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How Classroom Teachers Can Help Students Learn and Teach Them How to Learn

You would think that college students are expert learners; after all, they have completed 12 years of school and have chosen to extend their academic path. In reality, many college students are deficient learners who employ weak strategies in the classroom and while studying (Gubbels, 1999; Kiewra, 1991; Pressley, Yokoi, Van Meter, Van Etten, & Freebern, 1997).

I teach a college-level study skills course and have seen students' learning deficits firsthand. The first day of class, for example, I assess students' learning potential by presenting a lecture, providing an opportunity for students to review their lecture notes, and then testing them. What I observe are students recording sketchy notes, creating outlines, and studying noted ideas by rehearsing them one idea at a time. Employing these ineffective strategies (Craik & Watkins, 1973; Kiewra, DuBois, Christian, McShane, Meyerhoffer, & Roskelley, 1991) naturally leads to poor test performance.

Why are many students ineffective learners? It could be that students are rarely instructed *how* to learn. Strategy instruction is rarely incorporated into the curriculum (Applebee, 1984; Durkin, 1979). Durkin, for example, viewed more than 7,000 minutes of reading and social studies instruction and did not observe a single incidence of strategy instruction. Educators, it seems, teach content such as math and science, but fail to teach students *how* to learn such content. Reflect on your own education: Did anyone teach you how to record notes and study for exams? Probably not. Yet students are expected to know how to learn.

Fortunately, students can learn how to learn when taught strategies in the context of study skills courses. Study skills, or "Learning to Learn" (Gall, Gall, Jacobsen, & Bullock, 1990; Simpson, Hynd, Nist, & Burrell, 1997) courses, like the one I teach, often include units on motivation and time management, note taking, text learning, studying, and test taking (Kiewra & DuBois, 1998). Completing a study skills course, though, is not the only way to learn how to learn. Ideally, instructors can teach students how to learn by embedding strategy instruction within their subject matter courses (Pressley & Woloshyn, 1995). While teaching psychology or history, for example, instructors can also teach students strategies for text learning, lecture note taking, or studying for exams.

Good strategy instructors must know two things: (a) which strategies are effective and (b) how to teach them by embedding strategy instruction into content teaching. The latter—how to embed strategy instruction—is not too complicated. Strategy instructors should (a) *introduce* the strategy by modeling it and describing it, (b) *sell* the strategy by telling why it works, (c) *generalize* the strategy by telling where else it is useful, and (d)

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perfect the strategy by providing practice opportunities (Pressley & Woloshyn, 1995). As for the matter of which strategies are effective, this article focuses on strategies appropriate for four crucial learning components: Note taking, Organizing, Relating, and Monitoring. Together, the first letters of these four learning components spell "NORM." As you will see, these four learning components are hardly the norm for most college students who were never taught how to learn. This article addresses each NORM component by describing students' typical practices and specific strategies that should be employed. Examples of how instructors might embed strategy instruction into content teaching are also provided. The article's purpose, then, is to improve teaching so students achieve more and, ultimately, learn how to learn.

Note Taking

Lecture learning is prominent in college classrooms. Armbruster (2000) reported that college students usually spend about 80% of class time listening to lectures. Indeed, the lecture method remains "the 'sacred cow' among most college . . . instructors" (Carrier, Williams, & Dalagard, 1988, p. 223). If lecturing is the instructor's sacred cow, then lecture note taking is the students' "pet calf" (Titsworth & Kiewra, 2001). Ninety-nine percent of college students record lecture notes (Palmatier & Bennet, 1974), and 94% of American students believe that note taking is a valued and important activity (Dunkel & Davy, 1989).

Students are right to record notes and value note taking. There is strong evidence that recording lecture notes leads to higher achievement than not recording notes, whether the notes are reviewed or not (Kiewra, 1985a). Moreover, higher quantities of note taking are associated with higher achievement (and vice versa) (Kiewra & Benton, 1988; Kiewra & Fletcher, 1984; Titsworth & Kiewra, 2001). More specifically, students have about a 50% chance of recalling noted information on a test, but only about a 15% chance of recalling non-noted information (Aiken, Thomas, & Shennum, 1975).

The problem is that students typically record incomplete notes—usually 20-40% of the important lecture ideas (e.g., Kiewra, 1985b; O'Donnell & Dansereau, 1993). Students must record more notes and instructors should take steps to increase lecture note taking.

Providing the instructor's notes

One obvious strategy for increasing the quantity of notes available to students is for instructors to provide a detailed set of notes to review. Research shows that students who listen to a lecture and later review instructor-provided notes outperform students who record and review their own notes (see Kiewra, 1985c). One study went so far as to show that reviewing the instructor's notes is so effective, it can compensate for missing the lecture (Kiewra, 1985d). I certainly do not advocate that students miss class. I do advocate that instructors, if so inclined, provide students with detailed notes and explain the benefits of reviewing them. Of course, many instructors are too busy to generate complete notes or simply believe that note taking is the students' responsibility (Kiewra, 1984). For these instructors, there is, perhaps, a middle ground—providing skeletal note-taking devices.

Providing skeletal notes

Skeletal notes contain the lecture's main ideas interspersed with spaces for note taking. Skeletal notes provide the lecture's organization in advance and, if ample space is provided (Hartley, 1976), invite complete note taking. In one study, skeletal note takers recorded 56% of the lecture ideas, whereas conventional note takers recorded only 38% (Kiewra, DuBois, et al., 1991).

Providing lecture cues

Another strategy for increasing note taking is providing lecture cues. Cues signaling important ideas can be written on the chalkboard (Locke, 1977), on transparencies (Baker & Lombardi, 1985), or presented orally (Maddox & Hoole, 1975; Scerbo, Warm, Dember, & Grasha, 1992). In all of these studies, note taking or achievement or both were raised when importance cues were presented. Consider, for example, that Locke (1977) found that students record about 80% of information written on the chalk board—a huge jump in note taking beyond the roughly 30% of lecture points students normally record without assistance.

Instructors can also boost note taking by providing organizational cues that signal the lecture's main topics and common categories. Titsworth and Kiewra (2001) inserted organizational cues signaling the lecture's four topics (the names of four communication theories) and five common categories pertaining to each topic (e.g., definition, application, and context) throughout the lecture and at the start. Students receiving the brief lecture cues (e.g., "Now I'll address the context for personal communication theory") recorded 54% of the lecture's organizational points compared to 15% for those hearing an uncued lecture. Students hearing the cued lecture also recorded 64% of the lecture details, whereas uncued students recorded only 29% of the lecture details. This study shows that organizational cues can drastically boost organizational points and related details in notes.

Re-presenting the lecture

A fourth strategy for increasing note taking is re-presenting the lecture (Kiewra, Mayer, Christensen, Kim, & Risch, 1991). College students recorded notes while watching a videotaped lecture presented one, two, or three times. Students viewing the lecture twice (53%) or three times (60%) recorded more notes than those viewing the lecture one time (38%). Given these findings, I recommend that instructors and students make audio- or videotaped copies of lectures for students to replay so they can add to their notes each time they do so.

Reconstructing lecture notes

A fifth strategy for increasing the number of lecture notes for review is "reconstruction." Following the lecture, students should review their notes in hopes that their recorded notes prompt them to reconstruct and add missing lecture points (Rickards & Friedman, 1978).

Several informal studies I have conducted with my study skills classes show that reconstruction alone boosts the percentage of noted lecture points from about 30% to 50%. Students reconstructing notes with a partner boost the number of noted lecture points even higher. This greater increase is probably the result of note sharing and collaborative reconstruction. Whatever the reason, students' individual or joint attempts to embellish notes following the lecture seem worthwhile.

In summary, instructors can help students compile more complete notes by providing (a) detailed notes, (b) skeletal note-taking devices, (c) lecture cues, (d) audio- or videotaped copies of the lecture for re-presentation, or (e) opportunities to reconstruct missed lecture points at the conclusion of lectures. These instructional strategies, although immediately helpful, may not result in students' acquiring strategies they can use in future settings. The narrative below is an example of how an instructor might promote note taking and simultaneously teach a note-taking strategy. Notice that the four components of strategy instruction mentioned in the introduction are present.

> "Class, I noticed that many of you recorded incomplete notes when I lectured last week about schedules of reinforcement. Here is a set of complete notes that I created from that lecture to model good note taking. I numbered each lecture point that I recorded and you can see there were 90 key points. Quickly examine your notes from that lecture, and count how many of these 90 points you have. (Introduce strategy)
>
> "I'm not surprised that most of you have just 20-40 of these lecture points in your notes. Research shows that most students record only about 30% of the important lecture ideas. This is too bad because research also shows that the more notes students record the better they perform on tests. Let me tell you now about a strategy you can use to increase note taking. I call it the reconstruction strategy and it works like this: Soon after a lecture, reread your notes and try to recall or reconstruct lecture information missing from your notes. When you do, add the "new" information to your notes. It really works. I've had students try it in my study skills class and they report that they double the number of lecture points in notes—especially when they use the reconstruction strategy with a partner. (Introduce and sell strategy)
>
> "Let's have everyone practice the reconstruction strategy now in pairs by working through your notes from today. In a while, we'll see how much more complete your notes are. (Perfect strategy)
>
> "The reconstruction strategy, of course, is useful for any psychology lecture or for lectures in any subject area. Try using it in your other classes." (Generalize strategy)

Organizing

Once students record notes, what should they do with them to best learn the material and prepare for tests? Some study skills books recommend that students first organize their notes in outline form (e.g., Ferrett, 2000), and many students apparently take that suggestion to heart (Van Meter, Yokoi, & Pressley, 1994). The purpose of outlining is to readily see how information is organized into topics, categories, and associated details.

Using matrix notes

A great deal of research, however, has confirmed that organizing comparative information into a matrix results in greater learning than organizing it into an outline (See Kiewra, 1994; Robinson & Kiewra, 1995). Figure 1 is an outline containing information about four wildcats. Notice it contains four topics (tiger, lion, cheetah, and bobcat), five categories common to all topics (call, weight, life span, habitat, and social behavior), and details pertaining to the intersection of topics and categories (e.g., the tiger's call is a roar). The outline presents this information in a linear, top-to-bottom, structure. Figure 2 is a matrix representing the same information. Notice that topics appear on top, categories down the left margin, and details within the matrix cells. The matrix's two-dimensional structure is superior because it localizes (Kauffman & Kiewra, 1999; Kiewra, Kauffman, Robinson, DuBois, & Staley, 1999) related information better than the outline. For example, if asked which wildcat has the shortest life span, a student studying the outline would have to locate the details pertaining to each wildcat's life span from the four distinct sections of the outline, hold each fact in memory, then compare the life spans to devise a response (Robinson & Skinner, 1996). In contrast, the matrix localizes the four life spans in a single matrix row, making them easier to compare. Consider another example involving information pertaining to two categories: weight and life span. Students studying the outline are likely to overlook the relationship between wildcats' weight and life span. This information must be gathered and synthesized from eight different and separated lines within the outline. In contrast, this same information is localized along adjacent matrix rows, making it easy to see that heavier cats live longer than lighter-weight cats.

Wildcats

I. Tiger
   A. Call
      1. Roar
   B. Weight
      1. 450 pounds
   C. Life span
      1. 25 years
   D. Habitat
      1. Jungle
   E. Social Behavior
      1. Solitary

II. Lion
   A. Call
      1. Roar
   B. Weight
      1. 400 pounds
   C. Life span
      1. 25 years
   D. Habitat
      1. Plains
   E. Social Behavior
      1. Groups

III. Cheetah
   A. Call
      1. Purr
   B. Weight
      1. 125 pounds
   C. Life span
      1. 8 years
   D. Habitat
      1. Plains
   E. Social Behavior
      1. Groups

IV. Bobcat
   A. Call
      1. Purr
   B. Weight
      1. 30 pounds
   C. Life span
      1. 6 years
   D. Habitat
      1. Forest
   E. Social Behavior
      1. Solitary

Figure 1. Wildcat outline.

Wildcats

	Tiger	Lion	Cheetah	Bobcat
Call	Roar	Roar	Purr	Purr
Weight	450	400	125	30
Life span	25	25	8	6
Habitat	Jungle	Plains	Plains	Jungle
Social Behavior	Solitary	Groups	Groups	Solitary

Figure 2. Wildcat matrix.

As was true with note taking in general, instructors can help students obtain matrix notes for review by providing completed matrix notes (Kauffman & Kiewra, 1999; Kiewra et al., 1999) or by providing matrix frameworks for note taking (Kiewra, Dubois, et al., 1991). Instructors can also train students to construct matrices and other representations (Connelly, DuBois, & Staley, 1998; DuBois, Staley, Guzy, & DiNardo, 1995; Kiewra, 1994; Kiewra & DuBois, 1998).

An instructor can use matrices while teaching and embed matrix strategy training, as well. While teaching about the solar system, for example, an instructor can provide a matrix framework (containing topics and categories but no details) or a completed matrix like that shown in Figure 3. Presenting the matrix is, of course, the springboard for teaching the matrix strategy as briefly exemplified below.

> "Class, I'm providing you with a matrix about the solar system. The matrix strategy is a good one. It localizes or groups information in a way so you can easily spot relationships. Notice in the matrix how easy it is to see that the greater the distance planets are from the sun, the greater their time to revolve around the sun. Also notice that inner planets are smaller and rockier than outer planets (with the exception of Pluto). Notice how difficult it is to spot these relationships in the outline I've also provided. (Introduce and sell strategy)
>
> "Matrices are easy to construct. Let me tell you how I constructed this one. . . . Let's have you practice by extending this one to include new information about orbit speed and rotation time. . . . Before we stop, let's think of some other situations where we can use matrices in science, such as when comparing parts of an atom. . . ." (Perfect and generalize strategy)

Relating

Little is known about what students actually do with notes following lectures. Fortunately, two qualitative studies reveal a partial answer. Van Meter and colleagues (1994) interviewed hundreds of college students about their review behaviors and found that some students do not review notes at all; 29% revise them by adding, deleting, or reorganizing notes; 12% do nothing more than recopy them verbatim; and 47% report that they review their notes. Unfortunately, the researchers did not press students to clarify what they meant by "review." Some clarification comes from a study by Gubbels (1999) who investigated in depth the study behaviors of five college students. All five students reported that they reviewed notes using rehearsal-type strategies, such as repeating or rewriting information verbatim.

Rehearsal is also advocated as a study strategy. The popular study skills text, *Becoming a Master Student* (Ellis, 1997), recommends reciting and repeating information aloud so that you both hear it and "get the physical sensation in your throat, tongue, and lips." A leading cognitive psychology text (Anderson, 1985) reports on the PQ4R Method for learning text material. One of the four Rs is "recite," which involves repeating information.

Although rehearsal is advocated and popular, rehearsal is actually a weak study strategy. Rote rehearsal does not transfer information into long-term memory (Craik & Watkins, 1973). One remarkable study of memory in natural settings (reported by Neisser, 1982) even described a professor who read the same 500-word prayer aloud each day for 25 years and still did not know the prayer completely from memory. He required over 100 promptings in order to recall it correctly.

If not rehearsal, then what should students do with their lecture notes or other review materials? According to Mayer (1984, 1996) and others (e.g., Sternberg, 1985), students must relate or connect the material to be learned. Mayer advocates two types of connections: internal connections and

	Planets								
	Inner				Outer				
	Mercury	Venus	Earth	Mars	Jupiter	Saturn	Uranus	Neptune	Pluto
Miles from Sun:	36 million	67 million	93 million	142 million	483 million	886 million	2 billion	3 billion	3.5 billion
Time to Revolve Around Sun:	3 months	8 months	1 year	2 years	12 years	30 years	84 years	165 years	250 years
Diameter (miles):	300	8,000	8,000	4,000	89,000	75,000	32,000	31,000	1,000
Surface:	Rocky	Rocky	Rocky	Rocky	Slushy	Slushy	Slushy	Slushy	Rocky

Figure 3. Solar system matrix.

external connections. Figure 4 shows the two types of connections. The broken lines represent the internal connections made within the material studied (the Xs). For example, a student acquiring the facts that white rhinos eat grass, have square lips, and live in grasslands might connect these three facts by saying, "It makes sense that an animal in the grasslands eats grass because grass is plentiful. It makes sense that it has square lips that are useful for scooping mouthfuls of grass." Figure 4's solid lines show the external connections made between the material studied (Xs) and past knowledge (the triangles). For instance, a student might relate new information about white rhinos to past knowledge about cows, which also eat grass, have square lips, and live in grasslands.

Matrices for building internal connections

Matrices aid in building internal connections. As already mentioned, matrices localize related information, making it faster and easier to build connections among ideas. Robinson and Skinner (1996) had students search informationally equivalent texts, outlines, and matrices to answer relational questions such as "which animal is the largest?" Relationships were found more quickly when students searched a matrix compared to a text or outline.

Studying matrix notes also led to higher achievement on relational test items than studying an informationally equivalent text or outline following a lecture about wildcats (Kauffman & Kiewra, 1999). Two types of relational questions were used: local relations that involved relationships among wildcats relevant to one category such as call (e.g., Which two cats purr?), and global relations that involved relationships among wildcats relevant to two categories such as call and weight (e.g., "What is the relationship between call and weight?"). Students studying matrix notes outperformed the other groups on both relational item types.

Mental models for building external connections

Mental models (Mayer, 1989, 1996) help learners build external connections as they relate new information to a familiar analogous model. For example, when learning about how a pump works, a learner might relate the workings of a pump to past knowledge about how a syringe works. When learning about cell parts and functions, learners might relate these to parts and functions of a city. For instance, the cell wall that defines the cell's boundary and protects the cell is like the wall built around a city. The cell nucleus is much like the city library because both are information centers.

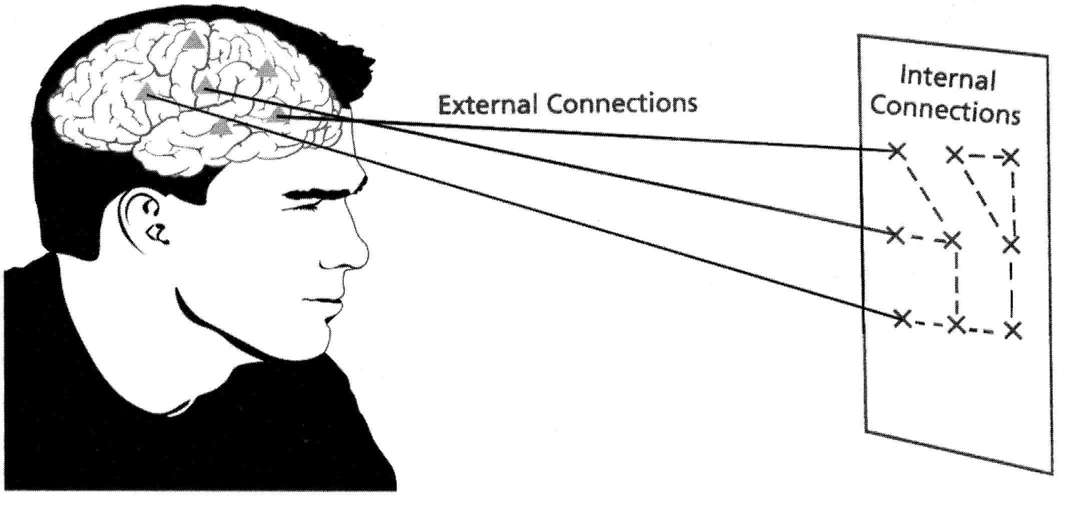

Figure 4. Diagram showing internal and external connections.

Self-explanations for building external connections

Self-explanations are another means for building external connections. Self-explanations are statements learners make as to why certain ideas are so. For instance, given the facts that tigers knock their prey over and cheetahs run their prey down, I ask myself why that is so. I may then use my past knowledge that tigers are large and cheetahs are fast to generate the self-explanations that these wildcats exploit their greatest strengths to capture prey.

Self-explanations have empirical support. For example, Bielaczyc, Pirolli, and Brown (1991) taught college students to generate self-explanations that linked facts and examples about LISP computer programming. Students trained in self-explanations outperformed students using memorization and recall techniques with respect to learning and applying LISP programming techniques. Pressley and his colleagues (1997) sometimes refer to self-explanations as "elaborative interrogation." They contend that students should habitually ask themselves "why" questions about new material to increase understanding. A series of studies by King (1989, 1991, 1992) and reported by Armbruster (2000) reveal the value of why-type questions. College and high school students taught to generate and answer why-type questions as a review strategy following lectures outperformed untrained students who reviewed in their normal fashion.

Instructors can easily embed strategy training for relating information in their courses. Below are excerpts of what an instructor might say while teaching students about the characteristics of fish and concurrently teaching a relation strategy.

> "The text points out that the catfish has a mottled appearance and lives at the bottom, while the albacore has a light-colored belly and lives at the surface. You might be able to simply memorize this information, but you might also forget it or reverse it because it seems rather arbitrary. Let me teach you a strategy for relating information that makes learning more meaningful and memorable. (Sell strategy)
>
> "I call this the self-explanation strategy. What I do is raise the question "why?" and then use my past knowledge to seek a logical explanation. In this case, I wonder why these fish have the appearance they do and how it might relate to their habitat. I know from past experiences that many animals such as deer and polar bears blend into their surroundings so they won't be easily seen by predators or prey. Perhaps, the catfish's dark upper side makes it hard to see from above because its dark upper side blends into a lake's dark bottom. Similarly, the albacore's light-colored belly makes it hard to be seen by other fish below because it blends well with the light-colored surface. (Introduce strategy)
>
> "Now try using this strategy to explain the relationships between the crappie and croaker's appearance and habitat. . . ." (Generalize and perfect strategy)

Monitoring

Ideally, students should know whether they are prepared for exams. According to Pressley and colleagues (1997), most students do not adequately monitor their understanding before exams and are, therefore, unaware that they do not know all they need to know. Pressley and colleagues (1990a, 1990b) had college students read short passages and report the main ideas after reading. Students also reported how confident they were in their responses. Results showed that readers were almost as confident in their incorrect responses as their correct ones. Thus, they were unable to accurately monitor their understanding.

It seems that students sometimes do not even try to monitor their understanding. Bransford and Nitch (1978) gave students the short passage below and asked them to rate its comprehensibility:

> The man was worried. His car came to a halt and he was all alone. It was dark and cold. The man took off his overcoat, rolled down the window, and got out of the car as quickly as possible. Then he used all his strength to move as fast as he could. He was relieved when he finally saw the lights of the city, even though there were far away.

All agreed the passage made sense. Students were then asked questions such as "Why did the man take off his overcoat if it was cold outside?" "Why did he roll down this window?" Only after pondering these teacher-delivered questions did students recognize that they did not understand the passage (which was actually about a submerged car).

Self-testing

The problem is that many students do not know that they don't know the material until they are tested. Of course, then it is too late. An excellent strategy to improve self-monitoring is self-testing (Davey & McBride, 1986; Meichenbaum, 1977). Students should test themselves so thoroughly prior to an exam that there is nothing the instructor can ask them that they haven't already asked themselves. Instructors can facilitate self-testing by providing students with previous tests or practice tests as study devices (Pressley et al., 1997). Or, they can do what I do in my study skills class and assign students to generate practice tests. In the context of this assignment, I teach students the self-testing strategy as follows:

> "Class, you are going to be tested next week on our motivation unit. Raise your hand if you think you know this material well. Almost all of you believe you know it well. Let's find out. Take this brief practice test now. . . . Hmm, results indicate that the average score was 64%. Now how well do you think you know this information? Most of you thought you knew this information but only realized you did not when I tested you. Had this been a real test, most of you would have failed. Let me teach you a great strategy: self-testing. (Sell strategy)
>
> "You should generate and answer test questions when you study. In fact you should do this cooperatively with others (O'Donnell & Dansereau, 1993) so you have more and different questions to assess your knowledge. (Introduce strategy)
>
> "Let's practice together generating more potential test questions for our upcoming exam and exams in your other classes." (Generalize and perfect strategy)

Conclusion

The strategies for Note taking, Organizing, Relating, and Monitoring recommended in this article are, unfortunately, not the "NORM" for most students who record brief lecture notes, and then review notes by constructing outlines, rehearsing details, and failing to monitor their test readiness. Good instructors, though, can promote good strategy use by teaching their subject matter in ways compatible with the favored NORM strategies presented in this article. For example, you can provide note-taking frameworks, lecture cues, and re-present lectures to boost lecture note taking; provide matrices to aid organization and build relationships among presented ideas; connect newly presented ideas to familiar models to build relationships between new and past knowledge; and supply practice tests to increase self-monitoring for test readiness.

Instructors who do these things—who present information effectively—are good instructors, but they can and should do more. Recall the old adage "If you give a man a fish, you feed him for a day, but if you teach him *how* to fish, you feed him for a lifetime." Instructors who present information so effectively that students are compelled to learn in effective ways are good "fish givers." They give students the means to learn what is being taught right now. What more can instructors do? Be fishing teachers (Kiewra et al., 2001). As you teach in ways that help students learn, teach students how to do these things (e.g., develop matrices and build models) on their own. Embed the teaching of learning strategies in content instruction so that the fishing pole is gradually transferred from your hands to students' hands, thereby helping them learn now and for a lifetime.

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