternative-representation help. A presentation at the use-a-generality task level (and sometimes at the remember-an-instance and remember-a-generality levels) is of higher quality to the degree to which it provides the student with one or more alternative representations. This principle applies to just two primary presentation forms—generality and instance. It applies across all content types. And it applies to the use-a-generality task level, the remember-an-instance task level (in a paraphrased form only), and the remember-a-generality task level (in a paraphrased form only). Some students are more verbally inclined and others are more pictorially inclined. If a given generality or instance can be presented via two or more different representations, then it is likely that more of the students will be able to understand it.

Sampling Principle. A presentation is of higher quality to the degree to which instances are selected to represent adequately the class of possible instances that the student will likely encounter in the real world. The following are some more specific versions of the sampling principle.

Number of items. A presentation is of higher quality to the degree to which the number of instances and instance practice available to students is sufficient for even the slowest students to learn the material well (e.g., learned with the appropriate amount of generalization or transfer). This principle applies to two primary presentation forms—instances and instance practice. It applies across all content types. But it applies principally to the use-a-generality task level.

Divergence. A presentation is of higher quality to the degree to which the instances and instance practice are divergent with respect to variable attributes (for concepts) or with respect to contexts (for procedures and principles), to a degree consistent with postinstructional instances. This principle applies to two primary presentation forms—instances and instance practice. It applies across all content types. But it applies only to the use-a-generality task level. If students are not exposed to a representative set of instances during the presentation, then they will be unlikely to generalize to the types of instances not presented, and there will be a decrement in their performance. Divergence enables students to see the variety of forms that the critical attributes can take or the variety of contexts within which the critical attributes can occur.

Difficulty level. A presentation is of higher quality to the degree to which the instances and instance practice represent the range of difficulty representative of postinstructional instances. A presentation is also of

higher quality to the degree to which the early instances and early instance practice are presented in an easy-to-difficult sequence. This may entail the use of a simplified representation for early instances and instance practice. These principles apply to two primary presentation forms—instances and instance practice. They also apply across all content types. But they apply only to the use-a-generality task level. Students confronted immediately with all of the embedded complexity of the real world may be confused and find it difficult to discriminate critical attributes from variable attributes. Once the critical attributes have been identified and internalized, subsequent exposure to difficult, high-fidelity instances is advisable.

Matching. A presentation is of higher quality to the degree to which the instances are matched with noninstances. This principle applies to one primary presentation form only—instances. It applies across all task levels. But it applies only to instances at the use-a-generality task level (see Figure 6.14). Matching enables a student to eliminate quickly potentially confusing, irrelevant attributes or inappropriate operations by being able to compare attributes simultaneously. This promotes discrimination. Matching is especially helpful for the concept type of content but also plays a role for procedures and principles. For procedures, common inappropriate procedures are demonstrated. For principles, common inappropriate explanations are provided for the student.

None of the above-mentioned principles of presentation adequacy varies with content type. But the optimal *characteristics* of many of the strategy components do vary with content type. Generalities, instances, practice items, and many kinds of helps should usually be written or arranged differently for each of the different types of content. Since the optimal characteristics of such strategy components for different task levels are described in some detail elsewhere in this book (see Chapter 1 of this volume), we merely outline the areas of applicability of those principles within our conceptual scheme. This outline is provided in Figure 6.14.

Procedures

The profile uses the following two steps for analyzing the adequacy of each required presentation form in each presentation.

Step 1. Determine whether or not each strategy component that ought to be present in or with each primary presentation form is indeed present. The profile provides a different diagnostic form for each task level for tabulating such information. If each required component is not present, add it.

Step 2. Determine whether or not all the characteristics that ought to comprise each strategy component actually do comprise it. The same diagnostic forms just mentioned are used to tabulate such information. If each required characteristic is not present, add it.

APPLICATIONS

The Instructional Quality Profile was designed primarily for analyzing the quality of existing instruction. However, because of the prescriptive nature of the profile's diagnoses, it is possible to apply the principles of this instrument in a variety of ways. These include (*a*) diagnosing specific weaknesses in existing instruction; (*b*) rating the effectiveness of existing instruction; (*c*) prescribing ways to revise the instruction so as to eliminate those weaknesses; (*d*) prescribing ways to design more effective new instruction and (*e*) prescribing effective learning strategies for students.

Detailed descriptions of procedures for each of these areas of application are beyond the scope of this chapter. In the following paragraphs, however, an attempt is made to outline briefly some procedures that may be used for these various applications.

Diagnosing Weaknesses

The starting point for diagnosing specific weaknesses in existing instruction is somewhat variable. It may not be necessary to perform any of the first four sets of diagnoses shown in Figure 6.13. Usually, the diagnosis procedure will start with the fifth set of diagnoses because often only the instruction is to be diagnosed and the test is often assumed to be good. In such cases, the following is a procedure that may be used to diagnose specific weaknesses in existing instruction.

First, classify each of the test items using the task–content table (Figure 6.7).

Second, locate the presentation that corresponds with each test item.

Third, use the test–presentation consistency table (Figure 6.12) to determine which primary presentation forms should be present in each presentation.

Fourth, analyze each presentation to see whether or not it contains all the required primary presentation forms and no unnecessary primary presentation forms. Also, develop a profile that lists all test–presentation inconsistencies.

Fifth, analyze each presentation to determine the adequacy of each of its required primary presentation forms that is present, and develop a

profile that lists all presentation inadequacies. Profile forms have been created to facilitate these last two steps (see Merrill, Richards, Schmidt, & Wood, 1977).

Rating Instruction

There are at least two ways of rating the effectiveness of existing instruction. One is by predicting the level of student achievement that is likely to result from the instruction, and the other is by comparing two or more pieces of instruction on the same subject matter to predict which of the two will result in higher student achievement. The procedure is basically the same for both types of rating, and it is also similar to the procedure just described, except that indexes are needed to rate the presentations on the basis of their weaknesses. Assuming again that only the instruction is to be rated and that the test is of high quality, this procedure would also start with the fifth set of profile analyses.

First, classify each of the test items using the task–content table (Figure 6.7).

Second, locate the presentation that corresponds with each test item.

Third, use the test–presentation consistency table (Figure 6.12) to determine which primary presentation forms should appear in each presentation.

Fourth, analyze each presentation to see whether or not it contains the required primary presentation forms, and develop a different index of consistency for the presentation corresponding to each test item. (There may be some duplication if the same presentation corresponds to more than one test item, but such duplication is necessary for an accurate prediction of student performance on the test.)

Fifth, analyze each presentation to determine the adequacy of each of its required primary presentation forms that is present, and develop an index of adequacy for the presentation corresponding to each test item. (Again there will probably be some duplication.)

Sixth, add up the consistency and adequacy indexes for the presentation corresponding to each test item. This will provide a rating of how well a student should perform on each test item. Those ratings can then be added, to provide a rating of how well a student should perform on the test (the measure of student achievement). To compare two or more instructional programs on the same subject matter, merely compare their ratings.

Procedures for developing the consistency and adequacy indexes are explained in the *Instructional Strategy Diagnostic Profile Training Manual* by Merrill *et al.* (1977). Space constraints prohibit including their specifications here. Also, index forms have been developed to facilitate those procedures (see Merrill *et al.*, 1977).

Revision Procedures

The procedure for revising a given instructional product to increase its probable effectiveness often requires all six sets of profile analyses. Such a procedure is outlined as follows.

First, analyze purpose–objective consistency. With respect to the orientation and transfer requirements of the instruction, are the objectives at the appropriate level? Do they include objectives that are irrelevant to the purpose of the instruction? Do they omit objectives that are important to that purpose? A survey of the test items and instruction may reveal important objectives that are not stated. Objectives should be written, modified, and/or deleted as is necessary to make them consistent with the purpose of the instruction.

Second, analyze objective adequacy. It is important to ensure that the justified objectives contain the characteristics that make them useful for guiding the design of test items and instructional presentations, because the objectives will serve as the basis upon which the remainder of the revisions will be made.

Third, analyze test–objective consistency on the basis of the 10 task–content classifications (Figure 6.7). Each test item that has a different task–content classification than its justified objective should be revised so as to represent the correct classification. Test items that have no objective should be deleted, and test items should be written for those objectives that have none.

Fourth, analyze test adequacy and revise the test items as necessary to ensure that they are reliable, correctly formatted, and adequate with respect to the other aspects of quality previously described.

Fifth, analyze test–presentation consistency. The first four steps outlined under "Diagnosing Weaknesses" can be used to identify whether or not each presentation contains the required, and only the required, primary presentation forms for the task level of its test item(s). If the analysis reveals the absence of required primary presentation forms, these should be written and added to the presentation. Primary presentation forms that are present but not required—and other types of material that do not contribute to the attainment of the objective—should be deleted. Often, instruction contains much that is irrelevant, redundant, or distracting from the presentation. A comparison of all the included material with the objectives can help determine its necessity or desirability.

Sixth and finally, analyze presentation adequacy by determining the adequacy of each required primary presentation form for each presentation. Often this analysis leads to the most extensive revisions. The required primary presentation forms may be buried in text, may need more concise statement, may need the addition of help, may need additional instances, and often—especially in the nonscience areas of the curriculum—may need additional practice. Also, the composition of each of these strategy components may be inadequate. Therefore, this sixth and last step in the revision of existing instruction should entail the revision of each of these aspects of the adequacy of each required primary presentation form in the instruction until they all meet the standards outlined under "Presentation Adequacy" earlier in this chapter.

One of the purposes of the profile was to provide an evaluation tool that could be used to guide the revision of an instructional package without an expensive and time-consuming empirical evaluation. Since the profile has been subjected to extensive validation of the principles involved (see the next section), it is possible to use it for revision without the costs of a prior empirical evaluation. However, it is recommended that you conduct an empirical evaluation of the revised instruction in order to check the validity of this instrument in your unique setting. You may even wish to compare it with the original instruction in the empirical evaluation. Once you have verified its validity in your particular setting, it should not be necessary to subject every revision of similar instruction to a complete empirical analysis.

Designing New Instruction

Although it was developed to evaluate existing instructional materials, the profile can also be used as a very effective design tool for the production of new instructional materials. Because it is prescriptive in nature, it is very easy merely to apply the prescriptions when designing materials. Very briefly, the procedure for designing more effective new instruction could be as follows.

First, perform the necessary task analysis and content analysis in order to determine the subject matter to be taught (all of which is beyond the scope of the profile in its current version).

Second, use the task–content table to help in writing your objectives. The task–content table suggests that there are only 10 kinds of objectives that can be written, with respect to task level and content type. Each category of the task–content table provides a formula for writing a different kind of objective, complete with all the aspects of objective adequacy. To have an adequately stated objective, it is necessary only to determine

the task–content combination desired, specify the subject matter topic to be taught, and then complete the formula. The specific formula for each type of objective has been specified by the profile, but their inclusion here would unnecessarily lengthen this chapter.

Third, after the objectives have been justified and adequately written, the test items should follow. Objectives are a form of generality for which test items are instances. Not only does the task–content table provide a set of formulas for writing quality objectives, but it also provides a set of formulas for writing test items that correspond to those objectives. These formulas also include the profile's aspects of test adequacy, as well as its aspects of objective–test consistency.

Fourth, with a consistent set of objectives and test items now developed, the profile provides a formula for preparing consistent presentations. The primary presentation forms that correspond to each task level (see Figure 6.12) represent a guide as to what the presentation should include. Using the prescriptions for these primary presentation forms, one can map out a skeleton lesson.

Fifth, and finally, the adequacy prescriptions indicate what each of the primary presentation forms needs to include, how additional examples should be designed and arranged, how feedback should be specified, etc. Again, the task–content table provides a set of formulas for designing each primary presentation form. There are at most 10 ways in which each primary presentation form should be designed, depending upon its task level and content type. These formulas include the aspects of which strategy components should be present in or with each presentation form (e.g., what kinds of helps), as well as aspects of the optimal makeup of each of those strategy components.

Using the profile as a design tool provides instruction that should already (i.e., without formative evaluation) have a high degree of effectiveness because of the previous validation of most of the principles that constitute the profile (see following section). It is advisable, of course, to subject the newly designed lesson to an empirical test in order to validate a particular application of these principles. It should not be necessary, however, to conduct as extensive an evaluation or as extensive revisions as would be required for a more intuitive approach to the design and development process.

Learning Strategies

The last application of the profile that we will discuss is the prescription of effective study skills for students. This application entails the use of the profile's principles as guides to effective ways to study. If a student knew

the principles of test–presentation consistency and presentation adequacy, then it would be easier to skip over irrelevant material, to search for essential information, and to organize it better (especially with respect to main ideas—generalities—versus illustrative material—instances—and with respect to knowledge on a remembering level versus on the using level).

It would also be easier for the student to determine whether or not a given presentation is adequate for learning what is necessary to pass the test. Thus a student could ask for examples when the presentation is inadequate in this regard. A student could ask for feedback with helps when this is not provided. One could request clarification as to what constitutes the primary generality versus what is elaboration or illustration. Such a set of study skills would probably make it much easier for a student to acquire the knowledge and behavior that a given set of instructional materials attempts to teach. Additional learning strategies can be found in O'Neil (1978) and O'Neil and Spielberger (1979).

RESEARCH SUPPORT

Over the past 6 years the Instructional Quality Profile and the principles underlying its formulation have been the subject of an intensive research effort. These research activities have involved several research methodologies, including experimental studies, correlation studies, and intervention studies.

Experimental Studies

One of our first major efforts to test the profile's principles was a review of experimental research literature (Merrill, Olsen, & Coldeway, 1976). Most of the studies reviewed were not purposely designed to test the profile's principles, and the vocabulary used by different investigators for the same variables differed considerably. Therefore, it was necessary to study the methods section of each study carefully and to reclassify the variables investigated on the basis of the profile's variables. In the process, many studies were rejected because sources of confounding were discovered. Of the many studies surveyed, 51 were selected as valid tests of one or more of the profile's principles. This review of research literature showed considerable empirical support for most of the principles. There were a few principles that no studies tested, and there were occasionl studies that showed no significant differences. But no studies contradicted any of the principles underlying the profile.

The authors and their asssociates have also devoted considerable time

and resources to designing and conducting new experimental studies to test more fully the contribution of each of the profile's variables. A detailed review is beyond the scope of this chapter. Research already completed includes the following. Olsen, Reigeluth, and Merrill (1976), Reigeluth (1977), and Reigeluth and Merrill (1977) investigated test–presentation consistency specifications of presentation forms (shown in Figure 6.12) for the use-a-generality task level. Wilcox, McLachlan, and Merrill (1978), and Wilcox, Richards, and Merrill (1978) investigated the isolation of presentation forms. Merrill and Tennyson (1971a) and Tennyson, Steve, and Boutwell (1975) investigated attention-focusing help for concept tasks. Coldeway and Merrill (1976), Wood, Gilstrap, and Merrill (1978), and Young, Smith, and Merrill (1972) investigated attention-focusing help on practice feedback for concept tasks. Wood, Gilstrap, and Merrill (1978) investigated alternative representations for generalities. Axtell and Merrill (1978) investigated the use of helps for generalities and instances. Merrill and Tennyson (1971b), Tennyson (1973), Tennyson, Steve, and Boutwell (1975), Tennyson, Woolley, and Merrill (1972), and Woolley (1971) investigated instance divergence and matching for concept tasks. Fletcher, Evans, and Merrill (1978) and Norton, Graham, and Merrill (1978) investigated instance divergence. Spiller, Rogers, and Merrill (1978) and Walker and Merrill (1978) investigated presentation form sequence.

In addition, about 25 research studies are in various stages of completion, including studies on presentation form sequence, instance number, generality and instance helps, practice feedback, attention-focusing help, and presentation form isolation.

In no case has any study that we have reviewed or conducted contradicted any of the profile's principles; all studies have either supported them or have shown no significant differences.

Correlation Studies

The purpose of these studies was to determine the degree to which consistency and adequacy indexes—as determined by profile ratings of existing instructional materials—correlate with student performance on the tests that correspond to those materials. The procedure consists of (*a*) identifying the presentation that corresponds to each test item; (*b*) rating each presentation using the profile's consistency and adequacy indexes; and (*c*) collecting test performance data on each test item (these are usually collected from existing sources—past tests). The presentations and their corresponding test items form the pairs for the correlation. Because several indexes are possible, multiple correlation is used.

No studies have been conducted yet on presentation adequacy, but

three studies (Wood, Richards, & Merrill, 1976) have been conducted for test–presentation consistency. The first was a college-level statistics course that was taught using a workbook. A multiple correlation showed that test–presentation consistency and test-item complexity together accounted for 50% of the student variance on the test. Consistency was not correlated alone, so we do not know its unadjusted contribution.

The second study involved a Navy course in electronics. The method of presentation was individual study. Test–presentation consistency and test-item complexity accounted for 58% of the student variance on the test.

The third study was a college-level physics course. This course had several components, including discussion sections, video tapes, textbook, and lectures. We analyzed only the textbook. Test-item complexity and consistency accounted for only 2% of the variance on the test.

After the high correlation in the previous studies, this latter result was very disappointing. But after careful analysis we realized that the test items were very different from the statistics and the electronics test items. The physics test items were mostly integrative items rather than items assessing a single principle, procedure, or concept (this distinction was illustrated in Figure 6.2). Furthermore, the methods of scoring for these items were very ambiguous. This has motivated us to extend the profile to a concern for content structure and integration (i.e., ways of organizing instruction on more than one conept, etc.).

The conclusion of these three studies is that the consistency index of the profile in its current version is an effective tool in predicting test performance when the test involves items that measure the use of a single concept, procedure, or principle but is less effective in predicting performance on tests that measure the integration of a set of interrelated ideas.

No correlation studies have been completed using the adequacy indexes or combinations of the consistency and adequacy indexes.

An Intervention Study

The purpose of this study is to see how much a course can be improved by the use of profile principles. The procedure entails (*a*) selecting a unit from an existing course in which students had demonstrated difficulty; (*b*) revising the unit using the profile as a guide; and (*c*) administering the modified materials to a group of students and comparing their performance with the performance of students on the original materials.

An intervention study has been conducted by our associates (Merrill, Wood, Baker, Ellis, & Wulfeck, 1978). It involved an individualized course for Navy enlisted men. The subject matter of the unit selected was

pumps. Twelve treatments were designed by varying different aspects of the profile variables. There were 20 students in each treatment. Eight of the treatments were designed to teach at the use-a-generality level and four of the treatments were designed to teach at the remember-an-instance level. The tests measured both ability to classify new instances of pumps—the use level—and ability to identify parts of a previously taught pump—the remember-an-instance level. Those trained with use treatments did significantly better on the use-level test items and significantly worse on the remember-level test items, whereas those trained with the remember treatments did significantly better on the remember-level test items and significantly worse on the use-level test items. This finding verifies the consistency hypothesis of the profile.

Within the eight use-level treatments, three specific presentation adequacy variables were manipulated: (*a*) the isolation of presentation forms; (*b*) the use of attention-focusing devices with instance displays; and (*c*) the use of a divergent set of instances for instance and instance practice displays.

On the use-level test items, the isolation groups performed significantly better than nonisolation groups, the divergent-instance groups performed significantly better than convergent-instance groups, and there were no significant differences between the attention-focusing groups and those which did not receive the attention-focusing material. This provides support for two of the three adequacy hypotheses tested.

Within the four remember-level treatments, one profile variable was manipulated—mnemonic versus no mnemonic—but there were no significant differences.

The conclusion of this study is that when the profile is used as a guide to revise materials in an ongoing instructional situation, performance can be improved over existing materials, and for the use level this improvement takes the specific forms predicted by the profile.

SUMMARY

In "Where Does It Fit?" we discussed the context of of the Instructional Quality Profile with respect to all of the aspects of the quality of instruction. That context is summarized in Figure 6.2.

In "What Does It Do?" we briefly described each of the six areas that must be analyzed in order to determine the quality of the instruction: (*a*) purpose–objective consistency; (*b*) objective adequacy; (*c*) objective–test consistency; (*d*) test adequacy; (*e*) test–presentation consistency; and (*f*) presentation adequacy.

In "How Does It Work?" we described the concepts, principles, and procedures that comprise the Instructional Quality Profile in each of the six areas. The procedures are summarized in Figure 6.13. Of these six areas, the profile probably makes the largest original contribution in Areas 5 and 6: test–presentation consistency and presentation adequacy. The principles of test–presentation consistency are summarized in the test–presentation consistency table (Figure 6.12). the principles of presentation adequacy are summarized in Figure 6.14.

In "Applications" we described five major applications of the principles underlying the profile: (*a*) diagnosing specific weaknesses in existing instruction; (*b*) rating the effectiveness of existing instruction; (*c*) prescribing revisions for existing instruction so as to eliminate those weaknesses; (*d*) prescribing ways to design more effective new instruction; and (*e*) prescribing an effective study strategy for students.

Finally, in "Research Support" we indicated that there is broad empirical support for the principles underlying the profile. This support comes from studies utilizing several different types of research methodology, including experimental studies, correlation studies, and an intervention study.

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