Applying Piaget's Stages of Intellectual Development and Guilford's Structure of Intellect Model to Training Instructional Developers

Kenneth H. Silber
University Professor of Educational Technology
College of Human Learning and Development
Governors State University
Park Forest South, IL 60466

Abstract. This article states and gives evidence that (1) there is a set of underlying skills required by the instructional developer to enable him or her to learn and apply specific ID skills; (2) these underlying skills take the form of a cognitive strategy—an internal thought and control process; (3) this cognitive strategy underlying ID is an internal problem solving process; (4) the components of this internal problem solving thought and control process underlying ID can be identified based on the theoretical frameworks of (a) Piaget's formal operational thought and (b) Guilford's structure of intellect model. In addition, this article reports the results of a preliminary study that indicate a strong relationship between formal operational thought and the ability to do ID. This article concludes that: There is little evidence that the cognitive strategy underlying ID can be taught to adult learners at all, and, if it can be taught, it can only be done (a) indirectly, by providing favorable conditions through instructional strategies and (b) over a long period of learning and practice. Consequently (1) more research is necessary; (2) we should use instructional strategies that create "favorable conditions" for developing cognitive strategy in our students; and (3) if we cannot teach the internal problem solving cognitive strategy that underlies ID, then we must use it as a screening device when selecting students for graduate ID programs.

The Problem

The prevailing approach to training instructional developers is based on the notion that performing instructional development is a process that requires a specific set of ID skills. Examples of such skills include conducting a needs assessment, analyzing a task, writing behavioral objectives, selecting media, conducting a formative evaluation, etc. Lists of such specific ID skills or competencies have been generated by Hendrix and Tiemann (1971), AECT (1974), and DID (1980).

The assumption in training instructional developers, based on this approach, seems to be that if one can competently perform these specific ID skills, then one will be a "good" developer. Based on this assumption, the small amount of discussion about training instructional developers that does occur (and there is precious little of such discussion) centers around what courses and learning resources are best suited to provide developers with these skills. The review of nine ID programs by Patridge and Tennyson (1978-79) and the article by Doughty and Durzo in this issue of *JID* reflect this approach.

The problem with the specific ID skills approach to training instructional developers is that those skills are *not* all it takes to make a "good" instructional developer. Bratton (see this issue of *JID*) suggests that the ability to understand the content, organization, values, and way of thinking of the discipline for which instruction is being developed is a critical skill for the developer to possess. Markle (see this issue of *JID*) argues that most instructional products do not require higher cognitive skills on the part of students—and that this may be the result of the lack of such skills by the developers. Wallington (1980 and this issue of *JID*) argues that there is a set of generic skills underlying the specific ID process: interpersonal communications skills, extracting and assimilating chunks of information and working them into a logical . . . framework, solving problems, applying principles of the behavioral sciences, and systematically searching for related information.

Thesis 1

These positions suggest the beginning point for this article:

> There is a basic set of underlying skills required of the instructional developer—skills that enable him or her to learn the specific ID skills in the first place and to apply them successfully on the job.

Next Steps

Merely suggesting this thesis is not enough. If it is to be useful in changing the way instructional developers are trained, it must be made more specific and practical by answering three questions:

(1) What is the nature of the underlying skills?

(2) What is the theoretical basis for identifying and categorizing these skills?

(3) Can these skills be taught to instructional developers? If so, how? Wallington's article (see this issue) takes one step toward answering question 1, but does not do so completely; it does not address questions 2 and 3 at all. This article will attempt to expand upon Wallington's list of generic skills, indicate two theoretical bases for identifying and categorizing the underlying skills, and draw some implications for the training of instructional developers.

Delimitations

This article will not concern itself with all possible underlying skills. It will limit itself to those skills underlying a major portion of the ID process—the cognitive processing of information in written and verbal forms. This delimitation means the article will not discuss two areas that are also an important part of the instructional developer's repertoire.

What will and will not be included can best be understood by reference to the four types of content identified by Guilford (1967). These are:

Semantic—"Semantic information is in the form of meaning to which words commonly become attached; hence it is most notable in verbal thinking and verbal communication" (p. 227).

Symbolic—"*Symbolic information is in the form of signs, materials, the elements having no significance in and of themselves, such as letters, numbers, musical notations, and other 'code' elements*" (p. 227, italics as in original).

Figural—"*Figural information is in concrete form, as perceived or as recalled in the form of images*" (p. 227, italics as in original).

Behavioral—"*Behavioral content* is defined as information, essentially nonverbal, involved in human interactions, where awareness of attention, perceptions, thoughts, desires, feelings, moods, emotions, intentions, and actions of other persons and of ourselves are important" (p. 77, italics as in original).

This article will address itself to the cognitive processing of semantic and symbolic content. It will not address the figural and behavior content areas. This is done because although there is sufficient theoretical and research information regarding the former types, there has been little or no work done on the latter two.

The omission of behavioral content is important because it is that type that the developer uses in interacting with subject-matter experts and others on a development team. The omission of figural content is important because it is that content type that is used by the developer in any media production.

When sufficient research and theory about these two types become available, an analysis comparable to the one done here for semantic and symbolic content ought to be attempted.

Nature of the Underlying Skills

In addition to Wallington's generic skills cited earlier, indications of the nature of the underlying skills can be found in three different sources: (1) a common sense analysis of the process of thinking while performing ID, (2) the types of capabilities identified by Gagné and Briggs, and (3) an operational model of problem solving.

A common thread runs through all three—they relate to the internal thinking processes that an instructional developer uses to perform the specific ID skills.

Thinking During ID. If we carefully analyze what happens to and within the developer during the ID process, something like the following pattern emerges:

(a) The developer is presented with some problem related to learning and/or performance.

(b) The developer must gather information about the problem, analyze it, synthesize it into some coherent statement, and evaluate the statement in terms of reality.

(c) The developer is presented with a body of content, usually in verbal written form, that he or she must learn or develop a cognitive structure for.

(d) The developer must analyze that body of content and restructure (or synthesize) it into a form that takes into account both the integrity of the content and the learning and instructional principles to be applied to it.

(e) The developer must evaluate the accuracy and adequacy of this restructuring and restructure again if the original attempt is not successful.

(f) The developer must translate the verbal written form of the content into other communication formats, such as visual and oral media.

The thinking processes underlying the specific ID skills, according to this analysis, are: gathering information, analyzing information, learning information, synthesizing information, evaluating solutions and information, restructuring information, re-restructuring information, and translating information into another format.

Types of Capabilities. Another more theoretically based way of looking at the thinking processes underlying ID skills is based on the notion of types of capabilities (Gagné & Briggs, 1979).

If one looks at the specific ID skills as separate entities, they can be seen as *intellectual skills:*

> Intellectual skills are the capabilities that make the human individual *competent.* They enable him to respond to conceptualizations of his environment . . . . Learning an intellectual skill means learning *how to do something* of an intellectual sort. (Gagné & Briggs, 1979, p. 49, italics as in original)

More specifically, applying the specific ID skills can be seen as either rule using or problem-solving-level intellectual skills:

> A rule has been learned when it is possible to say with confidence that the learner's performance has a kind of "regularity" over a variety of specific situations. In other words, the learner shows he is able to respond with a *class* of relationships among *classes* of objects and events. (Gagné & Briggs, 1979, p. 67, italics as in original)

> Sometimes, the rules which human beings learn are complex combinations of simpler rules. Moreover, it is often the case that these more complex, or "higher order" rules are invented for the purpose of solving a practical problem or class of problems . . . . In attaining a workable solution to a problem students also . . . learn something which can be generalized to other problems having similar formal characteristics (Gagné & Briggs, 1979, p. 69)

For example, the specific ID skill of writing behavioral objectives in Magerian form following Gagné's types of capabilities is rule using; one applies the relationships that make up a "correct" behavioral objective to the relationships in the content to write behavioral objectives. The specific ID skills of developing the relationships within the content itself, by selecting among the information processing approach, the task classification approach, the learning task analysis approach, the content analyses approach, or some combination of these, and then applying the selected approach to the content, is an example of problem solving.

It is the view of this paper, however, that more important insights about the internal thinking processes used by a person doing ID can be gained by viewing the entire ID process as a cognitive strategy:

> A cognitive strategy is a *control process*, an internal process by means of which learners select and modify

their ways of attending, learning, remembering, and thinking . . . . A cognitive strategy is an *internally organized* skill that selects and guides the internal processes involved in defining and solving novel problems . . . cognitive strategies have as their objects the *learner's own thought processes*. (Gagné & Briggs, 1979, pp. 71-72, italics as in original)

The capability of cognitive strategy fits more closely than does intellectual skill, the internal thought processes (described earlier) that underlie and control the specific ID skills, and the generic skills identified by Wallington.

For example, if one were faced with a problem, and one's internally organized thought processes automatically began to attend to and think about that problem as an ID-related one, and one's internal control process automatically began to call upon, select, and utilize the specific ID skills to define and solve the problem, then one would be employing a cognitive strategy.

We can conclude, therefore, that cognitive strategy is the internal control process for the specific intellectual skills of ID and the internal thought process that underlies and guides the use of the specific ID skills.

Further, viewing the use of the total ID process as a cognitive strategy has implications for explaining differences in effectiveness and efficiency of developers. Gagné and Briggs (1979) assert that:

> The efficacy of an individual's cognitive strategies exerts a crucial effect upon the quality of his thought. They may determine, for example, how creatively he thinks, how fluently he thinks, and how critically he thinks. (p. 72)

Thus, it is possible for a developer to possess the specific ID skills, but not bring them to bear on a problem at the right time, in the right manner, with the right results because he or she does not possess the internal control and thought process—the cognitive strategy—to select and utilize those specific skills in an appropriate manner.

Problem Solving. As was noted earlier, the developer's thought processes begin when he or she is presented with a problem and end when that problem is solved. The internal thought process underlying ID can, therefore, be viewed as a specific case of a general problem solving model.

Guilford (1967) suggests that Rossman's (1931) set of problem solving steps contains all the steps of classical problem solving models, as well as more recent models emphasizing information processing. Rossman's steps are: (1) need or difficulty observed, (2) problem formulated, (3) available information surveyed, (4) solutions formulated, (5) solutions critically examined, (6) new ideas formulated, and (7) new ideas tested and accepted (Rossman, quoted in Guilford, 1967, p. 313).

Viewing the internal thought process underlying ID as a problem solving process as defined by this model has several advantages: (a) it links the "common-sense-generated" list of "thought processes during ID" identified above to a theoretical model; (b) it links Wallington's generic skills identified above to a theoretical model; and (c) it supports the notion that the thought process underlying ID is a cognitive strategy as discussed above, and, further, delineates specific components of that strategy in terms of two theoretical models.

Thesis 2

We can summarize the discussion of the nature of the skills underlying ID by stating that:

> There is an internal thought and control process—a cognitive strategy—that underlies the use of specific ID skills.

Thesis 3

We can even go one step further and make a general statement that:

> The cognitive strategy underlying ID is an internal, problem solving thought and control process.

Delineation of the Cognitive Strategy

If we accept Thesis 3, then we are faced with the task of delineating the component parts of the cognitive strategy based on some theoretical framework. According to Gagné and Briggs, this is a difficult task:

> Internally organized strategies that govern the learner's behavior come in several varieties. At present, it is not possible to identify them singly with any degree of confidence, much less name them. (Gagné & Briggs, 1979, p. 52)

The identification of the cognitive strategy involved here as a problem solving one, and the description of that problem solving process by both steps and an operational model, as was done earlier, indicate that the task is *not* as impossible as Gagné and Briggs would have us believe.

Fortunately there are two theoretical frameworks that provide a basis for doing this. The first is Piaget's stages of intellectual development; the second is Guilford's structure of intellect model. The next two sections will describe how these theoretical frameworks can help identify the components, or subordinate skills, of the problem solving cognitive strategy underlying ID.

Piaget's Stages of Intellectual Development

It is not within the scope of this paper to review all of Piagetian theory, nor to discuss all of the developmental stages Piaget identifies. (See Inhelder & Piaget, 1958.)

The stages that *might* be relevant to the cognitive strategy being addressed here are the concrete operational and the formal operational stages. An analysis of the characteristics of these two stages points out some important, theoretically based characteristics of that strategy. Some characteristics of the concrete and formal operational stages are shown in Table 1 (Harmon & King, 1979, p. 17).

Based on these characteristics, and how they operate in each stage, it seems clear that the internal problem solving thought and control process, the cognitive strategy, underlying instructional development consists of formal operations.

If we match the steps or operations of the problem solving process with the characteristics of formal operations, it becomes clear that formal operations are required for, and are the components of, this cognitive strategy.

Components of the strategy identified in the table include: use of models; use of relationships between two or more variables; generation of hypotheses; thinking in terms of abstract patterns, concepts, properties; awareness of own reasoning; and checking on validity of conclusions.

In addition Harmon and King elaborate on some of the processes formal operators use—and, again, these are clearly components of the cognitive strategy we have been analyzing:

- "Identify and abstract a pattern and use their knowledge of that pattern to be systematic in solving some problem."
- "Adapt a systematic method."
- "Begin by recognizing that a particular instance is an example of some class of similar situations."
- "Use what they know about the class in general to predict a number of different possibilities relative to the given situation."
- "(Recognize) the abstract model or pattern that the particular problem only typifies or concretizes."
- "Begin with an abstract model or set of variables."
- "Consider both what actually exists at the moment and what other possibilities are latent in the particular situation."
- "Coordinate two or more disparate referential systems" (Harmon & King, 1979, pp. 14 & 15).

Thesis 4

The incredible parallel between the characteristics of formal operational thought and the cognitive strategy we have said underlies ID leads to Thesis 4 of this paper:

> The characteristics of Piaget's formal operational thought provide a theoretically based identification of the components of the internal problem solving thought and control cognitive strategy underlying ID.

TABLE 1. A comparison of concrete and formal operations. From "Operant Learning, Cognitive Development, and Job Aids," *Improving Human Performance Quarterly*, 1979, 8, 1, 17. Reprinted by permission.

	CONCRETE OPERATIONS	FORMAL OPERATIONS
Relevant to Model Building	Must use models whose components are real things.	Can use models that have abstract or symbol components.
	Can *not* use explanations that involve two or more independent variables or that depend on the control of one variable while another is being examined.	Can use explanations that involve two or more independent variables and/or that depend on control of variables as part of the analysis.
	Can *not* expect student to generate hypotheses, or think in terms of abstract patterns.	Can expect the student to generate hypotheses and to think in terms of abstract patterns.
	Can *not* expect student to be aware of his/her own reasoning, inconsistencies among various statements he makes, or contradictions with other known facts.	Student is aware and critical of his own reasoning and actively seeks checks on the validity of conclusions by appealing to other known information.
Relevant to Exercise Construction	Needs reference to familiar objects, actions, and observable properties.	Can reason with concepts, relationships, abstract properties, axioms and theories; uses symbols to express ideas.
	Need step-by-step instructions for complex procedures; should use successive approximations and emphasize practice.	Emphasize theory and/or overview.

Guilford's Structure of Intellect Model

Again, it is beyond the scope of this paper to explain completely the structure of intellect model. The model itself is shown in Figure 1 (Guilford, 1967; inside cover).

The internal problem solving thought and control cognitive strategy that has been discussed in this paper was studied extensively by Merrifield, Guilford, Christensen, and Frick (1962).

Based on simplified versions of the problem solving steps and the operational problem solving model described earlier, the authors hypothesized six abilities that made up problem solving: (1) think rapidly of several attributes or characteristics of a given object, (2) classify objects or ideas, (3) find different relationships, (4) think of alternative outcomes, (5) think of attributes of a desired goal, and (6) educe logically sufficient antecedents. For each ability, they hypothesized which SI cells would make up that ability.

The results of the study supported the notion that problem solving is too broad to be explained by a simple ability:

> There is no evidence whatever that problem solving as measured by these criterion tests is a unitary ability. (Merrifield, et al., 1962, p. 19)

Further, the study showed that the six problem solving abilities hypothesized

> and tested in this study can be explained in terms of factor dimensions that have logical positions in the structure of intellect. (Merrifield, et al., 1962, p. 19)

The most important result of the study was the identification of the 12 structure of intellect factors that make up problem solving. These specific factors are given below, using both the SI cell indicator and the common name for the represented ability as designed by Guilford:

CMU—verbal comprehension
CMC—conceptual classification
CMR—awareness of conceptual relations
CMS—general reasoning
CMI—conceptual foresight
DMU—ideational fluency
DMR—associational fluency
DMT—originality/spontaneous flexibility
NMC—production of categories of meaning
NMR—production of conceptual correlates/relations
NMI—deduction, and
EMI—sensitivity to problems.
(Merrifield, et al., 1962, pp. 3–4, 14–18)

These 12 factors are similar to the abilities suggested by Piaget's formal operational thought described earlier, meet the definition of components of a cognitive strategy, and match the "common sense" analysis of what thought processes a developer uses.

Thesis 5

Because of this similarity, we can state that:

Guilford's structure of intellect model provides a theoretically based identification of the 12 factors that make up the internal problem solving thought and control cognitive strategy underlying ID.

Testing the Two Theoretical Frameworks

Despite the logical soundness and theoretical bases of the five theses presented thus far, the theses are, at present, unproven hypotheses. There is no evidence, at present, to suggest either a positive or negative relationship between possession of Piaget's formal operational thought or Guilford's problem solving SI factors and the ability to do instructional development.

Such a relationship must be shown to exist before any changes in the training of instructional developers are made based on the theses suggested here.

The author has just completed a pilot study that addresses the relationship between possession of formal operational thought and success in an instructional development course at Governors State University (Woodward, Silber, & Jahn, 1981). At the beginning of the course, students were given the Test of Level of Thinking (TOLT) (Tobin & Capie, 1980a, 1980b). This 10-item test contains two items that measure each of five elements of formal operational thought: (1) proportional reasoning, (2) controlling variables, (3) probabilistic reasoning, (4) correlational reasoning, and (5) combinatorial reasoning.

A score of 4 or more indicates the person is operating at the formal operational level. The test has been shown to be both valid and reliable (Tobin & Capie, 1980a, 1980b). Test scores were correlated with: (a) course grade, (b) number of times an ID project had to be redone, (c) conceptual grasp (vs. mere performance) of the ID process, and (d) the instructor's subjective judgment of the student's performance as a developer.

Results showed that the score on total TOLT and on the questions measuring control of variables and combinatorial reasoning correlated .70 with course grade, conceptual grasp of the ID process, and the subjective rating.

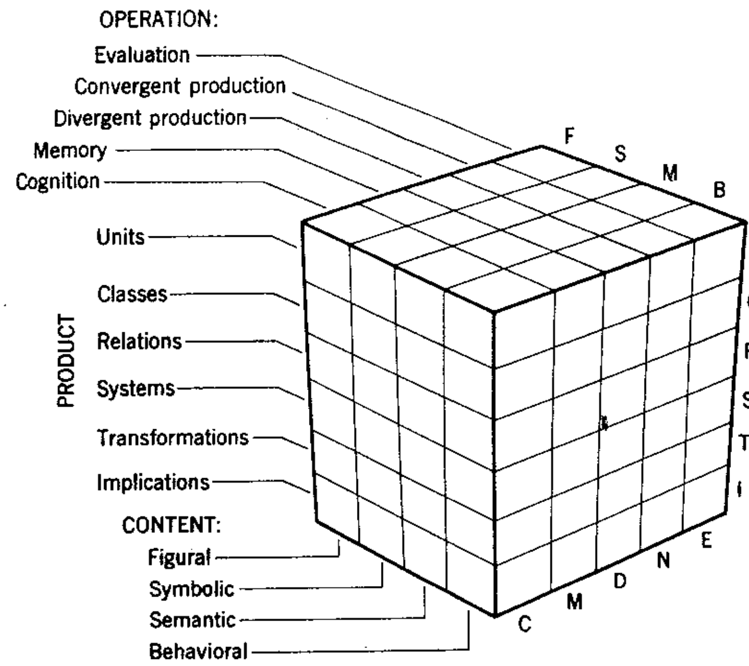

FIGURE 1. The structure of intellect model. From *The Nature of Human Intelligence* by Guilford. Copyright 1967, McGraw-Hill. Used with permission of McGraw-Hill Book Company.

These results indicate a strong relationship between the possession of formal operational thought and both the ability to *do* instructional development well and the ability to *understand* what the ID process is and how and why it works.

They support Theses 1-4—that is, there is an internal, problem solving thought and control cognitive strategy underlying ID that is based on the components of Piaget's formal operational thought. Further, they suggest that possession of this cognitive strategy is necessary to apply the specific ID skills well.

The author is currently conducting more extensive and better controlled studies at eight ID training programs, using both the TOLT and tests for Guilford's 12 factors, to try to (a) further prove the existence of the underlying cognitive strategy, (b) show its importance in being able to apply the specific ID skills, and (c) test and compare Piaget's components of formal operational thought and Guilford's problem-solving factors as theoretically based delineations of the components of the cognitive strategy underlying ID.

Review

Thus far, we have stated and given evidence that:

1. there is a set of underlying skills required by the instructional developer to enable him or her to learn and apply specific ID skills;
2. these underlying skills take the form of a cognitive strategy—an internal thought and control process;
3. this cognitive strategy underlying ID is an internal problem solving process;
4. the components of this internal problem solving thought and control process underlying ID can be identified based on the theoretical frameworks of: (a) Piaget's formal operational thought, and (b) Guilford's structure of intellect model.

In addition, we have reported the results of a preliminary study that indicate a strong relationship between the possession of formal operational thought and the ability to do ID.

Thesis 6

Based on what has been shown in this article, it is clear that any listing of "ID Competencies" that includes only "Specific ID" skills is incomplete. Both Gagné and Briggs' theoretical assertion (cited earlier) that the quality of an individual's cognitive strategy affects his or her ability to apply intellectual skills, and the results of the preliminary study (cited earlier), which show that possession of formal operational thought is related to the ability to do ID, we can conclude that:

> A competent instructional developer should possess the internal problem solving thought and control cognitive strategy underlying ID, with the component elements as identified by Piaget or Guilford.

The next logical question, then, is the final one this article will address: Can this cognitive strategy be taught to instructional developers, and, if so, how?

Training Instructional Developers

The logical conclusion from what has been said so far is that we ought to add—either in our content or our methodology—learning activities that teach the cognitive strategy underlying ID to the courses we already teach dealing with the specific ID skills.

Unfortunately, the situation is not as simple as this. There is considerable debate about (a) whether the cognitive strategy can be taught at all and, (b) if it can be taught, how best to do it.

Can it be taught? Many ID trainers will see this as a moot question. They would argue that since, according to Piaget, one reaches formal operational thought at the age of 15, and since their students are older than that, there is no need to teach the cognitive strategy at all—ID students already possess it.

Studies cited by Harmon and King (1979) indicate that this is *not* the case:

- From 40 to 60% of sampled college students function at the concrete operational level.
- Many adults function at the concrete level when they interact with tasks with which they are not familiar (Harmon & King, 1979, p. 13).

This conclusion was born out by the preliminary study (Woodward, Silber, & Jahn, 1981) where only 65.7% of the students, with a mean age of 35, functioned at the formal operational level.

Thus most ID trainers *will* need to think about teaching their students the cognitive strategy underlying ID. Guilford believes that this can be done:

> From numerous investigations on the question concerning training aimed at the improvement of creative potential we have considerable reason for guarded optimism. The writer shares the view . . . [that] thinking abilities as intellectual skills . . . are trainable . . . . They have been developed largely by informal practice, and they should be improvable by virture of formal practice. (Guilford, 1967, p. 336)

There are, however, two problems with Guilford's assertion. First, all the studies Guilford cites deal with the improvement of creativity, not with the improvement of the 12 factors the Merrifield study showed to be the elements of the problem solving cognitive strategy. Second, and perhaps more important, all the studies Guilford cites were done with elementary and high school students, not with college students and adults.

Harmon and King reach a different conclusion. Though they admit that the research on teaching formal operational thought is complex, and that no easy conclusion can be reached, they conclude—after reviewing seven studies:

> Insofar as we can teach *formal operational thought*, suffice it to say that it takes a lot of time and effort and is only partially successful. (Harmon & King, 1979, p. 18, italics as in original)

Of the two reasons Harmon and King give for their negative conclusion, the former—time and effort—is a pragmatic concern, while the latter—partially successful—is a more fundamental, theoretical concern.

Gagné (1977) expresses the same theoretical and pragmatic concerns. He begins by citing the positive results of studies using the Productive Thinking Program to teach students such cognitive strategies as generating new and unusual ideas, breaking mental sets to look at problems differently, attending to relevant facts and conditions of the problem, etc., and states that "there is some evidence, then, that cognitive strategies applicable to thinking and problem solving can be learned" (Gagné, 1977, p. 176). He switches positions, however, in his conclusion on the matter:

> At the same time, . . . it has apparently not been easy to show that deliberate attempts to teach cognitive strategies result in consistent and substantial learning and transfer of learning. Regardless of the nearly universal agreement on the educational goal of "teaching students to think," the evidence that this goal can be successfully accomplished when deliberately undertaken is actually quite meager at the present time. (Gagné, 1977, p. 176)

Gagné also addresses the pragmatic concern when he discusses how long it takes to learn cognitive strategies. While again citing one study in which "children seemed to acquire new strategies after only a small amount of instruction," (Gagne, 1977, p. 177) he notes that many

> adults have been convinced by their own experiences that strategies of thinking are seldom acquired quickly, but may require years of practice to reach the stage of refinement at which they are transferable to novel problem solving situations. (Gagné, 1977, p. 177)

From the positive and negative statements of these three sources, we can draw the following theoretical and pragmatic conclusions about whether the cognitive strategy underlying ID can be taught to college students:

- There is a little evidence that cognitive strategies can be taught to children;
- There is very little evidence at all that cognitive strategies can be taught to adults;
- If they can be taught to adults, it may require years of practice for them to learn and use a cognitive strategy.

How can they be taught? There is even less evidence about how to teach cognitive strategies than there is about whether they can be taught. Harmon and King (1979) provide an approach to teaching formal content to concrete operational students—but this is *not* the same as teaching formal operational thought—or a cognitive strategy—itself. The literature cited by Guilford (1967) related to teaching creativity and problem solving is *not* relevant because it treats problem solving as an intellectual skill applied to external problems, rather than problem solving as we have been discussing it here—a cognitive strategy that controls internal thought processes.

Gagné and Briggs (1979) clearly identify the difficulty of teaching cognitive strategies:

> In the case of other types of intellectual skills, one can plan a sequence of learning events external to the learner which will insure the learning of those skills. But cognitive strategies require a more indirect control; one has to organize external events so as to increase the probability of certain internal events; and these in turn determine the learning of the cognitive strategy. Accordingly, the design of instruction for cognitive strategies has to be done in terms of "favorable conditions," and cannot be accomplished by specifying the "sufficient conditions." (Gagné & Briggs, 1979, p. 72)

The most definitive statement Gagné and Briggs can make about teaching cognitive strategies is: "Generally, the favorable conditions are those which *provide opportunities for development and use* of cognitive strategies" (Gagné & Briggs, 1979, p. 73, italics as in original).

Thus, if we are to attempt to teach cognitive strategies, it should be not with a course on creative problem solving, but rather by incorporating instructional strategies into all courses we teach that demand that the student develop and use the problem solving cognitive strategy underlying ID. Gagné (1977) notes, however, that such an approach can take away from the learning of other kinds of capabilities.

From this literature, we can conclude: It is extremely difficult to teach cognitive strategies; the best we can do is to provide favorable (as opposed to sufficient) conditions for their development; the way to provide favorable conditions is through instructional strategies that call for the student to develop and constantly use the cognitive strategy; and the emphasis on teaching cognitive strategies can take away from the learning of other kinds of capabilities.

Thesis 7

Based on the discussions of whether the cognitive strategy underlying ID can be taught and, if so, how, we can state that:

> There is little evidence that the cognitive strategy underlying ID can be taught to adult learners at all, and, if it can be taught, it can only be done (a) indirectly, by providing favorable conditions through instructional strategies, and (b) over a long period of learning and practice.

Implications for ID Trainers

It is most disconcerting for this writer (and, surely, for the reader) to come this far and discover that: There is an internal problem solving thought and control cognitive strategy underlying ID, its nature and elements can be delineated by two theoretical models, and it is essential for instructional developers to possess this strategy since it can affect their ability to perform specific ID skills. At the same time: There is little evidence that the cognitive strategy can be taught to adults, and if it can it can only be taught indirectly and over a long period of time.

From this unfortunate situation, the author can draw three implications—two fairly straightforward, but not promising any immediate results, and one controversial, which will have the effect of immediately improving the quality of instructional developers we train.

1. *More Research.* It is clear that more research needs to be done in two areas. First, we must do more studies that validate the nature of cognitive strategy underlying ID and confirm its importance. Second, we must begin to do extensive research on instructional methodologies for teaching cognitive strategies to adults. With this research, we will confirm the correctness of Theses 1-6 and begin to eliminate the problems created by Thesis 7.

2. *Instructional Strategies.* We must begin immediately to use instructional strategies that create favorable conditions for the development of the cognitive strategy in our students. We must use techniques that help students learn and practice the elements of formal operational thought and the problem solving factors of the structure of intellect model. Our instructional strategies must require students to: identify and abstract patterns, adapt a systematic method, use models, use relationships between two or more variables, generate and test hypotheses, check on the validity of their own reasoning, produce categories of meaning, be sensitive to problems, be spontaneously flexible, be fluent both ideationally and associationally, etc.

3. *Screening.* If we cannot teach the internal problem solving cognitive strategy that underlies ID, then we must use it as a screening device. We must only allow into graduate ID programs those students who already use formal operational thought and who possess the SI problem solving abilities—the cognitive strategy.

This conclusion may be an unpopular one. But consider the alternatives for the profession of instructional development. If some of the graduates of ID training programs are not effective developers because they do not possess the thought processes and abilities to implement the internal problem solving instructional strategy that underlies ID and thus to use specific ID skills effectively, then those who use our services will begin to wonder even more than they do now—only this time with justification—what good we are, and how we can help them improve instruction.

This is a sad conclusion to reach after such an extensive analysis of what the basis of ID is, but I submit it is better to use this analysis to be realistic than to continue kidding ourselves that we can train effective developers by teaching only "specific ID skills."

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