Thinking Strategies
for Student Achievement

IMPROVING
LEARNING
ACROSS THE
CURRICULUM, K–12

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Introduction

Thinking: Levels, Purposes, and Contexts

Thinking skills are the most basic of all the skills that can be developed in the classroom and are the foundations of high achievement for all learners. Students learn to think effectively when they have many opportunities to think at different levels, for different purposes, and in different contexts as an integral part of their learning. From kindergarten through grade 12, they need daily challenges that develop, refine, and extend their thinking capacities while they acquire knowledge and build skills. This introduction elaborates on this viewpoint and provides a context for the instructional strategies presented in the chapters that follow: thinking strategies for student achievement. The context includes perspectives on thinking along with basic principles of learning that lead to engagement and high achievement.

Thinking at Different Levels

Cognitive psychologists and educators have consistently recognized that some kinds of thinking are of a higher order than others. For example, Vygotsky (1962, 1978) pointed out that we are born with the most basic cognitive functions but develop higher mental abilities, such as abstract reasoning, as we mature. He stressed that cognition is heavily influenced by the culture within which we are raised, the way we are socialized as we develop, and the different kinds of interactions we have with others. His emphasis on the importance of the sociocultural aspects of learning and cognition set the stage for a later interest in cooperative learning and other forms of student-to-student

interaction that help to develop high-level thinking abilities in social contexts (Lyman, 1981; Kagan, 1994; Singham, 1998; Jensen, 1998, 2005).

Benjamin Bloom was another proponent of the concept of levels of thinking. He and his colleagues identified six levels and presented them in a taxonomy of educational objectives (i.e., cognitive actions in which students should engage; Bloom Englehart, Furst, Hill, & Krathwohl, 1956). Bloom's levels of thinking are listed here from lowest to highest in terms of complexity with examples of how each level of thinking might be manifested in action.

Bloom's Taxonomy of Educational Objectives (1956)

Level of Thinking	Examples of Actions
Knowledge	list, recognize, recall, define, repeat, memorize, label
Comprehension	explain, describe, categorize, restate, translate, infer, discuss
Application	illustrate, demonstrate, interpret, solve, use in a new context
Analysis	compare/contrast, examine, test, inquire, infer, diagram, differentiate, prioritize
Synthesis	design, construct, organize, formulate, integrate, predict, modify, formulate
Evaluation	judge, criticize, argue, defend, persuade, reframe, consider from a particular perspective

Later researchers revised the taxonomy, as shown on the following page, to suit current educational needs (Anderson et al., 2001). The reversal of the last two original levels reflects a belief that the creative thinking involved in synthesizing information and generating something new is at a higher level of complexity than is the critical thinking involved in critiquing and evaluating.

Jerome Bruner (1960) also suggested that learning involves at least three levels of cognitive activity: acquisition, transformation, and evaluation. From his perspective, effective learners assimilate information by reading, listening, viewing, or a combination of inputs. Then they work with the information, analyzing, connecting, applying, and in other ways putting it to some relevant use that

Bloom's Taxonomy of Educational Objectives Revised (2001)

Level of Thinking	Examples of Actions
Remembering	recall, recognize, identify
Understanding	explain, summarize, infer, categorize, compare
Applying	implement, execute, solve, demonstrate, use in novel context
Analyzing	detect patterns, understand relationships, organize into a structure
Evaluating	use criteria or standards to judge, critique, assess, consider from another perspective
Creating	generate, invent, produce, reorganize into new system

extends beyond mere acquisition. Finally, they evaluate the extent to which their transformations have resulted in correct analyses, connections, and applications. Bruner also stressed the importance of intuitive thinking as an adjunct to analytical thinking, both of which he presented as examples of higher-level cognition.

The framework known as Dimensions of Learning (DOL) also makes use of the concept of levels of thinking (Marzano et al., 1992). Dimensions 2, 3, and 4 represent increasingly higher levels of thought, whereas affective elements are contained in Dimension 1 and mental habits in Dimension 5. On the following page is the DOL framework with selected examples of how each dimension might be represented in action.

For many years, teachers have used the concept of levels of thinking in deciding on questions, prompts, and assignments to enhance students' thinking and learning. For example, the DOL framework was introduced with many specific suggestions for classroom applications (Marzano et al., 1992), and Pohl (2000) suggests ways in which Bloom's taxonomy can be used to plan engaging classroom activities with a focus on high-level thinking. Jensen (1998, 2005) stresses that cognitive challenge is a critical feature of instruction that helps students function successfully as thinkers and learners.

Other psychologists and educators have concentrated on analyzing different aspects of high-level thinking. For example, Williams (1970, 1993) investigated the interaction between cognitive and affective responses to information and experience. The high-level cognitive

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Cubing

Overview and Background

Cubing is a thinking activity that encourages students to explore meanings of a given object, concept, or phenomenon from six perspectives, each of which calls for a different kind of high-level thought. The stimulus is a cube that has six different prompts, one on each face: describe, compare/contrast, associate, analyze, apply, and argue for or against. Students respond to each of the six in turn, either orally or in writing.

Cubing has been used for many years as an engaging classroom activity, primarily in the upper elementary and secondary grades. It can be a quick warm-up discussion activity, a prewriting exercise, or the basis of a more extended composition. Ordinarily, the topic is a concrete object, although Cubing can be used to examine abstract ideas from the six different perspectives. For early discussions of the strategy as well as recent commentaries and applications, see the following selected readings: Cowan and Cowan (1980), Vaughan and Estes (1986), and Tomlinson (2001).

Instructional Benefits of This Strategy
• helps students think about a topic from multiple perspectives • develops writing fluency

- develops flexibility in thinking
- encourages students to learn from each other by listening to each other's responses

Step by Step

Before being successful with Cubing, students need to understand each of the six modes of thinking that are used in Cubing. These are the important elements of each:

- To *describe* is to give attributes, details, or characteristics. For example, if the object is a crayon, writers might mention the crayon's color, the color and feel of the paper covering, the words and designs on the covering, the way the crayon feels when it's used as a writing implement, and the look of the resulting mark on the paper.
- To *compare/contrast* is to point out similarities and differences. For example, a crayon is similar to a pen in that one can write or draw on paper with it and different from a pen in that crayon marks can rub off, whereas ink ordinarily will not. A crayon might also be compared and contrasted with a pencil, a piece of chalk, a white-board marker, or another writing implement.
- To *associate* is to make connections. For example, a crayon might be associated with coloring books or drawing. A writer may also make idiosyncratic associations with a crayon, such as the memory of having received a box of crayons as a present.
- To *analyze* is to examine in order to explain structure and to note constituent parts and functions. For example, a crayon can be analyzed by noting that it is ordinarily made up of two parts: the hard, waxy stick that makes the marks and the paper cover that protects one's fingers.
- To *apply* is to indicate how something can be used. For example, a crayon can be used to create a drawing on paper or to color in a designated area such as is found in a coloring book. It might also be used to write a message or to mark a passage in a book or magazine. More unusual applications might include using it as an object in a collage or as a holiday ornament.

- To *argue for/against* is to enumerate advantages and disadvantages. For example, some advantages of a crayon are that it is inexpensive, colorful, and fun to use, while some disadvantages are that it may leave a stain on clothing, that it makes a relatively crude line, and that it is difficult to keep sharp.

You will probably want to explain and model each mode of thinking and have students practice each before combining them all in a cubing exercise. For students in the primary grades, you may want to combine only two or three modes at a time instead of all six. Here is a suggested sequence:

1. Decide how many groups of three or four you will have and prepare enough cubes so that each group will have one. Make cubes by folding sturdy paper into cubes or by repurposing wooden or plastic cubes. Label each face with one of the thinking processes: describe, analyze, compare and contrast, apply, associate, argue for or against.

2. Organize students into groups and give each group a cube. Announce the topic and tell students they will be exploring the topic from different perspectives, as shown on the faces of their cubes. Then have them turn their cubes so that DESCRIBE appears on top.

3. Tell students to focus on writing to describe the topic. Assure them that there's no "right" way to respond and that they should write whatever comes to mind to describe the topic. Have them all start at the same time and write for at least five minutes, or longer if you wish.

4. When the time is up, have students take turns reading what they wrote to the members of their group. By listening to each other, students will enhance their understanding of the topic and learn how the others in the group were thinking about it. This sharing also provides a short break before the next round of writing.

5. Now have students turn their cubes so that COMPARE/CONTRAST appears on top and have them compare and contrast the topic with anything else they can think of. (You may want to give them a suggestion to make sure they have something in mind. For example, if the focus is a crayon, you might say "Compare and contrast a crayon with a pen.") When the