

Putting Learning Strategies to Work

By increasing students' repertoires of tactics for learning, we can prepare them to develop their own strategies for problem solving in the classroom and beyond.

Recent research in cognitive and educational psychology has led to substantial improvements in our knowledge about learning. Researchers have identified certain mental processing techniques—learning strategies—that can be taught by teachers and used by students to improve the quality of school learning. Let me illustrate.

As a professor of educational and cognitive psychology, I often begin the semester with a simulation exercise designed to illustrate major principles about the role of learning strategies in classroom instruction. For example, recently I presented my students with the following scenario:

You are a high school student who has arrived at school 20 minutes early. You discover that your first-period teacher is planning to give a test covering Chapter 5. Unfortunately, you have prepared the wrong chapter, and there is no one around to help you out. Skipping class is not the solution, since this results in an automatic "F," and you would never dream of cheating. So you open your book and use the next 15 minutes as wisely as you can.

I gave my students 15 minutes to study. They then took a quiz with eight main idea questions and two applica-

tion questions. At the end of the quiz, I asked them to write in detail exactly what they did when they studied. Quizzes (without names) were collected and then distributed randomly to the class for scoring and for analyzing the study strategies reported in them.

Few people performed well on this test. A student who did wrote the following:

Learning is a form of problem solving that involves analyzing a learning task and devising a strategy appropriate for that particular situation.

There wasn't enough time for details. So I looked at the chapter summary first. Then I skimmed through the chapter and tried to understand the topic paragraphs and the summary paragraphs for each section. I also noticed what the headings said, to get the organization, and I noticed certain names that went with each heading, figuring they did something related to each topic, a study or something. I started to do some memory work on the headings, but time was up before I finished.

By comparison, most students answered only two or three of the main idea questions, reporting a study strategy something like the following.

Panic. There was not enough time! I started going over the chapter and got as far as I could, but it was hopeless. I assume you do not plan to grade this quiz, because that would be unfair!

As illustrated in these two examples, the differences between successful and unsuccessful learning strategies often are clear and striking. Whereas the successful learners assessed the learning situation and calmly developed a workable plan for dealing with it, the less successful learners were occupied with fruitless worries and vague strategies but little planning effort.

Such an exercise serves to introduce the following important principles about self-directed learning:

1. The plan that one uses for accomplishing a learning goal is a person's learning strategy. Learning strategies may be simple or complex, specific or vague, intelligent or unwise. Obviously, some learning strategies work better than others.

2. Learning strategies require knowledge of specific learning skills, or "tactics" (e.g., Derry and Murphy 1986), such as skimming, attending to chapter structure, and memorization techniques. The ability to devise appropriate learning strategies also requires knowledge about when and when not to use particular types of learning tactics.

3. Learning is a form of problem solving that involves analyzing a learning task and devising a strategy appropriate for that particular situation. Different learning situations may call for different strategies.

Further, I asked my students to determine whether any reported learning strategy had produced useful knowledge. Alas, no participant had applied the knowledge acquired in the 15-minute study session to the two application questions on the quiz. Even when learning strategies are apparently successful according to one form of measurement, the resultant learning is not necessarily usable later in problem solving. Thus, we added a fourth principle to our list:

4. In most school learning situations, strategies should be devised with the aim of creating usable, rather than inert, knowledge. Clearly, not all learning strategies will lead to the formation of usable knowledge structures.

Next I will elaborate these principles in greater detail, suggesting how they can influence classroom practice.

Strategies as Learning Plans

There is much confusion about the term *learning strategy*. The term is used to refer to (1) specific learning tactics such as rehearsal, imaging, and outlining (e.g., Cook and Mayer 1983, Levin 1986); (2) more general types of self-management activities such as

planning and comprehension monitoring (e.g., Pressley et al. in press a); and (3) complex plans that combine several specific techniques (e.g., Derry and Murphy 1986, Snowman and McCown 1984).

To clarify the uses of the term, I distinguish between the specific tactics and the learning strategies that combine them. Thus, a learning strategy is a complete plan one formulates for accomplishing a learning goal; and a learning tactic is any individual processing technique one uses in service of the plan (Derry and Murphy 1986, Snowman and McCown 1984). That is, a learning strategy is the application of one or more specific learning tactics to a learning problem. Within this definition, the plethora of learning techniques (popularly called "strategies") being promoted by various researchers and practitioners can be viewed as potentially useful learning tactics that can be applied in various combinations to accomplish different learning jobs.

This definition points to the need for two distinct types of strategies instruction: specific tactics training and training in methods for selecting and combining tactics into workable learning plans. Teachers can incorporate both types of training into regular

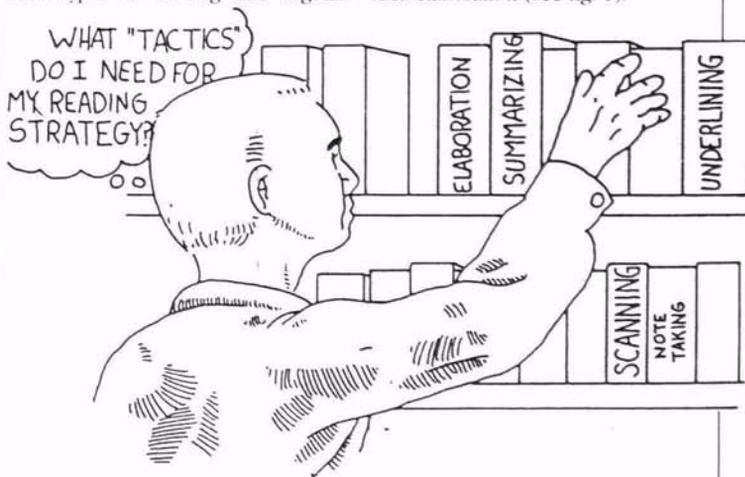
classroom instruction by thoughtfully combining different study tactics—outlining plus positive self-talk, for example—and assigning them along with regular homework.

Learning Strategies Employ Specific Learning Tactics

In this section I discuss tactics in three major categories: (1) tactics for acquiring verbal knowledge, that is, ideas and facts fundamental to disciplines such as science, literature, and history; (2) tactics for acquiring procedural skills such as reading, using language, and solving problems that underlie various curriculum disciplines; and (3) support tactics for self-motivation, which are applicable to all types of learning situations. (For a more thorough treatment of these topics, see the reviews by Derry and Murphy 1986, Weinstein and Mayer 1985, Levin 1986, and Pressley et al. in press b.)

Verbal learning tactics

Strategies aimed at improving comprehension and retention of verbal information should build upon tactics that enhance these mental processes: (1) focusing attention on important ideas, (2) schema building, and (3) idea elaboration (see fig. 1).



Art from a student worksheet courtesy Sharon Derry

Category	Examples	Some Conditions of Use	Strengths or Weaknesses
Attentional Focusing			
<i>Simple focusing</i>	Highlighting. Underlining.	Structured, easy materials. Good readers.	No emphasis on importance or conceptual relations of ideas.
<i>Structured focusing</i>	Looking for headings, topic sentences. Teacher-directed signaling.	Poor readers. Difficult but considerate materials.	Efficient, but may not promote active elaboration, deep thinking.
Schema Building	Use of story grammars, theory schemas. Networking.	Poor text structure. Goal is to encourage active comprehension.	Inefficient, but develops higher-order thinking skills.
Idea Elaboration	Some types of self-questioning. Imagery.	Goal is to comprehend and remember specific ideas.	Powerful, easy to combine. Difficult for some students unassisted. Will not ensure focus on what is important.

Fig. 1. Tactics for Learning Verbal Information

A learning strategy is a complete plan one formulates for accomplishing a learning goal; and a learning tactic is any individual processing technique one uses in service of the plan.

Attentional focusing. Two types of attention-focusing tactics are simple focusing and structured focusing. In the simple focusing category, highlighting and underlining are common examples. Unfortunately, the use of simple focusing procedures does not necessarily ensure identification of important information. I have often confirmed this point by requesting to see the textbooks of students who are having academic problems. Frequently I find almost every word in their texts highlighted.

Students, weaker ones in particular, should be taught to combine simple focusing with structured focusing, whereby the learner directs primary attention to headings, topic sentences, or other signals provided by the instructional presentation. The teaching of structured focusing is a well-established practice in English classes, and it can profitably be reinforced in other courses to help students identify information they need to learn. However, the success of structured focusing depends heavily on well-structured, considerate instructional presentations (as

well as on considerate teachers who test for the main ideas). And the use of these tactics does not ensure that the ideas identified will actually be remembered.

Schema building. A more powerful type of verbal-learning tactic is schema building, which encourages active analysis of an instructional presentation and formation of a synthesizing framework. One well-known form of schema building is networking (Dansereau 1985, Dansereau et al. 1979), whereby a student draws a node-link map representing the important ideas in a text and the interrelationships among them. This technique is powerful, but it is difficult to teach and time-consuming to apply (McKeachie 1984). Simpler forms of schema building include the use of teacher-suggested schemas, such as the well-known tactic of requiring students to analyze stories in English literature by identifying the theme, setting, plot, resolution, and so on. Similar assignments can facilitate verbal learning in other courses of study. For example, Dansereau (1985) improved students'

performance on science tests by teaching them to use a theory schema as a study aid for scientific text.

Schema building encourages in-depth analysis and is particularly useful if instruction is inconsiderate or unclear. Schema-building strategies are generally employed as comprehension aids; however, they also aid memory through the organization and elaboration of ideas.

Idea elaboration. Idea elaboration is a memory-enhancing process whereby students link each important new idea with prior knowledge so as to connect them. These linkages can be based on an image, a logical inference, or on anything else that serves to connect new ideas to prior knowledge (Gagne 1985).

Many elaboration tactics capitalize on imagery, a powerful memory-enhancing technique. For example, the key-word method for acquiring

foreign vocabulary involves creating a mental image (prior knowledge) representing the sound of a foreign word (new information), and relating that image to another image (prior knowledge) representing the meaning of the word's English equivalent. Many types of elaboration tactics facilitate memorization (e.g., Bransford and Stein 1984), and these can be employed to great advantage in many courses.

Procedural learning tactics

Most learning strategies research has examined tactics for acquiring verbal information. However, some strategy researchers are developing techniques for acquiring procedural skills. Procedural learning has three aspects (Anderson 1983, Gagne 1985): (1) learning how to carry out basic actions such as performing long division or executing a tennis lob; (2) learning to

recognize the conceptual patterns that indicate when it is appropriate to perform particular actions (such as recognizing that a word problem is a division situation or that a tennis lob is required); and (3) learning to combine many pattern-action pairs into a smooth overall system of response. Consider, for example, the complex combining of subskills that underlies the actual playing of a tennis match.

Based on this view, Figure 2 presents three categories of mental tactics for procedural learning: (1) tactics for learning conceptual patterns that cue applicability of associated actions; (2) tactics for acquiring the component actions (performance subskills) themselves; and (3) tactics for perfecting and tuning complex overall performance.

Pattern-recognition tactics. Pattern recognition plays an important role in the development of procedural per-

Category	Examples	Some Conditions of Use	Strengths or Weaknesses
Pattern Learning			
<i>Hypothesizing</i>	Student reasons and guesses why particular pattern is or isn't example of concept.	Goal is to learn attributes of concepts and patterns.	Inefficient unless feedback given. Encourages independent thinking.
<i>Seeking reasons for actions</i>	Student seeks explanations why particular actions are or are not appropriate.	Goal is to determine which procedures are required in which situations.	Develops meta-cognitive knowledge. Inefficient if not guided. If too guided, might not promote thinking skills.
Reflective Self-Instruction	Student compares reification of own performance to expert model.	Goal is to tune, improve complex skill.	Develops understanding of quality performance. May increase self-consciousness, reduce automaticity.
Practice			
<i>Part practice</i>	Student drills on one specific aspect of performance.	A few specific aspects of a performance need attention.	Develops subskill automaticity. Doesn't encourage subskill integration.
<i>Whole practice</i>	Student practices full performance without attention to subskills.	Goal is to maintain or improve skill already acquired or to integrate subskills.	May consolidate poorly executed subskills. Helps develop smooth whole performance.

Fig. 2. Tactics for Learning Procedural Knowledge

Category	Examples	Some Conditions of Use	Strengths or Weaknesses
Behavioral Self-Management	Student breaks task into sub-goals, creates goal-attainment plan, rewards.	Complex, lengthy task; low motivated students.	Promotes extrinsic, rather than intrinsic, motivation. Very powerful.
Mood Management			
<i>Positive self-talk</i>	Student analyzes, avoids negative self-statements, creates positive self-statements.	Preparation for competitive or difficult performance; presence of negative ideas.	Good intrinsic motivator; requires conscious attention during performance.
<i>Relaxation techniques</i>	Student uses deep breathing, counting, other clinical relaxation methods.	Text anxiety; highly anxious students.	Techniques controversial in some districts.
Self-Monitoring	Student stops self during performance to consciously check mood, progress, etc.	Goal is to increase conscious awareness and control of thinking process.	May interrupt concentration.

Fig. 3. Tactics for Developing Motivation

formance; however, students are probably not aware of this. Thus, developing students' procedural learning abilities includes both conveying the important function of pattern recognition and helping students develop tactics for acquiring performance-related patterns.

Examples of tactics in the patterns-acquisition category include hypothesizing and seeking reasons for actions. In applying these tactics, the learner attempts to discover the identifying features of a pattern or concept through guesswork, reasoning, and investigation. For example, while watching a tennis pro at work, the student might hypothesize about the features of play that cause the pro to execute a lob or a groundstroke. Hypotheses are confirmed or altered through continued observation, until the pattern features are known. Alternatively, the student might seek reasons by consulting the tennis pro directly. Seeking information overcomes the major weakness of the hypothesizing tactic, inefficiency. However, the virtue of hypothesizing is that it can be used in situations where expert advice is not available.

Practice tactics. Other aspects of procedural learning include the acquisition of basic component actions

(subskills) and, ultimately, the development of smooth complex performances that combine those subskills. There are learning tactics that can help students derive maximum benefit from their practice sessions. One example is part practice, whereby the student attempts to improve a complex performance by perfecting and automating an important subcomponent of that performance. For example, a student might greatly improve performance on mathematics tests by memorizing and practicing square-root tables. Or performance in tennis might be improved by concentrating practice on service and smashes. Part practice should be alternated with whole practice (Schneider 1985), whereby the student practices the full complex performance with little attention to individual subskills.

Reflective self-instruction. Another class of procedural learning tactics is reflective self-instruction, whereby the student attempts to improve personal performance by studying an expert model. For example, a student might videotape her tennis swing and compare that to a tape of an expert's swing. Or the student might critically compare her homework solution for a geometry proof to the teacher's expert

solution presented on the board. Reflective self-instruction can concentrate either on specific component subskills or on whole complex performances. One key to successful self-instruction is the availability of adequate performance models. By providing models of expert performance and guiding students in how to benefit from those models while learning, teachers can provide training in the valuable technique of reflective self-instruction.

Mental support tactics

Acquiring useful knowledge in school is a lengthy and difficult process demanding a great investment of time and effort on the part of the student. Thus, tactics are needed for helping learners maintain a positive attitude and a high state of motivation during learning and practice. Researchers (e.g., Dansereau et al. 1979, 1985; Meichenbaum 1980; McCombs 1981-82) recommend several types of support tactics: (1) behavioral self-management, (2) mood management, and (3) self-monitoring (see fig 3).

The behavioral self-management category includes such tactics as breaking a complex learning chore into subgoals, developing a schedule

for meeting subgoals, devising a reporting procedure for charting progress, and devising a self-reward system for completing major subgoals. Mood management tactics include concentration and relaxation techniques (useful for combating test anxiety); and positive self-talk, used to establish and maintain a positive frame of mind before and during learning and performance (e.g., Meichenbaum 1980). Finally, an example of self-monitoring is the technique of stopping periodically during learning and practice to check and, if necessary, readjust strategy, concentration, and mood.

Frequently used by professional athletes, mental support tactics can also be used by students to increase academic performance and motivation and to decrease tension associated with evaluation. They are applicable to all types of learning situations and can be combined with both verbal and procedural learning tactics in study assignments. For example, to study for

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a history test, a student might devise a learning strategy that orchestrates several specific tactics, such as positive self-talk with self-checking (to maintain motivation), networking (to help organize facts in a meaningful way), and use of imagery or mnemonics (to help with memorization).

Strategy-Building as Problem Solving

The ultimate aim of tactics training is to provide students with tools that will enable them, as autonomous learners, to devise their own strategies. Unfortunately, a persistent problem in strategy training has been students' failure to apply tactics in situations outside the class in which they were learned originally.

However, several training techniques can alleviate these problems. A large number of researchers (e.g., Baron 1981, Bransford and Stein 1984) suggest teaching students to respond to all learning tasks using a general problem-solving model. For example, Derry, Jacobs, and Murphy (1987) taught soldiers to use the "4C's" to develop plans for study reading. The 4C's stood for: clarify learning situation, construct a learning strategy, carry out the strategy, and check results.

One presumed advantage of such plans is that they remind students to stop and think reflectively about each learning situation prior to proceeding with the task (Baron 1981). Also, such plans may serve as mnemonic devices that help students recall previously learned tactics associated with each step. There is some empirical support for the idea that problem-solving models enhance tactics transfer (Belmont et al. 1982).

Another procedure for inducing tactics transfer is informed training (Campion et al. 1982, Pressley et al. 1984). This procedure enhances direct tactics instruction with explicit information regarding the effectiveness of various tactics, including how and when they should be used. As Levin (1986) points out, there are different learning tools for different learning jobs. With informed training, students learn that tactics selection is

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always influenced by the nature of the instructional material as well as the nature of the learning goal. For example, if a text is not highly structured and the primary aim of study is to comprehend and remember important ideas, a strategy that combines networking with idea elaboration would be appropriate. However, if the aim is primarily comprehension rather than retention, a schema-building technique alone would suffice. Informed training is superior to "blind training" in producing transfer and sustained use of specific learning tactics (Pressley et al. 1984, Campione et al. 1982).

Previously I suggested that teachers can help develop students' learning skills by devising, assigning, and explaining learning strategies and by providing feedback on strategy use.

Such established classroom practices are excellent vehicles for informed training.

Learning Strategies Should Produce Useful Knowledge

Cognitive psychology has taught us much about the nature and structure of usable knowledge. Verbal information is likely to be called into service only if it is understood when learned and only if it is stored in memory within well-structured, well-elaborated networks of meaningfully related ideas. Procedural skills, on the other hand, are likely to be accessed and accurately executed only if they have been developed through extensive practice and only if the environmental patterns that indicate their applicability are well learned. If the primary aim of schooling is the creation of useful knowledge, then strategy application should result in the deliberate creation of a well-structured knowledge base, whether verbal, procedural, or both.

It is unlikely that reliance on any single learning tactic alone will ensure the creation of well-constructed knowledge. Rather, multiple tactics are usually required. For example, if an elaboration technique is applied for the purpose of enhancing individual ideas, another schema-building tactic may be needed to tie related ideas together. Or if practice is used to perfect a specific aspect of procedural performance, a pattern-learning tactic may still be needed to ensure that the skill is executed only when appropriate. Thus, useful knowledge is most likely to evolve through a dynamic process requiring, first, an informed analysis of each learning problem, then selection and combining of all the learning tactics needed to produce a well-formed mental structure.

Not every learning strategy produces useful knowledge. Some strategies lead to isolated, unstructured bits of learning that will remain forever inert. For this reason, both teachers and students should be aware of the nature and form of useful knowledge and of learning strategies that are likely to facilitate its creation.

Strategy Training for Lifelong Learning

Students who receive good strategy training during their years in school can acquire a form of knowledge especially useful in coping with the wide variety of learning situations they will encounter throughout their lives. Given the amount of time that people spend in school, in job-related training, and in acquiring knowledge associated with their interests and hobbies, the ability to find good solutions to learning problems may be the most important thinking skill of all. □

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