The Use of Scaffolds for Teaching Higher-Level Cognitive Strategies

Not only are scaffolds useful for teaching well-structured skills, but they also provide the support students need to tackle higher-level thinking strategies.

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The teaching of higher-level thinking operations is a topic that interests many of today's educators. These operations include comprehension and interpretation of text, scientific processes, and mathematical problem solving. While much has been written on the need for students to perform higher-level thinking operations in all subject areas, the teaching of these operations often fails, not because the idea is poor, but because the instruction is inadequate.

How does one help students perform higher-level operations? One solution that researchers have developed is to teach students cognitive strategies (Pressley et al. 1990; Perkins et al. 1989; Weinstein 1979). A strategy is not a direct procedure; it is not an algorithm. Rather a strategy is a heuristic that supports or facilitates the learner as he or she learns to perform the higher-level operations.

For example, to facilitate reading comprehension, students may be taught to use cognition strategies such as generating questions about their reading. To generate questions, students need to search the text and combine information, which in turn helps them comprehend what they read. To help students in the writing process, they may be taught how to organize their writing and how to use self-talk prompts to facilitate the revision process. These cognitive strategies are more like supports or suggestions than actual step-by-step directives.

But how does one teach cognitive strategies? Our review of about 50 studies in which students ranging from 3rd grade through college were taught cognitive strategies showed that successful teachers of such strategies frequently used instructional procedures called *scaffolds* (Palincsar and Brown 1984; Paris et al. 1986; Wood et al. 1976). Scaffolds are forms of support provided by the teacher (or another student) to help students bridge the gap between their current abilities and the intended goal. Scaffolds may be tools, such as cue cards, or techniques, such as teacher modeling. Although scaffolds can be applied to the teaching of all skills, they are particularly useful, and often indispensable, for teaching higher-level cognitive strategies, where many of the steps or procedures necessary to carry out these strategies cannot be specified. Instead of providing explicit steps, one supports, or scaffolds, the students as they learn the skill.

The support that scaffolds provide is both temporary (Tobias 1982) and adjustable, allowing learners "to participate at an ever-increasing level of competence" (Palincsar and Brown 1984, p.122). Scaffolding gradually decreases as the learning process unfolds and students become proficient.

Before using scaffolds, it is important to determine whether students have sufficient background ability to learn a new cognitive strategy. Researchers (particularly Palincsar and Brown 1984) note that scaffolds are only useful within the student's "zone of proximal development" (Vygotsky 1978), that is, the area where the student cannot proceed alone, but can proceed when guided by a teacher using scaffolds. When Palincsar and Brown (1984) taught strategies designed to foster reading comprehension, they selected students whose decoding skills were near grade level, but whose comprehension was below grade level. They did not select students with poor decoding skills, because such students did not have sufficient background skills to profit from this instruction. Similarly, scaffolds cannot help students read a physics text or history text for which they do not have the necessary background knowledge.

Presenting a New Cognitive Strategy

In the studies we reviewed, teachers typically began teaching a cognitive strategy by introducing and explaining a concrete prompt. Concrete prompts,

How to Teach Higher-Order Cognitive Strategies

1. Present the new cognitive strategies.
- (a) Introduce the concrete prompt.
- (b) Model the skill.
- (c) Think aloud as choices are made.

2. Regulate difficulty during guided practice.
- (a) Start with simplified material and gradually increase the complexity of the task.
- (b) Complete part of the task for the student.
- (c) Provide cue cards.
- (d) Present the material in small steps.
- (e) Anticipate student errors and difficult areas.

3. Provide varying contexts for student practice.
- (a) Provide teacher-led practice.
- (b) Engage in reciprocal teaching.
- (c) Have students work in small groups.

4. Provide feedback.
- (a) Offer teacher-led feedback.
- (b) Provide checklists.
- (c) Provide models of expert work.

5. Increase student responsibility.
- (a) Diminish prompts and models.
- (b) Gradually increase complexity and difficulty of the material.
- (c) Diminish student support.
- (d) Practice putting all the steps together (consolidation).
- (e) Check for student mastery.

6. Provide independent practice.
- (a) Provide extensive practice.
- (b) Facilitate application to new examples.

also called procedural facilitators (Scardamalia et al. 1984), are scaffolds specific to the strategy being taught, yet general enough to allow application to a variety of different contexts. For example, to help students learn the strategy of generating questions, some teachers first gave students "question words" — *who, what, when, where, why, how* — and taught them to use these words as prompts. These six simple question words were the concrete prompts. In the study by King (1989), students used a list of general question stems that could be used to form questions about a particular passage:

- How are ___ and ___ alike?
- What is the main idea of _____?
- What do you think would happen if _____?
- What are the strengths and weaknesses of _____?
- In what way is ___ related to ___?
- How does ___ affect ___ ?
- Compare ___ and ___ with regard to _____.
- What do you think causes ___?
- How does _____ tie in with what we have learned before?
- Which one is the best ___ and why?
- What are some possible solutions for the problem of _____?
- Do you agree or disagree with this statement: _____? Support your answer.
- What do I (you) still not understand about _____ ?

Several different concrete prompts have also been developed for teaching the strategy of summarizing. Baumann (1984) and Taylor (1985) used the following prompt:

- Identify the topic.
- Write two or three words that reflect the topic.
- Use these words as a prompt to help figure out the main idea of the paragraph.
- Select two details that elaborate on the main idea and are important to remember.
- Write two or three sentences that best incorporate these important ideas.

Palincsar (1987) used a different prompt for teaching summarizing:

- Step 1: Identify the topic sentence.
- Step 2: If there is not a topic sentence, identify the topic and the most important information about that topic.
- Rule 1: Leave out unimportant information.
- Rule 2: Give steps or lists a title.
- Rule 3: Cross out information that is redundant/repeated.

To assist students during the writing process, Scardamalia, Bereiter, and Steinbach (1984) offered students cues to stimulate their thinking about the planning of compositions. These cues took the form of introductory phrases and were grouped according to the function they served: planning a new idea, improving, elaborating, goal setting, and putting it all together. Students first determined the type of cue needed, then chose a particular cue to incorporate into a silent planning monologue (see box, page 29, for cues for opinion essays).

Other investigators developed specific prompts to help students improve their writing. For example, Englert, Raphael, Anderson, Anthony, and Stevens (1991) provided Plan Think-Sheets that cued students to consider their audience ("Who am I writing for?" "Why am I writing this?"), and Organize Think-Sheets to help students sort their ideas into categories ("What is being explained?" "What are the steps?").

After presenting the concrete prompt, the teacher modeled its application as the students observed. Thus, when teaching students to generate questions, the teacher modeled how to use the cues to think of questions related to a particular passage. When teaching students to write a summary, the teacher identified the details of a paragraph or passage, used the details

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to form a main idea, and stated the details in the summary. In writing an explanation paper, the teacher used the planning cues in a self-talk (monologue) style. The teacher modeled how to use the Plan Think-Sheet to record ideas and thoughts about the topic.

Modeling of the process by the teacher gradually diminished as students began to take on more of the responsibility for completing the task. The teacher continued to model only the part(s) of the process that students were unable to complete at a particular time. Often during the transitional stage, when the students were ready to take on another part of the task, the teacher continued to model, but requested hints or suggestions from the students on how to complete the next step in the task. Several studies also relied on more capable students to provide the modeling.

Another scaffold, similar to modeling, is "thinking aloud." For example, when teaching students to generate questions, the teacher describes the thought processes that occur as a question word is selected and integrated with text information to form a question.

Anderson (1991) provides illustrations of think-alouds for several cognitive strategies in reading:

> *For clarifying difficult statements or concepts:* I don't get this. It says that things that are dark look smaller. I know that a white dog looks smaller than a black elephant, so this rule must only work for things that are about the same size. Maybe black shoes would make your feet look smaller than white ones would.
>
> *For summarizing important information:* I'll summarize this part of the article. So far, it tells where the Spanish started in North America and what parts they explored. Since the title is "The Spanish in California," the part about California must be important. I'd sum up by saying that Spanish explorers from Mexico discovered California. They didn't stay in California, but lived in other parts of America. These are the most important ideas so far.
>
> *For thinking ahead:* So far this has told me that Columbus is poor, the trip will be expensive, and everyone's laughing at his plan. I'd predict that Columbus will have trouble getting the money he needs for his exploration.

In a mathematics study by Schoenfeld (1985), the teacher thought aloud as he went through the steps in solving mathematical problems. He also identified and labeled the problem-solving procedures he was using (for example, making diagrams, breaking the problem into parts). Thus, as Schoenfeld points out, thinking aloud may also provide labels that students can use to call up the same processes in their own thinking.

When teaching mathematical problem solving, Schoenfeld (1985) asked the college students in his class to provide him with particularly difficult problems. Each class began with his attempt to solve one of the problems. Through modeling and thinking aloud, he applied problem-solving procedures and revealed his reasoning about the problems he encountered. Students saw the flexibility of the strategies as they were applied to a range of problems and observed that the use of a strategy did not guarantee success.

The following excerpt is an example of Schoenfeld modeling his thinking process as he gets a feel for a problem:

> What do you do when you face a problem like this? I have no general procedure for finding the roots of a polynomial, much less for comparing the roots of two of them. Probably the best thing to do for the time being is to look at some simple examples and hope I can develop some intuition from them. Instead of looking at a pair of arbitrary polynomials, maybe I should look at a pair of quadratics: at least I can solve those. Now, what happens if . . .

As individual students accepted more responsibility in the completion of a task, they often modeled and thought aloud for their less capable classmates. Not only did student modeling and think-alouds involve the students actively in the process, but it allowed the teacher to better assess student progress in the use of the strategy. Thinking aloud by the teacher and more capable students provided novice learners with a way to observe "expert thinking" usually hidden from the student.

Regulating Difficulty During Guided Practice

In order to help the learner, many teachers began with simpler exercises and then gradually increased the diffi-

culty of the task. This allowed the learner to begin participating very early in the process. For example, in a study by Palincsar (1987), an early task consisted of generating questions about a *single sentence*. The teacher first modeled how to generate questions, and this was followed by student practice. Then the complexity was increased to generating questions after reading a *paragraph*, followed by more student practice. Finally, the teacher modeled and the class practiced generating questions after reading an entire *passage*.

When learning the strategy of summarizing, students in the study by Dermody (1988) first learned how to write summary statements on single paragraphs. After students received guided practice on this task, teachers showed them how to combine several summary statements to produce a single summary for a longer passage and had them practice this more difficult task.

In many of the studies, instruction on the cognitive strategy began with the teacher completing most or all of the task through modeling and thinking aloud. The teacher continued to carry out the parts of the task not yet introduced to the students or those parts students were unable to complete at the time. Additional components were added to the students' responsibilities as they became more skillful. Sometimes, their participation began at a very simple level. For example, as the teacher modeled the strategy, the students were asked to provide the label. Or students were requested to state the next step in the process the teacher needed to model. As student involvement increased, teacher involvement was withdrawn. Teachers provided hints, prompts, suggestions, and feedback when students encountered difficulty in their attempts to complete part of the task. Sometimes these difficulties required the temporary increase of teacher involvement until students were able to overcome the difficulty.

Planning Cues Used for Opinion Essays

New Idea

An even better idea is . . .
An important point I haven't considered yet is . . .
A better argument would be . . .
A whole new way to think of this topic is . . .
No one will have thought of . . .

Improve

I'm not being very clear about what I just said so . . .
A criticism I should deal with in my paper is . . .
I really think this isn't necessary because . . .

Putting it Together

If I want to start off with my strongest idea, I'll . . .
I can tie this together by . . .
My main point is . . .

Elaborate

An example of this . . .
This is true, but it's not sufficient so . . .
My own feelings about this are . . .
I'll change this a little by . . .
The reason I think so . . .
Another reason that's good . . .
I could develop this idea by adding . . .
Another way to put it would be . . .
A good point on the other side of the argument is . . .

Goals

A goal I think I could write is . . .
My purpose is . . .

In some studies, students received cue cards containing the concrete prompts they had been taught. Having a cue card allows the student to put more effort into *applying* the prompt, rather than *remembering* it. For example, in the study by Billingsley and Wildman (1984), the students were provided with a card containing the list of question words (*who, what, why*) they could use to generate questions. Singer and Donlon (1982) taught students to use the elements of story grammar (for example, leading character, goal, obstacles, outcomes, and theme) as a prompt to generate questions and gave them lists of these story elements for reference. Wong and Jones (1982) provided students with cue cards printed with a concrete prompt to use as they generated questions on the main idea of a passage. Eventually the cue cards were removed, and students were asked to formulate questions or write summaries without them. Below is a Self-Questioning Cue Card:

(a) Why are you studying this passage? (So you can answer some questions you will be given later.)
(b) Find the main idea/ideas in the paragraph and underline it/them.
(c) Think of a question about the main idea you have underlined. Remember what a good question should be like.
(d) Learn the answer to your question.
(e) Always look back at the questions and answers to see how each successive question and answer provides you with more information.

When presenting a prompt that has several steps, the difficulty can be regulated by "teaching in small steps," that is, first teaching one step and providing for student practice before teaching the next step. In this way, students deal with manageable, yet meaningful, bits. In a study (Blaha 1979) in which students were taught a strategy for summarizing paragraphs, the teacher explained and modeled the

first step, identifying the topic of a paragraph, and provided for student practice on new paragraphs. Then she taught the concept of main idea, and students practiced both finding the topic and locating the main idea. Following this, she taught students to identify the supporting details, and the students practiced that part of the task. Finally, the students practiced doing all three steps of the strategy.

Another way to regulate the difficulty of learning a new cognitive strategy is to anticipate and discuss potential student errors. For example, in one study the teacher anticipated errors in summarizing by presenting a summary with a poorly written topic sentence and asking students to identify the problem. In a questioning study, the teacher showed questions that were inappropriate because they were about a minor detail and then asked students to state why they were inappropriate. The students then used these hints and suggestions as they generated their questions.

Another example of anticipating errors occurs in the study conducted by Brady (1990). The investigator noticed that students had a tendency to produce summary statements that were too broad, often providing only the general topic of the passage (for example, "This paragraph was about toads.") To help students avoid this error, Brady developed a simple yet successful concrete prompt; he suggested students begin their summary statements with the phrase "This paragraph tells us that _____." This prompt significantly improved the quality of summary statements.

Varying the Context for Practice

Students in most studies practiced the application of cognitive strategies in one or more of three different contexts: teacher-guided practice, reciprocal teaching, and work in small groups. When teaching cognitive strategies, the teachers guided students by providing hints, reminders of the concrete prompts, reminders of what was overlooked, and suggestions on how something could be improved. Students participated by giving answers and deciding upon the correctness of other students' answers. Where appropriate, students were asked to justify their procedures by explaining their thinking. Through this process, students' "oversimplified and naive conceptions are revealed" (Brown and Campione 1986). Such dialogue may also aid in understanding. As Brown and Campione (1986) write, "Understanding is more likely to occur when a student is required to explain, elaborate, or defend his or her position to others; the burden of explanation is often the push needed to make him or her evaluate, integrate, and elaborate knowledge in new ways."

Dialogue and Scaffolded Instruction

Teacher: Today we are going to do something using those four things we talked about last week. Does anyone remember those four activities that we were talking about when we were talking about thinking as we listen to the story?

Student 1: We give a summary.

Teacher: One was summary, right. And what do we do when we talk about summarizing? T _____ ?

Student 2: Tell about the story.

Teacher: Yes, and you don't have to tell all about it, just the most important ideas. What was another thing we talked about? B _____?

Student 3: Questions.

Teacher: Yes, we talked about questioning. And do you remember what we did when we were talking about questioning? What do we ask questions about? About anything at all?

Student 3: About the story and to see if we understand.

Teacher: Right. We will ask questions that will give us information about the story and that will help us see if we were listening or if we fell asleep. What is something else we did? We did two more things. Summarizing, questioning. . . . Remember we talked about the weatherman, and we said that the weatherman does this? What does the weatherman do?

Student 4: Give a . . .

Teacher: What does he do when he tells us it's going to be a beautiful weekend?

Student 4: Prediction!

Teacher: Right. You remembered that big word. And what do we do when we predict about the story?

Student 4: We think about what might happen.

Teacher: Next in the story. Right. And then we did one more. The last thing was . . . if you don't know something you might raise your hand and ask that it be . . . clarified. That was a big word, wasn't it? So, we're going to start today with some stories, and we're going to use those four different activities . . . summaries, questioning, predicting, and clarifying to help us understand the story.

Source: Palinscar, A.S. (1986). "The Role of Dialogue in Providing Scaffolded Instruction." *Educational Psychologist* 21, 73-98.

In some studies, guided practice took place in the context of a dialogue among teacher and students — reciprocal teaching (Palincsar and Brown 1984) — with students and teacher rotating the role of teacher. This allowed for shifting of responsibility to the students and gradual internalization of the cognitive strategies. As the student took on the role of the teacher in the process of applying the strategies to a text, the teacher was able to evaluate the student's progress and provide feedback or assistance (see box, page 30, for an example of a dialogue).

Collaborative social dialogue was also emphasized in Englert and colleagues' (1991) Cognitive Strategy Instruction in Writing. During guided practice, students were invited to participate in a dialogue about a class writing project. Students and teacher worked collaboratively to generate self-questions, apply the new cognitive strategies, and carry on the dialogue to complete a class paper. The students progressively took on more responsibility for completing the writing task. The investigators contend that as students accept more responsibility in the exchange that takes place during the instructional dialogues, they begin to internalize the dialogue. The investigators suggest that this inner dialogue allows students to (1) talk to themselves about their own writing, (2) hear what their own writing has to say, and (3) talk to others about their writing.

In some studies, notably those conducted with high school and college students, the students practiced the task in small groups without the teacher. For example, King (1989) reported that after hearing a lecture, students met in small groups and practiced generating questions about the lecture. Students in Schoenfeld's (1985) study had opportunities to participate in small group mathematical problem solving. Schoenfeld suggests small group work facilitates the learning process in four ways. First, it provides an opportunity for the teacher to assess students, to provide support and assistance as students actively engage in problem solving. Second, group decision making facilitates the articulation of knowledge and reasoning as students justify to group members their reasons for choosing alternative solutions. Third, students receive practice in collaboration, a skill required in real-life problem solving. Fourth, students who are insecure about their abilities to solve problems have the opportunity to see more capable peers struggle over difficult problems.

Providing Feedback

Feedback is important in teaching cognitive strategies as it is for all forms of learning. Traditional feedback from teachers and other students on the correctness of response took place throughout the lessons on cognitive strategies.

In several studies the teacher provided self-checking procedures to increase student independence. For example, as part of their instruction in teaching students to summarize a passage, Rinehart, Stahl, and Erickson (1986) had students use the following list of questions to check their summaries:

> Have I found the overall idea that the passage is about?
> Have I found the most important information that tells me more about the overall idea?
> Have I used any information that is not directly about the main idea?
> Have I used any information more than once?

Checklists for writing programs ranged from checklists on punctuation ("Does every sentence start with a capital letter?") to checklists on style elements. For example, students being taught to write explanations were taught to ask, "Did I tell what materials you need?" "Did I make the steps clear?" (Englert et al. 1991). Teachers usually presented these checklists at the end of guided practice. The teacher modeled the use of the checklist and provided students with guidance as they began to use the checklists.

In some studies, students were provided with expert models to compare their work to. For example, where students were taught to generate questions, they could compare their questions with those generated by the teacher. Similarly, when learning to write summaries, students could compare their summaries on a passage with those generated by an expert.

Increasing Student Responsibility

Just as it is important to simplify material and provide support for students in the initial stages of learning a cognitive strategy, it is also important to reduce the number of prompts and provide students with practice using more complex material. Thus, the responsibility for learning shifts from the teacher to the student. This gradual decrease in supports and gradual increase in student responsibility has been described as a shift in the teacher's role from that of coach to that of supportive and sympathetic audience (Palincsar and Brown 1984).

After the students in the study by Wong and Jones (1982) had used cue cards to develop fluency in writing a summary, the cue cards were removed and students wrote summaries without these prompts. In the studies by King (1989), in which students used half-

completed sentences as references when generating questions, the teacher withdrew the supports after the guided practice, and students were left to generate questions on their own.

Increasing the complexity of material was evident in the study by Palincsar (1987), in which students learning to generate questions began by working on a single sentence, then a paragraph, and finally, an entire passage. Schoenfeld (1985) sequenced the problems he presented to his students when teaching mathematical problem solving. He first gave students problems they were incapable of solving on their own; this provided the motivation for learning the strategy he planned to introduce. After presenting the strategy, he provided problems that were easily solved when the strategy was applied. As students became skilled at applying the strategy, he introduced a new strategy. Interspersed among these new problems were several problems requiring the application of previously taught problem-solving strategies, forcing students to discriminately apply the strategies learned to the type of problems encountered. As the course progressed, students were expected to combine strategies to solve complex problems.

In some studies, the support that students received from other students was also diminished as work progressed. For example, in the study by Nolte and Singer (1985), the students first spent three days working in groups of five or six and then three days working in pairs before working alone on the task.

In the study by Englert and colleagues (1991), in which students were taught cognitive strategies in writing, students first participated in a collaborative dialogue that centered on the application of the newly learned strategies to a whole-class writing project. Students then chose their own topic, applying the same strategies used in the group writing. Students were encouraged to collaborate with a peer or peers by sharing ideas, discussing each other's writing, asking questions, getting feedback, reporting progress, or asking advice. The teacher provided additional support by finding examples of strategy use or problems found in the students' writing, displaying them on the overhead. The teacher initiated a class dialogue on the student examples, focusing the discussion on the strategies used, the problems encountered by the students, and possible solutions. After the students completed this piece of writing, the teacher asked them to independently write another paper for publication in a class book.

When series of steps have been taught and practiced separately, as in some summarizing and writing strategies, one of the final tasks during guided practice is having the students practice putting the component parts of the strategy together. A teacher can then assess student implementation of the complete strategy, correct errors, and determine whether additional teaching or practice is necessary. Such assessment is important before students begin independent practice.

Providing Independent Practice

The goal of independent practice is to develop *unitization* of the strategy, that is, the blending of elements of the strategy into a single, unified whole. The extensive practice, and practice with a *variety* of material — alone, in groups, or in pairs — also *decontextualizes* the learning. That is, the strategies become free of their original "bindings" and can now be applied, easily and unconsciously, to various situations (Collins et al. 1990). Cognitive Strategy Instruction in Writing (the program implemented in the Englert et al. 1991 study) provided students with several opportunities to apply the strategies they had been taught, first in a whole-group setting, then individually with peer and teacher assistance, and then a third time independently.

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Toward a Broader Application?

Scaffolds and the procedures for using them provide us with many ways to think about how to help students learn cognitive strategies (see box, page 27). Such concepts as modeling, thinking aloud, using cue cards, anticipating errors, and providing expert models can also be applied to the teaching of well-structured skills. This suggests that instead of a dichotomy, there is a continuum from well-structured explicit skills to cognitive strategies. At all points in the continuum, some instructional processes, such as presenting information in small steps and providing guided practice, are important. Yet, as one moves from well-structured skills to cognitive strategies, the value of providing students with scaffolds — models, concrete prompts, think-alouds, simplified problems, suggestions, and hints — increases.

The tools and techniques we refer to as scaffolds are at a middle level of

specificity. That is, they provide support for the student, but they do not specify each and every step to be taken. There is something appealing about this middle level. It lies somewhere between the specificity of behavioral objectives that seemed overly demanding to some, and the lack of instruction that many criticized in discovery learning settings. Perhaps it is the beginning of a synthesis. □

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Authors' note: We hope that the ideas presented here can serve as a heuristic for teachers to support their classroom instruction in cognitive strategies. The teaching of cognitive strategies is a higher-level operation itself; there is no specific, predetermined, or guaranteed path of instructional procedures to follow. Rather, there are sets of procedures, suggestions and scaffolds that a teacher selects, develops, presents, attempts, modifies, and even abandons in order to help students learn the cognitive strategy.

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