Improving Student Thinking

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Believe it or not, our students—regardless of age or grade level—not only can think but they do. They make decisions, attack problems, pose hypotheses, evaluate information, and even make inferences. Unfortunately, of course, many don’t carry out these operations very skillfully or consistently, or at all the appropriate times or places, at least in our classes. Consequently, they often fail to develop the kinds of subject matter understandings, insights, and knowledge that we try so hard to help them develop. Isn’t there something we can do in our classrooms to help our students improve the quality of their thinking, so they can think better and learn the subjects they study as well as they really could and as well as we would like them to?

The answer, happily, is a resounding yes!

Research, exemplary classroom practice, and accumulated teaching experience indicate that there are at least four things you and I can do right now in our classrooms that will improve the abilities and inclinations of our students to think better than they do when left on their own. And, we can do these at the same time that we engage our students in achieving the various subject matter learning objectives called for by our curricula. Specifically, we can

• provide a classroom learning environment that makes thinking possible and students willing to engage in it;
• make the invisible substance of thinking visible and explicit;
• guide and support student execution of newly encountered, difficult, or complex thinking operations during their initial efforts to apply them; and
• integrate instruction in thinking with instruction in subject matter.

Before we consider some of the many ways to incorporate these approaches into our daily teaching, however, it is important to note that improving thinking differs considerably from facilitating thinking. The latter consists of making thinking easier. It is commonly a one-time intervention to help students overcome a temporary obstacle or to ease them through a difficult thinking task. Improving thinking, on the other hand, means making thinking work better—more rapidly, accurately, “expertly”—in the long run than it does now. This requires a continuing, systematic, long-term effort to move students toward achieving and maintaining the highest levels possible of skilled, self-directed, self-correcting thinking. The four approaches described here are especially useful for achieving that goal.

Providing Thoughtful Learning Environments

Unless the learning environments of our classrooms nurture and support student thinking, especially higher-order thinking, our students are unlikely to be very receptive to serious efforts on our part to help them improve their thinking. Among the features of such learning environments two stand out as especially crucial: (1) repeated opportunities to engage in meaningful thinking beyond the level of recall and (2) encouragement to engage and remain engaged in such thinking. By ensuring that our classrooms consistently exhibit these features, we make them “thinker-friendly” as well as “thinking-friendly.” Specialists call such classrooms thoughtful classrooms (Wiggins 1987).

Providing Thinking Opportunities

The secret to providing repeated classroom opportunities to engage in thinking is to engage students in productive learning tasks. These are tasks that require students to produce knowledge new to them, rather than simply to reproduce information or knowledge claims already presented to them in texts, lectures, or media. One powerful way to do this is to frame learning assignments or lessons around thoughtful questions.

A thoughtful question is a question that—to produce an
acceptable response—requires students to go substantially beyond where they are and, like the crew of the Enterprise, “to boldly go where no man has gone before.” To answer these questions, students must locate and use information they may not yet possess as well as restructure familiar information to produce something they do not already know. “What did Columbus discover?” is not a very thoughtful question. “Who discovered Columbus—and why?” is much more thoughtful.

Thoughtful questions stimulate thinking and trigger additional related questions. They engage students in defining terms; posing hypotheses; identifying, finding, assessing, and manipulating data; making and testing inferences; generating and evaluating conclusions and arguments; and applying concepts, principles, and other kinds of knowledge. They are not yes/no questions. They cannot be answered simply by recall. They do not have a single preferred “right” answer (Newmann 1990; Wiggins 1987). Organizing lessons, units, or topics around such questions provides students continued opportunities to engage in all kinds of thinking to generate worthwhile and meaningful subject matter learning.

Productive learning activities also provide considerable opportunities for sustained thinking. Activities like judging the accuracy of a given claim or body of information or generating a strong argument in support of a conclusion may require as few as one or two classroom periods (Beyer 1997). Longer tasks such as the following provide even more opportunities for continued student thinking:

Create and justify the “good citizenship merit badge” requirements for a specific kind of person in a given culture or place at a particular time in history, such as for a Nez Perce youth in the 1870s, an enslaved or free African American in the 1830s, or a king’s vassal in the Middle Ages.

Organizing our lessons around thoughtful questions and productive learning tasks helps make thinking a central part of student learning in our classrooms.

Encouraging Student Thinking

Providing opportunities to think, however, is fruitless unless students take advantage of them. And, as we all know, too many students frequently do not! It is thus also essential that we encourage students to seize and sustain engagement in thinking opportunities if we are to create and maintain a thoughtful learning environment.

The kind of encouragement required here is not the redouble-your-effort kind derived from simple cheerleading or from exhortations like, “Think! Think again! Now think harder!” On the contrary, it is the kind of encouragement that emboldens students to engage in thinking. This means providing them some tangible aid, prompt, or other support that gives them reason to feel that they will or can succeed at the task at hand.

We can provide such encouragement by arranging students so they face each other as well as by surrounding them with bulletin board displays of quotations, cartoons, puzzles, and copies of their own work that illustrate the importance and value of good thinking. Providing wait time for them to think before we accept their responses to our questions or claims and before we respond to their assertions or answers also serves that purpose (Rowe 1974). So, too, does our modeling the behaviors and dispositions of skillful thinking and helping our students exhibit these behaviors and dispositions. Rather than cutting thinking off with remarks such as, “Good answer!”, we can build on their responses to sustain continued thinking by, for instance, asking for evidence to support the accuracy of a response or for examples or more details or assumptions underlying it.

We can also encourage student thinking by minimizing or eliminating the negative risks of thinking (Lipman 1991; Nickerson 1988-89). We can consistently emphasize the positive value of rejected hypotheses and “wrong answers” in leading us to valid hypotheses and “answers.” We can constantly employ the language of thinking by using precise thinking terms to denote the specific cognitive actions, skills, conditions, or products in which we wish to engage students. For instance, instead of asking, “What do you think will happen next?” we should ask, “What do you predict will happen next?” (Olson and Astington 1990; Perkins 1992). And we can keep classroom discourse focused on truth and proof rather than on who says what, welcome and explore divergent or unusual views, and reward the validated products of high-risk thinking (Newmann 1990).

When engaging in new or difficult thinking tasks is a normal and expected part of our classrooms and “emboldening boosts” are consistently given, students have reason to believe that they can engage successfully in such thinking. It is this kind of support—combined with the topics we ask them to think about—that encourages them to take advantage of the thinking opportunities we provide.

Making Thinking Visible

Before we can repair or strengthen something that is broken or is not working as well as it should be, we need to be aware of exactly how it presently functions. We also need to be aware of how it works or might work when functioning as it could or should function. This is as true of student thinking as it is of any other procedure or process. The first step in improving student thinking thus consists of making students conscious of how they presently think and how others more skilled than they carry out the same thinking operations. This means we need to make the seemingly invisible thinking processes visible and explicit, especially when our students are focusing on new or complex thinking operations.

The Invisible Substance of Thinking

What is there we can make visible and explicit about any act of thinking? Cognitive scientists assert that every thinking skill (operation, strategy, or act) consists of three elements: one or more procedures (series of steps and/or rules)
by which it is or can be executed skillfully and efficiently; the conditions under which it is appropriately employed; and any declarative knowledge associated with it, such as the criteria employed in making judgments or evaluations or the heuristics (rules of thumb) that guide expert application of a procedure (Anderson 1983; Nickerson 1988-89). Students benefit immensely from becoming conscious of and articulating exactly how they presently execute a given thinking operation or skill as well as how experts do it, of where and when it is appropriate to employ the operation, and of anything they know—or should know—that would make its application more efficient, effective, and "expert" (Papert 1980; Vygotsky 1962).

Making the Invisible Visible

We help students make visible and explicit these normally unarticulated elements of any thinking skill in several ways. One is by engaging students in reflecting on what they did to carry out a thinking operation they have just completed. This is known as metacognitive reflection. Once students have completed a thinking task, we have them think back on exactly what they did mentally, step by step, to complete it, and why they took those steps. In doing this, students articulate what they recall doing, listen to how some of their peers believe they did the same thing, and then analyze these accounts to identify apparently useful, and even additional unarticulated, steps and rules. By continuously articulating and then comparing these procedural descriptions with each other and with explicit procedures employed by individuals more skilled than they in carrying out the same operation, students can spot weaknesses or omissions in the way they do it, identify steps or rules that appear to be especially useful in carrying out the thinking operation, and adapt or incorporate these into how they execute it in the future (Beyer 1997; Nickerson, Perkins, and Smith 1985; Sternberg 1984).

Another way to make the invisible thinking visible and explicit is to model a thinking operation to be developed (Pressley and Harris 1990; Rosenshine and Meister 1992). Modeling consists of demonstrating step-by-step how a skill is executed, with accompanying explanation noting the key steps in the procedure and why these steps are important. If we are proficient at executing the thinking skill in question and can verbalize clearly how we do it, we ourselves can model it for our students. We may also use written protocols or videos or essays that model this procedure, if any are available. Occasionally, a student who has demonstrated skill in carrying out the thinking operation can model the procedure. Then, if we provide an immediate opportunity to apply the modeled procedure while it is still visible to them, students can attempt to replicate it. With continued practice and reflection they can adopt or adapt it to develop a skilled routine of their own for executing the skill.

The key here is making students conscious of exactly how they presently carry out a thinking act or skill (imperceptible to their awareness or execution may be), of how their peers do it, and of how more skilled thinkers do it. Metacognitive reflection and modeling serve these ends well. Improving the quality of student thinking requires repeated use of both of these techniques with each thinking skill we teach.

Guiding and Supporting Student Thinking

Providing continuing guidance and support to students who are trying to apply newly encountered thinking skills proves indispensable to moving them toward skillful, autonomous use of these skills (Rosenshine and Meister 1992). Two kinds of such guidance and support prove especially effective to this end: scaffolding and cueing. Once students have become conscious of a procedure or routine for executing a new thinking operation, scaffolding and cueing can be used to guide their continuing follow-up practice and application of the procedure in a variety of contexts.

Scaffolding Thinking

A scaffold is a skeletal framework of a thinking procedure—such as a checklist—that makes the steps in that thinking procedure explicit. Students use the scaffold to steer themselves through these steps as they try to carry them out. Such devices allow students to concentrate on applying the rules and steps of an unfamiliar or complex thinking procedure to a given body of information without having also to try to recall what steps to employ. Use of thinking scaffolds minimizes procedural errors in trying to apply a newly encountered thinking skill and enables students to internalize a more effective skill-using routine sooner than they otherwise might if they had to carry out the skill, from memory, exclusively on their own (McTighe and Lyman 1988).

There are three kinds of devices that prove especially effective as scaffolds for thinking. Procedural checklists, such as that for decision making shown in figure 1, are the most explicit. They provide a list, in order, of the mental steps by which a specific thinking procedure can be effectively carried out. Process-structured questions are less explicit. Like the example in figure 1, these devices walk students through the steps in a thinking procedure not by telling them the steps directly but by asking a series of questions that require students to execute in sequence each of the steps that constitutes the given thinking procedure. Graphic organizers, like that in figure 1, are charts or diagrams that present visually—and occasionally with written prompts—the steps in a thinking procedure (McTighe and Lyman 1988). As students fill in the various sections of the thinking skill organizer, they move through these steps. Graphic organizers provide less explicit support and guidance than either checklists or process-structured questions but can still effectively scaffold or structure student thinking.

Not all checklists, lists of questions, or graphic organizers scaffold thinking, however. Many checklists and ques-
tions trigger thinking but do not, by the way they are arranged or worded, effectively move students through the steps in a cognitive procedure. Furthermore, as commonly used, many webs, matrices, charts, and diagrams tend to represent the products of thinking—products such as concepts, generalizations, and so on—rather than a procedure by which a thinking product is generated. To be effective in scaffolding thinking, checklists, question sets, and graphic organizers must activate and present a cognitive procedure in a clear, step-by-step fashion.

**Cueing Thinking**

A cue is a prompt that reminds us of what to do or say next without telling us all that we are to do or say. Cueing thinking consists of prompting students to employ a specific thinking operation. Cues are usually much less explicit than scaffolds. They also depend much more for their effectiveness on the degree to which students have already internalized—stored in memory—under that cue label or signal the procedures and the rules that constitute the action or skill they seek to call forth. Cueing thinking proves helpful to improving student thinking only after students have become consciously aware (through metacognitive reflection and/or modeling) of an effective skill-using procedure and have had enough scaffolded practice in applying it to have stored that specific knowledge in memory.

Thinking cues take many forms (Rosenshine and Meister 1992). They range from the more explicit, such as previewing and rehearsing a skill about to be applied, to simply naming that operation, to even less explicit devices such as...
as mnemonics and symbols. We can preview a thinking operation that students are about to employ by having volunteers provide its various names, report any special rules or heuristics that they know might guide its use (including the criteria it applies, if it is a critical thinking operation), tell why it is appropriate to use at this point, and define it. Asking for the definition last allows students to use the preceding volunteered information as cues for searching their memories for this definition or as information from which to construct an appropriate working definition.

We can help students rehearse a thinking skill they are about to practice by having volunteers report one or more routines or procedures by which it can be effectively employed and/or any rules, criteria, and heuristics that direct or inform its use. When students have been applying a skill for some time, however, merely stating the technical label of the skill—or words associated with it—customarily serves as a sufficient cue. Mnemonics, if devised or learned earlier by the students when they were first articulating or devising skilled procedures for executing a skill, also can serve as useful thinking cues. For example, consider the acronym DECIDE as a cue for the process of decision making:

- Define goal
- Enumerate alternatives
- Consider consequences
- Investigate effects
- Determine best alternative
- Execute

Acronyms like this one not only aid students in recalling the skill to employ but can actually cue the steps in a procedure for executing it (Beyer 1997).

Integrating Instruction in Thinking with Subject Matter

Thinking is affected and shaped as much by the subject matter to which it is applied as that subject matter is shaped by the kind of thinking that is employed to process it and the skill with which that thinking is applied. Efforts to improve student thinking, therefore, need to be carefully integrated into instruction in subject matter (Resnick and Klopf er 1989). We can and should teach thinking and subject matter at the same time.

To accomplish this, we must do at least two things. First, we must ensure that our students have repeated opportunities throughout our courses to apply the thinking skills in which they need to improve. This can be done, in part, by focusing on topics and themes within our subjects that are relevant to our students and to life today and in the future. It can also be accomplished by building student study around productive thinking activities and questions, as described above.

In addition, we must provide explicit instruction and then guided practice—as appropriate—in each thinking operation to be improved the first dozen or so times students are called upon to apply it. One way to plan for this instruction is to identify prior to beginning a course the specific thinking skills we believe our students will need to improve. Next, we can plan specific opportunities for the students, once they have first encountered the need to use these skills, to apply each at first frequently and then intermittently thereafter. Then we can design in advance the appropriate skill instruction for each point in this skill-using sequence using the subject matter our students are to be studying along the way.

Another way to provide such instruction is to be always alert while teaching to any thinking skills with which our students seem to be having difficulty. The first time we notice such difficulty we can then switch our instructional focus from subject matter to how to carry out the skill by introducing that skill. John Bransford (1993) calls this “just-in-time teaching.” Appropriate guided practice can follow, over a sequence of subsequent lessons, as described above.

Both of these teaching approaches capitalize on what research tells us about student motivation to learn. And that is that students are more willing to attempt and to attend to learning a new skill when they are introduced to it and provided guidance in applying it at a time they have a perceived need to use it but realize they cannot do it effectively (Sigel 1984). Such skill lessons do not ignore the topic or subject being studied at the time. Indeed, they should use this subject matter as a vehicle for articulating the skill so students learn about this content while they also improve their proficiency in executing the skill.

Once a thinking skill has been introduced—made visible and explicit—we need to provide guided practice in it each time the students must apply it to develop further subject matter learning. Such practice not only helps students move toward skilled, autonomous use of the skill but also helps them develop the kinds of complex subject matter learning we usually wish them to develop. In guided practice of a skill, students first attend to how they executed the skill and then to the subject matter knowledge developed by its application. In time, little attention at all need be given to the skill. Upon our cue, students will soon be able to execute it effectively and eventually can do so on their own initiative. By combining instruction in thinking and subject matter in this way we capitalize on the symbiotic relationship between content and thinking: content serves as a vehicle for applying thinking and thinking serves as a tool for understanding content and producing knowledge.

Combining These Approaches to Improve Student Thinking

Many of us have long been aware of these four teaching approaches. However, we have too often elected to employ only one of them, the one that we or someone deems is “best” for us or our students. This is most unfortunate because, in order to improve the quality of student thinking and subject matter learning, we need to use all—rather than just one—of these approaches in our classrooms.
Each of the four approaches described here addresses a different element of what is required to improve thinking. Thoughtful classrooms provide the kind of nurturing thinking environment so essential for all the other approaches to “take.” Making the invisible substance of thinking visible and explicit requires such an environment and establishes the baseline from which improvement can proceed. Scaffolding and cueing student thinking provide the guidance and support students need to apply with increasing efficiency, ease, and what math instructors call “elegance” the thinking procedures that they are developing. And employing all of these approaches in the subject matter being studied gives purpose to and motivates continued student skill development.

Is This Worth Doing?

Is the effort to do this worth it? Of course it is. All our students think. But most of them can think better—more often—and with greater success than they now do. And many, if not most, of them certainly can learn more or better in our courses than they do now. Interestingly, research demonstrates that in classes where teachers attend continuously and explicitly to the cognitive skills needed to understand subject matter, students not only improve their proficiency in these thinking skills but they also attain higher achievement in subject matter (Estes 1972). Use of the teaching approaches described here will help us accomplish precisely these goals.

REFERENCES


