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A Conceptual Model for the Design and Delivery of Explicit Thinking Skills Instruction

Abstract

Developing student thinking skills is an important goal for most educators. However, due to time constraints and weighty content standards, thinking skills instruction is often embedded in subject matter, implicit and incidental. For best results, thinking skills instruction requires a systematic design and explicit teaching strategies. The purpose of this paper is to describe a conceptual model for the design and delivery of explicit instruction in thinking skills, strategies, and habits of mind-- the CRTA Model. The model is applicable for instruction in domain-specific or general content areas and for students at all grade levels, k-16. The paper describes the major controversies surrounding the provision of thinking skills instruction and explains how the CRTA Model accommodates each.

Keywords

Thinking Skills Instruction

Design of Instruction

Thinking Skills, Strategies, and Habits of Mind

CRTA Model

Pedagogy

Post-Secondary Education

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INTRODUCTION

Educators throughout history have deemed skillful thinking to be an important goal of education. In today's information age, educators regard strong thinking skills as essential for successful navigation in a rapidly changing world. National education goals, state education standards, and association/accreditation standards affirm that strong thinking skills (also referred to as *critical thinking* or *higher order thinking* skills) are expected educational outcomes, in the United States and elsewhere. Increasingly, national and state assessments include items designed to assess thinking skills such as problem solving, decision making, and reasoning (Asp, 2001; Costa & Kallick, 2004; Eggen & Kauchak, 2004).

However, for most students, skillful thinking does not occur incidentally or as the result of maturation alone (Case, 1992). For most students, skillful thinking, like skillful writing, requires explicit instruction and practice with feedback. Additionally, research indicates that instruction in thinking skills promotes intellectual growth and enhances academic achievement (Baum, 1990; Kuhn, Black, Keselman, & Kaplan, 2001).

Decisions about how to provide instruction in thinking skills are complex and controversial. Among the many controversies are the following: how to define *critical* or *higher order thinking*; whether or not thinking skills instruction is best infused into the regular curriculum or provided separately and discretely; whether or not thinking skills instruction is best provided directly or inferentially; and whether or not thinking skills instruction takes time away from content instruction.

The purpose of this paper is to discuss each controversy and to provide one model that successfully addresses each--the CRTA Model (Kassem, 2000a, 2000b,

2000c), now revised. The model is applicable for thinking skills instruction in domain-specific or general content areas, and for students at all grade levels, K-16.

THE CONTROVERSIES

Definitions of *Thinking*

Unfortunately, no standard definition of *critical thinking* exists. Instead, many definitions, indicators, descriptors, and programs have evolved. Socrates, sometimes referred to as the father of *critical thinking*, developed a method of dialogical reasoning (i.e., probing debate/exchange among parties used to challenge intellectual confusion and prejudice) some 2,400 years ago. The resulting Socratic method helped define *critical thinking* as a process of critical inquiry, of questioning ideas and obtaining evidence in an effort to avoid egocentric thinking. Those applying this conceptualization of *critical thinking* typically teach reasoning skills, often incorporating the rules of formal or informal logic into content instruction (Arendt, 1978; Schwarze & Lape, 1997).

Definitions of *higher order thinking* have also been influenced by the writings of John Dewey (1933), who defined *critical thinking* as "reflective thought," characterized by careful and persistent consideration of beliefs or conclusions and the reasoning that supports them. Dewey considered reflection to be an important part of learning and thinking, an emphasis that focused attention on *metacognition*--the ability to think about and improve upon one's own thinking processes and learning strategies (Kuhn, 2000; Ormrod, 2004). Those applying this conceptualization of *thinking* teach metacognitive content (e.g., knowledge of one's own learning, memory, and capabilities), processes (e.g., monitoring one's own learning), and strategies (e.g., use of Reciprocal Teaching to improve reading comprehension) [Kuhn, Black, Keselman, & Kaplan, 2001; Palincsar & Brown, 1984].

Other definitions of *critical or higher order thinking* have emerged from the field of education. A taxonomy of cognitive objectives, originally offered by Bloom et al. (1956) and recently modified by Anderson et al. (2001), defines six cognitive processes categorized in a

one-way hierarchy, from simple to complex. The revised taxonomy adds a second continuum—types of knowledge (factual, conceptual, procedural, and metacognitive), arranged hierarchically. Those applying this conceptualization of *critical thinking* use the taxonomy as a tool for defining cognitive processes and for designing instructional objectives, questions, learning activities, and assessments aligned with higher levels of the continua.

Many psychologists (e.g., Feuerstein, Sternberg) define *critical or higher order thinking* in terms of cognitive processes or strategies identified as part of the Information Processing Model of Cognition (Atkinson & Shiffrin, 1968), a theory describing memory and thinking in terms of processes for encoding, storing, and retrieving information. Those applying this conceptualization of *critical or higher order thinking* teach for meaningful learning (e.g., the use of advance organizers to bridge new learning and students' prior knowledge), elaboration (e.g., the use of cooperative learning to encourage students to discuss and add their own conclusions to a topic), and organization (e.g., the use of graphic organizers to visualize the interrelationships among concepts) [Ormrod, 2004]. Some researchers (e.g., Cohen, 1971) consider critical thinking, creative thinking, decision-making, and problem solving to be complex thinking processes (i.e., combinations of cognitive processes) used for a particular purpose.

In defining and describing *critical or higher order thinking*, a number of researchers include the concept of *dispositions* or *habits of mind*. *Dispositions* are learners' intentional inclinations to approach thinking and learning in a particular way, or the characteristics of self-regulated learners (Ormrod, 2004). Many experts (e.g., Beyer, 1987; Costa, 1991; Ennis, 1987; Facione, Facione, & Giancarlo, 1998; Paul, 1990; Perkins, Jay, & Tishman, 1993) have identified dispositions essential to good thinking, including: inquisitiveness, open-mindedness; flexibility; perseverance, and fair-mindedness. Beyer (1997), Costa (2001), Costa & Kallick (2000), and others believe that habits of mind can be improved with effective

instruction. Those who apply this conceptualization of *critical thinking* in the classroom use modeling as one means of teaching productive dispositions.

In practice, definitions of *critical thinking* and preferred ways of teaching *critical thinking* are unique and heavily influenced by institutional missions/goals, standards, student needs, and the instructional objectives of individual faculty members.

The CRTA Model

The CRTA Model for the design and delivery of explicit thinking skills instruction is based upon an eclectic, all-encompassing definition: *critical thinking is rationally, fairly, and reflectively deciding what to do or what to conclude* (adapted from Norris & Ennis, 1993). The definition combines cognitive processes (reasoning), metacognition (reflection), and dispositions (e.g., fair/open-mindedness) for the purpose of making decisions (complex cognitive process) or drawing conclusions (based upon evidentiary knowledge). This working definition undergirds the four target categories (knowledge, dispositions, cognitive processes/strategies, and metacognitive strategies) of Component 2 of the CRTA Model, described in a subsequent section.

Infused vs. Separate Thinking Skills Instruction

To infuse thinking skills instruction means to teach thinking skills as integrated components of the regular curriculum. Beyer (1997) and Swartz & Parks (1994), among others, offer extensive, practical guidelines for infused thinking skills instruction, including: teach explicit strategies (e.g., ways to organize data); give students practice with new strategies in the domain under study; include opportunities for student reflection on the efficacy of new strategies; and follow up with more opportunities to practice new strategies, in order to improve transfer.

Separate thinking skills instruction refers to courses or programs offered apart from the regular curriculum. Many successful stand-alone courses and programs have evolved. Pogrow's (1988) HOTS (Higher-Order Thinking Skills) Program, for example, is a separate computer-based program for elementary students combining special software with specific teaching practices to build students' inference and metacognitive skills.

The CRTA Model

Research evidence attests to the effectiveness of both infused and separate approaches to thinking skills instruction (Beyer, 2001; Cotton, 1991). The CRTA Model can be used as a tool for providing either infused or separate thinking skills instruction, as described in subsequent sections.

Direct vs. Inferential Thinking Skills Instruction

Teaching thinking skills directly means giving students step-by-step instructions on the thinking skills targeted by instructional objectives. Beyer (1987, 1997) states that direct thinking skills instruction involves an explicit focus on the cognitive skill or process to be learned. According to Beyer, an explicit focus includes naming and demonstrating the skill; explaining when to use the skill; providing explicit procedures or rules for carrying out the skill; providing guided practice of the skill; supplying teacher feedback; providing time for student reflection; and providing extended practice of the skill, with transfer to new contexts in mind.

Teaching thinking skills inferentially means providing indirect instruction, enabling students to evolve or discover the appropriate thinking skills on their

own. Pogrow's (1988) HOTS Program is based on an inquiry model of learning, in which teachers serve as guides, and students must figure out what strategies to use and when to apply them. Pogrow calls this process "controlled floundering," because students must struggle to find their own way, but with teacher guidance.

The CRTA Model

Research evidence indicates that thinking skills instruction can be effective if provided either directly or inferentially (Beyer, 2001; Cotton, 1991). The CRTA Model is a useful tool with either method. However, the CRTA Model indicates that instruction in thinking skills, strategies, habits of mind, and knowledge components should be *explicit.*

Explicit thinking skills instruction means that thinking skills are the primary focus of the lesson, rather than being imbedded in content and/or taught covertly. Providing explicit instruction in thinking skills involves activating prior knowledge; naming, defining, and providing examples; giving students immediate and extended practice with feedback; providing time for reflection; and explicitly assessing the thinking skills, strategies, and habits of mind (Beyer, 1997; Gagne′ & Briggs, 1992; O'Tuel & Bullard, 1993).

The CRTA Model differs from the Beyer (1987, 1997) model, however, in that the order in which instructional events occur varies according to method chosen. That is, *explicit* thinking skills instruction can be provided effectively using direct, indirect, or combination (blended) methods, as long as thinking skills are clearly the main foci of instruction. Subsequent sections describe the manner

in which the CRTA Model can be used to provide explicit thinking skills instruction using direct, indirect, or blended methods.

The Time Required for Thinking Skills Instruction

The exact amount of time needed for effective thinking skills instruction varies according to circumstance. However, research indicates that the commercial or specially-developed programs that have resulted in improved academic performance are time-intensive. Pogrow's (1988) HOTS program, for example, requires 35 minutes per day, four days per week for several months. Feuerstein's (1980) Instrumental Enrichment program requires three to five hours per week for about two years. Both programs, when implemented as intended, have enhanced achievement (Cotton, 1991; Pogrow, 1988).

For classroom instructors, decisions about what to teach and how to allot time are influenced by many factors, including community expectations, institutional missions/goals, teaching philosophies, and state/national standards. Some educators believe that teaching thinking skills takes time away from teaching content objectives. This is probably true. Instructors must decide how important thinking process skills are in relation to "coverage" of course content. Current learning theory suggests that information processed more deeply is most likely to be remembered (Ormrod, 2004; Perkins, 2004). A thinking skills approach shifts the focus of lessons to the thinking processes needed to elaborate upon, analyze, or evaluate information for a deeper understanding. As Perkins (1992) has said, "Learning is a consequence of thinking. Retention, understanding, and the active use of knowledge can be brought about only by learning experiences in which learners think about and think with what they are learning" (p. 8).

The CRTA Model

The CRTA Model is based on the premise that most students need the same focused, time-intensive instruction in thinking skills/strategies that they need for reading, writing, and calculating skills. This shift in focus from content to process objectives is designed to help create what some educators have termed, "*thinking classrooms* " (Perkins, 1992; Tishman, Perkins, & Jay, 1995).

THE CRTA MODEL

Background

The CRTA Model (Kassem, 2000a, 2000b) for the development of thinking skills originated as the result of a year-long collaboration between the researcher and secondary educators who sought to improve student critical thinking and problem-solving proficiencies as part of a School Improvement Plan. Original research described the model and reported results after a one-year implementation of the model in a secondary school context.

The model has been revised and elaborated as a result of subsequent applications in a higher education context. The revised model is appropriate for the design and delivery of direct, indirect, or blended instruction for the development of thinking skills, strategies, dispositions, and content knowledge in any content domain and in any educational setting; the model can be implemented as infused or stand-alone instruction. Implementation results in a post-secondary setting are forthcoming (Kassem, 2000c, in press).

Overview of the Model

The ***CRTA*** acronym derives from the following four basic components of the model:

1) **C**reating the right Climate—this component is the necessary precursor for all others, since it involves establishment of an atmosphere conducive to the risks and struggles of a focus on higher order thought processes;

2) **R**evising and Revealing Instructional Objectives—this component includes four *target categories*: knowledge, dispositions/habits of mind, cognitive processes/strategies, and metacognitive strategies. Component 2 is also affiliated with the fourth component, **A**ssessing Thinking Explicitly, since it is necessary to assess students' prior knowledge and readiness before beginning instruction;

3) **T**eaching Thinking Explicitly—this component includes suggested *sub-components* for explicit, focused instruction in one or more of the four *target categories*. The spokes of the Teaching/Learning Wheel show the major parts of explicit instruction in thinking. Dotted lines indicate that the methods used to teach thinking may be either indirect or direct (or a combination of both), as long as thinking skills are the primary foci of instruction. (Dotted lines note different timing for learning experiences when indirect or direct methods are employed.); and

4) **A**ssessing Thinking Explicitly—this component involves the collection and evaluation of information needed to improve learning and instruction (See Figure 1).

Insert Figure 1 about here.

Explication of the Four Components of the CRTA Model

The four components of the CRTA Model are interdependent and recursive. For example, thinking skills instruction must begin with the development of an open, tolerant, inviting climate for learning--one conducive to risk taking and ambiguity. But attention to such an atmosphere is an ongoing process and must often be reestablished during other phases of the model. Similarly, the explicit assessment of thinking skills is a necessary conclusion to instruction, since it provides feedback regarding the successes and failures of the current learning cycle. However, assessment is an ongoing process, one that

begins the first day of the learning cycle and continues throughout the cycle. Thus, the CRTA Model, while somewhat linear in appearance, is far more recursive in application. An in-depth examination of the components of the model elaborates this point.

Component 1. Creating the Right Climate

The right climate is a respectful, non-threatening atmosphere that encourages reflection, skillful thinking, cooperation, and risk taking. Such a climate requires the instructor to build a trusting relationship with students, communicate an authentic purpose or reason for learning, provide sufficient motivation for engaging in complex thinking tasks, and model the same habits of mind and cognitive processes expected of students.

Developing the right climate requires that instructors pay attention to student emotions and comfort levels; students need to feel that it is safe to take risks or express alternate points of view, to make mistakes, and to speak up when they feel uncomfortable. It takes time to establish attitudes of mutual respect and trust; therefore, the instructor must set the tone for such an atmosphere the first day and continue to allot time for similar endeavors. For example, the first day of class, the instructor might use a think-pair-share exercise in which students first think of something interesting, unique, or funny about themselves; pair with a buddy to exchange thoughts; and then share what they learned about their buddy with the rest of the class. This type of team-building activity enables students to learn by reflection and verbalization in a manner that is less intimidating than talking about themselves in front of the whole class. Team-building activities also

permit the instructor to gather valuable information about students (e.g., students' social skills, communication skills, personality variables, and levels of readiness), incorporating Component 4 (Assessing Thinking) of the CRTA Model.

Creating the right climate also involves clearly conveying high expectations, an authentic purpose for higher order cognitive objectives, and a moderate degree of challenge that provides the opportunity for each student to experience success, given appropriate support. Caine , Caine, McClintic and Klimek (2005) refer to such an environment as a state of *relaxed alertness*—a supportive atmosphere of low threat but high expectations from the instructor. Such an atmosphere also involves conveying a high degree of confidence in students' ability to attain the learning goals, given appropriate assistance. Exhibiting confidence in students is one way to positively influence students' motivation and emotions, both of which greatly affect learning (Ormrod, 2004).

Describing expectations involves Component 2 of the CRTA Model, Revealing Objectives, and Component 4 of the model, Assessing Thinking. Students generally do not like academic surprises; therefore, it is important to reveal higher order cognitive objectives to students at the advent of instruction, to explain or discuss why they are important and meaningful, and to describe how they will be assessed. For example, the instructor might convey to students that one higher order objective is, "Students will be able to give classroom examples of ways to facilitate the development of thinking skills, strategies, and habits of mind." The instructor might refer students to Problem-Solving Prompts (posted

online) that will be used to assess this objective following an in-class collaborative problem-solving exercise (See Figure 2).

Insert Figure 2 about here.

Finally, creating the right climate means that instructors must model the habits of mind (e.g., reflection, persistence, open-mindedness) that they wish to instill in students. For example, the instructor might explain the reasons for instructional design decisions and ask for student feedback regarding those decisions, thus modeling reflective habits of mind and openness to the views of others. Additionally, the instructor might make available (online or in class) instruments that will be used to assess students' habits of mind (see Figure 3, Kassem Habits of Mind Inventory Excerpt), so as to make clear the criteria for evaluating habits of mind.

Insert Figure 3 about here.

Component 2. Revising and Revealing Higher Order Cognitive Objectives

For the design of instruction, Component 2 of the CRTA Model indicates the need for instructors to reflect on teaching practices and determine the cognitive knowledge, processes, metacognitive strategies, and habits of mind that will be the foci of instruction. Although goals and objectives are typically established before instruction begins, it is often necessary to revise or refine them throughout the course (and afterwards), as a result of assessment information. Perhaps most importantly, the instructor must clearly communicate to students

both the cognitive objectives and the aligned assessments. The more clearly students understand what is expected, the more likely they are to achieve desired results.

The Four Target Categories of Component 2

Component 2 of the CRTA Model includes four *target categories* of higher order cognitive objectives, described below.

Knowledge. Knowledge objectives include the names, definitions, and procedures of the thinking skills/strategies/habits of mind that are the foci of instruction. This fundamental sub-component helps students develop a language of thinking, a vocabulary that facilitates communication. An example of a knowledge-based cognitive objective is: "Students will be able to define *critical thinking, habits of mind*, and *metacognition*."

Habits of Mind. These are the characteristics and dispositions of self-regulated learners that are designated as the foci of instruction. Ennis (1987) referred to this sub-component as the *critical spirit* of critical thinking. This sub-component helps students develop the work habits and productive attitudes needed to accomplish higher order cognitive objectives. An example of a dispositional objective is: "Students will be able to exhibit the persistence and open-mindedness necessary to complete a collaborative problem-solving task."

Cognitive Processes/Strategies. These are thinking skills and strategies that facilitate the ability to learn, make sense of, and use information. Inferring, applying, analyzing, evaluating, and creating are examples of cognitive processes drawn from the most recent revision of Bloom's cognitive taxonomy (Anderson et al., 2001). The use of graphic organizers (such as concept maps or Venn diagrams) to visualize and better remember information is an example of a cognitive strategy. An example of a strategy-

focused cognitive objective is: “Students will be able to use a graphic organizer to visualize/represent a complex problem.”

Metacognitive Strategies. These are the reflective, self-monitoring techniques and tools used to improve upon one’s own thinking. Underlying this sub-component is the assumption that students who are the most self-aware, self-monitoring, and self-regulating of their own thinking processes will be the most successful life-long learners. A second assumption is that giving students the time and the means to reflect on what they have learned helps them solidify memories of new cognitive skills or strategies, thus facilitating positive transfer. An example of a cognitive objective focused on a metacognitive strategy is: “Students will be able to use out-loud problem solving to solve a complex problem during a collaborative group task.”

Component 3. Teaching Thinking Explicitly

Component three of the CRTA Model is the explicit teaching of identified cognitive knowledge, skills, strategies, and habits of mind. Explicit thinking skills instruction means that thinking skills, strategies, and habits of mind (not content) are the foci of instruction.

The Components of the Teaching/Learning Wheel

The components of the CRTA Teaching/Learning Wheel indicate that thinking skills instruction can be provided successfully using direct, indirect, or combination methods. Irrespective of the method(s) selected, explicit thinking skills instruction should (eventually) include: gaining attention and activating prior knowledge; naming, defining, and exemplifying; providing immediate and extended practice with feedback; and providing time for reflection regarding the cognitive knowledge, skills, strategies, and habits of mind targeted for instruction.

The learning cycle described below illustrates use of the CRTA Teaching/Learning Wheel to attain the following cognitive objectives:

1. Students will be able to define *critical thinking, habits of mind*, and *metacognition*;
2. Students will be able to give classroom examples of ways to improve higher order thinking skills/strategies; and
3. Students will be able to exhibit reflective thinking and openness to others' perspectives.

Gain attention/activate prior knowledge. In order to gain students' attention by referencing an authentic occurrence, the instructor asks, "Have you ever been asked to sign a petition?" All student comments and examples are welcomed by the instructor, who then says, "I have a petition I would like for you to see."

Provide immediate practice with feedback. The instructor presents students with a sample petition (see Figure 4); students are to decide whether or not they would sign the petition and to explain their reasoning in writing. Beginning instruction with an authentic task (an indirect teaching method) helps generate student interest; it also initiates a focus on reflection (a habit of mind) and on reasoning (a cognitive process skill).

Insert Figure 4 about here.

All student response to the exercise are accepted, paraphrased back to students, and supported by the instructor in an effort to establish an atmosphere of open inquiry. Student responses help the instructor assess students' prior knowledge of *critical thinking*. (Typically, very few students in the class possess the prior knowledge necessary to realize that the chemical in question is water; however, many students say they would not sign the petition because they need additional information.)

The instructor then asks, "What thinking skills (if any) does this task involve?" All student responses are accepted, paraphrased back to students, and noted on the board, after which the instructor prompts, "Based on these responses, how would you define *critical thinking*?" Again, all definitions are accepted and noted on the board—an indirect method of deriving a definition.

Name, define, and exemplify. Using a direct method of instruction, the instructor offers a simple working definition of critical thinking: *Critical thinking is rationally, fairly, and reflectively deciding what to do or what to conclude* (adapted from Norris & Ennis, 1993). Students and the instructor compare this definition with those generated by students. The instructor elaborates upon each part of the definition, emphasizing that skillful thinking involves thinking processes (e.g., reasoning and concluding), metacognition (e.g., self-reflection), and appropriate habits of mind (e.g., fair/open-mindedness). The instructor provides definitions for each new concept and solicits student examples of each, reflecting a combination of direct and indirect methods.

Reflect. The instructor asks students to take a few moments to write down examples of ways thinking skills, strategies, and habits of mind can be improved through classroom learning experiences. Class discussion of student examples (an indirect method) typically leads to the topic of problem solving, among others, which enables the instructor to segue to the next exercise.

Extend practice with feedback. Students learn that they will soon be asked to collaborate with classmates to solve a complex problem, one that will help them improve higher order cognitive processes and strategies. The instructor

expresses confidence that all students will be able to solve the problem but adds that solution will require persistence and openness to others' perspectives, two important habits of mind. In order to give students additional practice with the *habits of mind* concept and help them further reflect upon the introductory lesson on critical thinking, the instructor gives students a Habits of Mind Inventory (HOMI) to complete for homework (refer to HOMI excerpt, Figure 3). The HOMI serves not only as a form of extended practice, but also as a form of assessment, the final component of the CRTA Model.

Component 4. Assessing Thinking Skills/Strategies/Habits of Mind Explicitly

To complete the learning cycle, the newly-developed cognitive knowledge, skills, strategies, and habits of mind must be assessed and the results used to improve learning.

Herein, *assessment* means collecting data regarding performance in order to make informed judgments (*evaluations*). Assessing and evaluating thinking skills requires inference, since thinking skills cannot be observed directly. Increasing the accuracy and appropriateness of assessment data improves the validity of the inferences drawn. The instructor takes several measures to improve the accuracy and appropriateness of assessment data.

First, the instructor states cognitive objectives clearly, in terms of performance-based outcomes--what students should know and be able to do as a result of instruction. Cognitive objectives are then aligned with multiple methods of assessment, thus sampling a wider array of student performance, including student comments about *how* they derived solutions to the problem. For example, one cognitive objective from the thinking skills unit is: "Students will be able to give classroom examples of ways to improve higher order thinking." The instructor collects assessment evidence regarding

this objective both informally (e.g., by means of class discussion) and formally (e.g., by means of students' responses to the Problem-Solving Prompts; refer to Figure 2).

Second, because frequent assessment with feedback facilitates learning, the instructor gathers information about learners' progress toward cognitive objectives and provides feedback to learners at three critical periods--before, during, and after instruction.

For example, before the unit, the instructor assesses students' prior knowledge of, and comfort with, the topic of *critical thinking* by using The Petition exercise (see Figure 4). This formative assessment not only activates students' prior knowledge, it also helps the instructor assess students' level of emotional readiness. Data from this assessment enables the instructor to adjust the substance and pace of instruction accordingly. For example, if students cannot offer examples of higher order thinking, the instructor elaborates with examples from previous classes.

During instruction, the instructor assesses student's thinking skills by means of direct observation, providing prompts and feedback as needed. The following instructor prompts and comments, adapted from Barell (1995), are examples of ways the instructor assesses higher order thinking during instruction:

1. **Validating students' diverse perspectives**—"Thank you for being willing to express your point of view on this topic."
2. **Seeking clarification**—"I'm not sure I follow you. Could you clarify what you mean by ___?"
3. **Asking for elaboration**—"Who could elaborate on what Sue has suggested?"
4. **Asking students to share thought processes**—"How did you arrive at that decision? Could you share the mental processes you went through?"

5. **Seeking evidence**—"Please supply evidence for the conclusions you draw in your field reports."
6. **Seeking alternate points of view**—"Who reached a different conclusion about this scenario?"
7. **Modeling a positive attitude, having high expectations, and showing confidence in students' ability to attain higher order objectives**—"Thank you for your willing spirits and persistence on that rather complex task. I knew you could do it!"

Class members also provide feedback to each other during a task. For example, if direct observation indicates that students' written responses to The Petition exercise are limited, the instructor uses a Think-Pair-Share strategy, in which students first write their own reasons for signing or not signing the petition, are paired with another student to discuss The Petition, and finally share their responses with the whole class.

Summative assessments, those administered after instruction and practice on thinking skills, strategies, and habits of mind, can include exams, written responses, personal communiqués, collaborative projects, culminating exhibitions, etc. For best results, a variety of summative assessments is effective. For example, the instructor assesses knowledge-based cognitive objectives using multiple-choice items on exams. The instructor assesses cognitive skills/strategies, metacognitive strategies, and habits of mind using written responses to the Problem-Solving Prompts (see Figure 2).

Since much forgetting occurs within 24 hours of a learning episode (Sousa, 2001), the instructor assesses learning again one week after the original problem-solving exercise by asking students to respond in writing to the following prompt: "What, if anything, did you learn about developing problem-solving skills and strategies from working on the sequencing problem in small groups?" Additionally, at the end of the

semester, the instructor assesses students' habits of mind via direct observation and self-assessment using a rubric (see excerpt, Figure 5).

Insert Figure 5 about here.

To summarize, the fourth component of the CRTA Model involves explicit assessment of instructional objectives related to cognitive knowledge, skills, strategies, and habits of mind. In order to improve the validity of assessment evidence and make more informed inferences regarding thinking skills, the instructor: states cognitive objectives in performance-based terms and prepares aligned assessments; uses multiple methods of assessment; and collects assessment evidence before, during, and after instruction. In order to improve learning, students receive immediate feedback on all assessments. Summative assessment results are used to modify instructional designs for subsequent units on thinking skills, strategies, and habits of mind.

CONCLUSION

Although the evolution of skillful thinking is a developmental process, it does not occur incidentally or as the result of maturation alone. Research evidence indicates that many thinking skills and strategies are teachable, and that instruction in thinking skills promotes intellectual growth and enhances academic achievement. However, decisions about how to teach and assess thinking skills, strategies, and habits of mind are controversial and complex.

The current work contributes to this body of knowledge a conceptual model for the design, delivery, and assessment of explicit classroom instruction in thinking skills, strategies, knowledge, and habits of mind. The CRTA Model (Kassem, 2000a, 2000b, 2000c), now revised, is applicable for instruction in domain-specific or general content areas and for students at all grade levels. The model can be used to provide direct, indirect, or blended instruction on targeted cognitive objectives, and it can be used to provide infused or stand-alone instruction. Although additional research is needed, the CRTA Model is a useful tool for the design and delivery of thinking skills instruction.

Captions for Figures

Figure 1 The CRTA Model for Facilitating Development of Thinking Skills, Strategies, and Habits of Mind

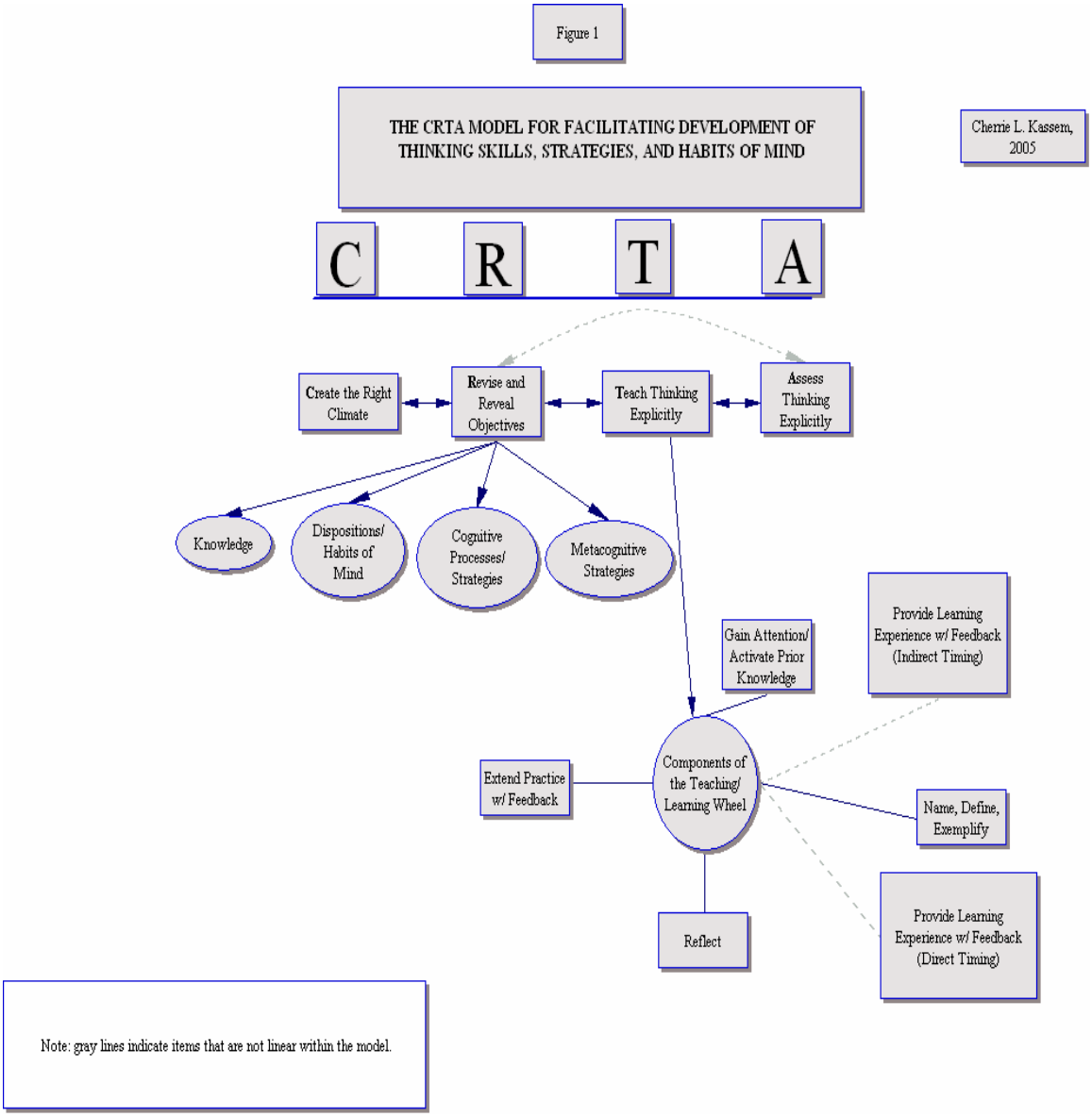
Figure 2 Problem-Solving Prompts for Reflection and Assessment

Figure 3 Kassem Habits of Mind Inventory (HOMI) Excerpt

Figure 4 The Petition

Figure 5 Rubric for Assessment of Habits of Mind

Figure 1


THE CRTA MODEL FOR FACILITATING DEVELOPMENT OF THINKING SKILLS, STRATEGIES, AND HABITS OF MIND
Cherrie L. Kassem, 2005
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T
A
Create the Right Climate
Revise and Reveal Objectives
Teach Thinking Explicitly
Assess Thinking Explicitly
Knowledge
Dispositions/ Habits of Mind
Cognitive Processes/ Strategies
Metacognitive Strategies
Gain Attention/ Activate Prior Knowledge
Provide Learning Experience w/ Feedback (Indirect Timing)
Components of the Teaching/ Learning Wheel
Extend Practice w/ Feedback
Name, Define, Exemplify
Reflect
Provide Learning Experience w/ Feedback (Direct Timing)
Note: gray lines indicate items that are not linear within the model.

Figure 2--Problem-Solving Prompts for Reflection

1. What were the first things you did to try to solve this problem?

2. What made solving this problem difficult or challenging?

3. What specific strategies did you use to solve the problem?

4. How can teachers help students improve their problem-solving skills and strategies?

5. How can teachers help students improve their metacognitive strategies?

6. How can teachers help students improve their persistence and perspective-taking abilities?

Figure 3—Kassem Habits of Mind Inventory Excerpt

HOMI

Habits of Mind Inventory**

****Habits of mind are defined as the thinking attributes of self-regulated learners. They represent disciplined, mindful behaviors exhibited consistently on appropriate occasions. This instrument is a self-report inventory for adults who want to know more about their own thinking habits.**

RESPONDENTS: Consider each of the thinking habits defined below. Using the six-point Likert scale, **rate the frequency** with which you **exhibit** the **performance indicators** under each of the HOMI categories:

1	**2**	**3**	**4**	**5**	**6**
not yet		**sometimes**		**often**	

1. **Critical awareness**--Being mindful and sensitive to the appropriateness of a particular behavior in a given context.

   _____ I pay attention to context cues and to the emotions/perspectives of others.

   _____ I listen with empathy and understanding.

   _____ I am well-informed about new information and new resources.

   _____ I am aware of gaps in my own knowledge.

   _____ I am aware of my own ego/ethnocentricities

   _____ I am aware of my own range of emotions and of outlets for those emotions.

2. **Open-mindedness**--The willingness to acknowledge and accept points of view other than one's own.

   _____ I seek diverse perspectives and new information.

   _____ I consider all perspectives when making decisions.

   _____ I am willing to suspend judgment.

   _____ I accept feedback well.

   _____ I am able to compromise.

3. **Reflectivity**--The habit of consciously and routinely exploring thoughts and feelings in the spirit of self improvement.

_____ I take time to think before responding or before acting.

_____ I can communicate my own beliefs.

_____ I can describe my own thinking/learning processes.

_____ I make careful goals, plans, and strategies.

_____ I seek and evaluate reasons or ideas.

_____ I modify behavior and/or beliefs based on self reflections.

_____ I am open to continuous learning.

Figure 4--The Petition

I would like to urge you to sign the attached petition suggesting stricter control or total elimination of the chemical 'dihydrogen monoxide' for the following reasons:

1. It can cause excessive sweating and vomiting.
2. It is a major component in acid rain.
3. It can cause severe burns in its gaseous state.
4. Accidental inhalation of this chemical can kill you.
5. It contributes to erosion.
6. It decreases the effectiveness of automobile brakes.
7. It has been found in tumors of terminal cancer patients.

Please indicate your willingness to support this cause by signing below:

_____ .

Figure 5—Habits of Mind Assessment

6. Degree of Habits of Mind Appropriate for Pre-service Teachers

Needs Improvement	*Satisfactory*	*Excellent*
Little critical awareness or awareness/	Moderate critical awareness	Critical
reflective thinking;	and reflective thinking;	reflective thinking,
unreceptive to alternate mindedness, views or feedback; not	receptivity to alternate views and feedback, persistence,	open-
persistence, flexibil-		
persistent or flexible; work clarity, was inaccurate or unclear;	flexibility, accuracy, clarity, and confidence shown	ity, accuracy,
confidence shown 90-		
often lacked confidence.	80-90 %.of the time.	100% of the time.
5	**15**	**25**

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