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Editors-in-Chief

TORSTEN HUSEN
University of Stockholm, Sweden

T. NEVILLE POSTLETHWAITE
University of Hamburg, FRG

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D. D. Marsh

Instructional Strategies and Tactics

Instructional strategies and tactics are subsets of methods of instruction. Strategies are more global and encompassing than tactics. Anyone concerned with teaching or designing instructional systems must make decisions about which instructional strategies and tactics to use. Those decisions will influence the effectiveness, efficiency, and appeal of the instruction.

1. An Organizing Scheme

In prescribing instructional strategies and tactics, the three most important concerns are outcomes, conditions, and methods (Reigeluth 1983a). Briefly, the outcomes are the effects of the methods of instruction: their effectiveness, efficiency, and appeal. The conditions influence the effects of the methods and therefore influence the selection of methods. They include the nature of the content, the learners, the learning environment, and the constraints of the development process. The methods of instruction are the means that can be used to improve the outcomes under different conditions.

Practitioners who need to create instruction must be concerned with the following kinds of methods:

(a) Organizational strategies, including: microstrategies—tactics for teaching a single piece of the content (see Merrill 1983), such as generalities, examples, and practice; midlevel strategies—approaches that apply to a set of pieces of the content, providing a framework for the tactics (see Romiszowski 1984), such as an expositive strategy or an experiential strategy; and macrostrategies—strategies for selecting, structuring, sequencing, synthesizing, and summarizing large chunks of content (e.g., a course or curriculum), providing a framework for the midlevel strategies.

(b) Mediational strategies, which are concerned with the way in which the organizational strategies are mediated (sometimes referred to as delivery strategies).

(c) Management strategies, which are concerned with the way in which the organizational and mediational strategies are controlled, including such concerns as mastery learning and learner control.

Given that microorganizational strategies are the ones which have been most thoroughly developed to date, this article will concentrate on them, with brief status reports on the other kinds of strategies.

2. Microorganizational Strategies

Many instructional theorists have proposed that the selection of microorganizational strategies and tactics should depend primarily on the nature of what is to be learned (see Reigeluth 1983b). Different theorists have offered different taxonomies of "what is to be learned," but there is a surprising degree of similarity among those taxonomies.

Perhaps the first type of learning to be analyzed and investigated (because it is the simplest, most superficial type of learning) is what Bloom calls "knowledge" (Bloom 1956). Merrill refers to this type of learning as "remember verbatim" (Merrill et al. 1979), and Ausubel calls it "rote learning" (Ausubel et al. 1978). It is also one aspect of Gagné's "verbal information" (Gagné 1985).

A more complex type of learning is what Bloom calls "application." Merrill refers to it as "use-a-generality," and Gagné calls it "intellectual skills." Certainly, learning to apply a rule requires very different methods of instruction from just memorizing it.

An even more complex type of learning has only recently begun to receive widespread investigation

under the rubrics of "thinking skills" and "learning strategies." It includes Bloom's higher levels ("analysis," "synthesis," and "evaluation"), Merrill's "find-a-generality," and Gagné's "cognitive strategies."

Interestingly, several of these taxonomies of learning have identified another type of learning which has been largely ignored by instructional theorists until now, and in fact was even largely ignored by learning theorists until recently. It is similar to (though somewhat more complex than) what Bloom calls "comprehension" and what Merrill refers to as "remember paraphrased," and comes closest to what Ausubel identifies as "meaningful verbal learning." It is also the other aspect of Gagné's "verbal information." When students have to learn what an atom is, one hardly has concept classification (applying the concept) in mind. The learners are not expected to be in a situation where they need to be able to say, "Oh! Look at that! That's an atom!" And their teachers certainly don't want them just to recall by rote what an atom is. There is clearly another type of learning which is perhaps best characterized by the word "understanding." It seems to arise through the construction of meaningful (nonarbitrary) linkages or relationships between the new idea and what the learner already knows.

In sum, there are in the cognitive domain four major types of learning which require very different methods of instruction. The most "intuitive" labels may be: (a) memorizing information, (b) understanding relationships, (c) applying skills, and (d) applying generic skills. The various types of "domain dependent" content (content in the subject areas), such as concepts, procedures, and principles, can be acquired as any one of the first three types of learning. A concept can be memorized (either its definition or an example of it), or it can be understood (its relationships with other knowledge), or it can be applied (instances can be classified as examples or nonexamples of it). The fourth kind of learning is "domain independent" and generally requires more time to acquire. There is strong evidence that these four types of learning dictate different choices of strategies and tactics more than any other consideration or factor.

It is important to note that these types of learning are not levels of learning in the sense that one level must be acquired before another level can be acquired. People often acquire rules on an application level without being able to verbalize or state the rules. This happens to all ages, from children (e.g., linguistic rules) to experts in complex domains (e.g., problem solvers and strategists). Also, many procedures are learned on the application level without any understanding of what is happening or why it works. Math and statistics are often learned this way. And students clearly do not need to memorize a passage in order to be able to understand it.

2.1 Facilitating Memorization

The field of instructional theory has grown out of a behavioral orientation which focused most efforts on prescriptions for memorizing information (association tasks). Research has shown that there are three tactics which should universally be used to facilitate this type of learning: presentation, practice, and feedback. First, present the information that is to be memorized. Second, provide the learner with opportunities to practice remembering it under conditions typical of the postinstructional requirements. Finally, provide immediate feedback on each practice, by confirming correct answers or giving the correct answer on wrong answers.

Additional tactics include: repetition, chunking, prompting, and mnemomics. Practice opportunities should be repeated until the learner has mastered the information. If more than about seven items of information are to be memorized, then the items should be chunked into groups of no more than about seven items each; and the presentations, practice, and feedback should focus exclusively on one chunk until it is mastered. Prompting is a way of helping learners when they cannot remember the information. Prompts are designed to help the learner establish retrieval cues. Mnemonics, which are based primarily on cognitive theory, can greatly decrease the amount of time and effort students need to memorize information. They include first-letter mnemonics (acronyms), phrases, visual images, rhymes, and songs.

2.2 Facilitating Application of Skills

The behavioral orientation of learning theory and instructional theory also yielded some valuable prescriptions for teaching skill application (especially concept classification and procedure using). Merrill's (1983) component display theory extends the notion of presentation-practice-feedback to generality-examples-practice-feedback. The generality is a definition of the concept or statement of the procedure or principle. The examples are instances of the concept or demonstrations of the procedure or principle. The practice is an opportunity for the learner to classify new instances of the concept; to perform the procedure in a new situation; or to use the principle to predict effects, explain causes, or implement solutions (achieve desired effects) in new situations (Merrill 1983, Reigeluth and Schwartz 1989). The feedback confirms a correct answer or corrects the learner's cognitive processing on wrong answers.

Additional tactics include consistency, divergence, progression of difficulty, attention focusing, and alternative representation, among others. Consistency entails making the examples, practice, and test items as similar as possible to the post-instructional requirements. Divergence entails

making the examples as different as possible from each other, making the practice items as different as possible from each other, and making the test items as different as possible from each other. The examples and practice should also be arranged in an easy-to-difficult order. The learner's attention should be focused on important aspects of the generality, examples, and feedback, through use of color, comments, shading, zooming, animation, loudness, and so forth. And the generality, examples, and practice items should often be represented in a different form, such as realia, iconic, and abstract (symbolic) forms. For a review of research on each of these tactics, see Merrill et al. (1976).

2.3 Facilitating Understanding

Behavioral theory has little to say about how to facilitate understanding. Hence, there is relatively little in the way of validated prescriptions for facilitating the acquisition of understanding (meaningful learning). What work has been done has largely been on the development of descriptive learning theory (cognitive theory), rather than prescriptive instructional theory, with the exception of Ausubel's work (see Ausubel et al. 1978).

There appear to be two different kinds of understanding which require very different instructional strategies and tactics. One is what might be called conceptual understanding, for it entails understanding an idea by relating it to other knowledge in a semantic network or schema. Crucial to this form of understanding is identifying the kinds of relationships which represent important dimensions of understanding for the new idea (Lindsay and Norman 1977). They may include superordinate, coordinate, and subordinate relationships, as well as analogical, experiential, functional, and others. Once the important relationships have been identified, it is possible to select a tactic appropriate for teaching each. Superordinate relationships are built by relating the new knowledge to a meaningful context or advance organizer. Coordinate relationships are built through comparison and contrast, subordinate through analysis of varieties and/or components, analogical through comparison and contrast with an analogy, and experiential through description of concrete examples or case studies.

The other kind of understanding is what might be called causal understanding, or mental model, for it entails understanding an interrelated set of causal relationships and interdependencies. Since causal models are usually quite complex, one important instructional strategy is to use an elaboration sequence based on simplifying conditions (Reigeluth 1987; see section 2.8 below). For example, White and Frederiksen (1987) designed a progression of microworlds (computer-based simulations) for teaching the laws of motion. The first microworld was the simplest because it stipulated many simplifying conditions, such as that the object could move in one-dimensional space only and there was no friction. The conditions simplified the causal model to the point where it could be relatively easily acquired by experimenting in the microworld. Then those simplying conditions were gradually relaxed, one or two at a time, requiring the causal model to gradually grow in complexity. Other important tactics appear to be: labeled illustrations (Mayer 1989), demonstrations, exploration, and practice in predicting, explaining (or inferring), and solving problems (Reigeluth and Schwartz 1989).

2.4 Facilitating Application of Generic Skills

Behavioral theory has not contributed much to knowledge about how to teach generic skills. However, instructional theorists and cognitive scientists have recently begun to devote greater attention to generic skills: thinking skills, problem-solving skills, learning strategies, and metacognition. Of the work that has been done here, most of it has been on deciding what to teach rather than how to teach it. It seems likely that the most important methods will be a good simple-to-complex sequencing strategy for teaching any given generic skill, and prescriptions for integrating such single-skill sequences with each other and with a range of domain-dependent content sequences (both are macro-organizational strategies). Other than this, it seems likely that a generic skill will have to be analyzed as to its skill (primarily procedure-using) components and its understanding components, and that those components will be taught using the micro-organizational strategies and tactics appropriate to each.

2.5 Affective Learning

These four types of cognitive learning (memorizing, applying, understanding, and generic skills) represent important aspects of instructional theory. But another important aspect is affective learning: attitudes and values, morals and ethics, social development, emotional development, personal development, and such. Martin and Briggs (1986) have provided a beginning for instructional prescriptions in this area.

2.6 Other Considerations

However, the selection of microorganizational strategies and tactics should not just depend on the nature of the content. The nature of the learner is important, as well as the capabilities of the media that are selected. There is growing evidence that the nature of the learner has the greatest influence on decisions about what to teach, rather than how to teach it (Jonassen 1982). It is not desirable to teach things which the learner has already mastered, for that would be a waste of time and money, and it would demotivate the learner. On the opposite extreme, it is undesirable to teach things which are

too far beyond the learner's current knowledge, for lack of important prior knowledge (including prerequisite skills—Gagné 1985) would make learning very difficult, if not impossible.

Perhaps the second most important way that the nature of the learner influences the selection of microorganizational strategies and tactics is in making decisions about the amount of instructional support provided to the learner, that is, how rich the instruction should be. It is important to assess the difficulty of the content based on the learner's ability and prior familiarity with it. The more difficult it is, the richer the instruction needs to be, including the use of more examples and practice, alternative representations (especially hands-on and visuals), attention-focusing devices, hints, and shaping (or successive approximations).

A third way that the nature of the learner is important is in the selection of motivational strategies. A motivational profile of the learner is very important for selecting appropriate motivational strategies (Keller 1983, 1987).

With respect to media capabilities, significant strides in information technologies are providing educators and trainers with tools of a magnitude of power previously undreamed of. Most current microorganizational strategies were developed with a "page" mentality. To take full advantage of the capabilities of new mediational systems, educational thinking must advance beyond such a static, confining level. Strategies and tactics are needed which take advantage of the dynamic, interactive, and artificial intelligence capabilities of computers and interactive video.

Computer-based simulation possesses great potential for taking advantage of advanced technologies. But most simulations fall miserably short of their potential. Prescriptions for improving their quality are under development. Alessi and Trollip (1985) and Reigeluth and Schwartz (1989) have developed some prescriptions, but much more work remains to be done to test, refine, and further develop such prescriptions.

Advances in information technologies have also made possible the design of intelligent tutorial systems which can be used alone or in combination with simulations or other instructional approaches. The major deficiency to date for such systems is an inadequate set of instructional rules for an expert tutor so it will optimally facilitate learning. There is much room for improvement in the area of operationalizing prescriptions to the level of specificity necessary for expert tutors. Merrill (1989) has made some important advances in this area, but much more work is needed.

2.7 *Midlevel Organizational Strategies*

Some instructional planning is done on a level which is broader than microstrategies (for a single idea) but considerably narrower than macrostrategies (for an entire course). Bruner's notion of a "learning episode" is a good example. A learning episode has a problem-solving character, it has a clear beginning and a clear end, it builds up to a climax of understanding, and its length should be proportional to the payoff—the magnitude of the climax of understanding (Bruner 1960). Romiszowski's (1984) "overall instruction strategies" is another example, and it includes such alternatives as an expositive strategy and an experiential strategy.

At present, there is very little in the way of reliable prescriptions in this area. It seems likely that the prescriptions will be developed for the use of such strategies as: apprenticeship, debate, field trip, game, ancient symposium, laboratory, lecture, project, simulation, role play, brainstorm, tutorial, and others (Dorsey et al. 1989).

2.8 *Macroorganizational Strategies*

Macroorganizational strategies include prescriptions for how to select, structure, sequence, synthesize, and summarize the course content. In research on structuring and sequencing a course or training program, it emerged that every pattern of sequencing is based on a single type of relationship within the content (Reigeluth 1989). For example, the chronological sequence is based on the time relationship among events; Gagné's hierarchical sequence is based on the learning prerequisite relationship among skills; the "forward-chaining" procedural sequence is based on the older relationship among activities; Reigeluth's elaboration theory's conceptual elaboration sequence is based on the "parts" or "kinds" taxonomic relationships among concepts; Scandura's shortest-path sequence (further developed and popularized by P Merrill 1976, 1987) is based on the simple-to-complex relationship among paths of a procedure, and so forth.

In the cognitive domain, the Reigeluth–Merrill elaboration theory (Reigeluth and Stein 1983) prescribes a holistic approach to sequencing that may enhance such goals as building stable cognitive structures, facilitating creative thought, and allowing for maximum appropriate learner control. The elaboration theory's simplifying assumptions method (Reigeluth 1987) calls for beginning the instruction with the simplest kind of typical task an expert would perform, and teaching it on the application (skill) level. The conditions which make that kind of task so simple are identified, and subsequent lessons in the course gradually relax those conditions so that ever more complex tasks are learned. These tasks can be primarily domain-dependent skills, generic skills, or understandings.

There is still relatively little known about the kinds of relationships that are most important for facilitating learning. New approaches to sequencing will probably be developed as new kinds of relationships

are identified, especially for the affective domain. It seems likely that optimal sequencing "strands" will be developed for each of a variety of types of learning, then interwoven with each other to form a complete course or curriculum sequence.

Synthesis is the process of explicitly teaching important relationships among ideas. Summarizing entails providing systematic review, perhaps by having the learners periodically use what they have learned. Very little attention has been paid to developing useful strategies and tactics for synthesis and summarizing (see VanPatten et al. 1987). This is particularly unfortunate since they can have such powerful impact on learners.

3. *Mediational Strategies*

Given that instructional technology has strong roots in media, instructional designers have a tendency to constrain their instructional designs to certain mediational systems, particularly to such resources as print, computers, and video. However, many other types of mediational systems can be used. The source of instruction can be human or nonhuman; a human source can be a professional or an amateur; a nonhuman source can be instructionally designed or not created specifically for purposes of instruction; and the intended receiver can be an individual or a group. These characteristics yield the typology of mediational systems shown in Table 1. Note that the labels in the boxes are familiar concepts that do not overlap 100 percent with the concept as defined by the characteristics of the source and receiver. They are included here merely to be illustrative—the sort of approach one might think of first for each category. There is also considerable overlap between these categories and the midlevel strategies mentioned earlier. Furthermore, it is important to keep in mind that almost any medium (or combination of media) can be used within each of these categories.

Instructional designers have had a tendency to use self-instructional modules without considering that another mediational system might be better. Cost-benefit analysis is likely to be very important in making informed decisions. For practical guidelines in this area see Romiszowski (1988). It is important to think of the instruction in terms of interactions between the mediational system and the learner, rather than to just think in terms of delivery of content by the system (Merrill 1988).

4. *Management Strategies*

As instructional tools become more powerful and more varied, the task of managing the instruction becomes more formidable and more important. It is not just a matter of coordinating diagnosis-and-revision activities, although that is certainly very important. It is also a matter of deciding which kind of resource is important for whom and when, and which strategies and tactics are important for whom and when on each resource. A wide variety of considerations comes into play, including individual differences, mastery learning, record keeping, learner control, scheduling, incentives, and much more. With the development of expert systems, it is possible to think of designing an "advisor" into computer-based instruction. Such an advisor will monitor the learner's activities, intervene with advice when appropriate, answer questions about instructional management, and serve other instructional management functions. But what are the rules which should govern such an advisor? And what instructional management activities are best left to a human? Much more work is needed to develop useful prescriptions regarding such management issues.

5. *Other Concerns*

Another issue that has been too little explored in research and theory is that of motivating learners. All of the above-mentioned kinds of strategies and tactics can be used to enhance motivation to learn: organizational, mediational, and management. Motivational strategies were largely ignored by instructional theorists until very recently. Keller (1983, 1987) has done much to integrate the current knowledge about motivation into a set of prescriptions for instructional designers, but more work is needed in this area, particularly regarding motivational strategies which are uniquely possible with advanced technologies.

A largely neglected issue in instructional systems design is the design of whole educational systems. Powerful new learning tools are not being adopted by school systems the way they can and should be; the structure of the school system works against it. At the same time, there is increasing recognition that the problems with schools are ones which cannot be fixed by providing more of everything: more teacher

Table 1
Typology of mediational systems

		SOURCE			
		Human		Nonhuman	
		Professional	Amateur	Designed	Natural
RECEIVER	Individual	Tutoring	Peer tutoring	Self-instructional module	Individual projects
	Group	Lecture	Discussion	Group activities	Group projects

training, more teacher pay, more school hours in a day, more school days in a year, and so forth. For a quantum improvement in education, a different system is needed; schools must be restructured and redesigned. Educational technology is beginning to awaken to this responsibility, as is demonstrated by the special issue of the *Journal of Instructional Development* on instructional design in the schools (Vol. 10, No. 4). Banathy has long been working on ways to bring about systems changes in the schools (see Banathy 1988). Perelman (1987) has offered some valuable guidelines for transforming schools. Much work is needed in this area, to identify productive approaches for schools to restructure, and to identify some viable visions of what a restructured school might be like.

See also: Instructional Design: An Overview*; Instructional Psychology*

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C. M. Reigeluth

Interactive Video

Interactive video can be defined as the presentation of video and audio information according to the response input made by the viewer. The presentation of images and sound is via a television monitor, which is usually part of a self-contained user-station with microcomputer video source and input device. The source of video can be one of several devices such as videodisc, videotape, or compact disc. The response