LEARNING TO THINK CRITICALLY

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INTRODUCTION

One of the most important jobs teachers have in the classroom is not just imparting knowledge and facts to their students, but teaching them how to learn and how to become critical thinkers. The Common Core State Standards (2011) focus on developing skills such as critical thinking among students, and the Partnership for 21st Century Skills (2011) designed a framework to define skills and knowledge students need to be successful in school, the workplace, and the community. According to this framework, critical thinking is one of the key learning and innovation skills identified as necessary for 21st-century success. As is often the case in social science research, several different terms are used to describe the same basic construct (Lai, 2011). What we refer to as critical thinking in this chapter has also been called higher-order thinking (Grant, 1988, Lipman, 1995), metacognition (Dean & Kuhn, 2003; Kuhn, 1999; Schraw, Crippen, & Hartley, 2006; Swartz, Costa, Beyer, Reagan, & Kallick, 2008), problem solving (Carlson & Bloom, 2005), evaluating (Anderson, Krathwohl et al., 2001; Krathwohl, 2002) or analytical thinking (National Research Council, 2012; Sternberg & Grigorenko, 2007; Sternberg, Torff, & Grigorenko, 1998). No matter what the name, the idea remains the same; in short, critical thinking makes use of cognitive skills and strategies in order to engage in thinking that is “purposeful, reasoned, and goal-directed” (Halpern, 2007, p. 6).

It is not necessarily enough simply to know the definition of critical thinking. In order to teach students how to become critical thinkers, and for students to learn how to think critically, it is important to be able to identify the features and steps involved in critical thinking; individual differences among students that may need to be taken into consideration when teaching critical-thinking skills; the role of the student, teacher, and context in teaching critical thinking; and, outcomes associated with critical thinking that impact teaching and learning. This chapter discusses the research done in each of these areas in greater detail, but also extends the discussion further by suggesting that although critical thinking is an important skill for students to have in their repertoire, teachers should also focus on students’ creativity, practical skills, and the development of wisdom, for the purposes of encouraging and developing more well-rounded, successfully intelligent students.
HISTORICAL OVERVIEW AND THEORETICAL FRAMEWORK

The history of critical thinking can arguably be traced back to the days of Socrates, and his process of questioning and cross-examining ideas, known as the Socratic Method (Hoaglund, 1993; Yang, Newby, & Bill, 2005). However, John Dewey’s (1909) work on reflective thinking and inquiry has been generally viewed as the beginning of the modern critical-thinking movement (Fisher, 2001; Streib, 1992; see also Chapter 19 of this volume, “Instruction Based on Inquiry”). Over the last century, several researchers have continued to examine and develop the concept of critical thinking, including Edward M. Glaser (1941), who evaluated the importance of critical-thinking skills or dispositions in examining evidence; Robert H. Ennis (1962, 1987, 1993), who built on Glaser’s work and also looked at decision making as part of the critical-thinking process; and Richard W. Paul (1989, 2005; Paul & Elder, 2008), who expanded critical-thinking research to include aspects of problem solving (see Fisher, 2001; Streib, 1992, for a more detailed historical overview).

Those who engage in critical thinking do so in part to improve their thinking, generally leading to such positive outcomes as making sure one makes the right decisions or solves problems correctly. The process of studying and evaluating one’s thoughts—which consequently improves them—is the essence of critical thinking (Paul, 2005; Elder & Paul, 2008). The first stage in critical thinking is the analysis stage. Although this stage, during which individuals deconstruct their thinking and ask questions targeted at clarifying the goals, data, concepts, assumptions, and implications of the thought process, is considered the first step, it does necessitate a relatively solid foundation in reasoning skills such that students can begin to reflect on the goals and purposes of thinking. Further, in this initial step, students clarify the question that gave rise to the thinking process in the first place. To this end, students must be able to think purposefully; identify assumptions; use concepts, theories, and data; and be able to interpret information in order to understand the implications of their thoughts (Elder & Paul, 2008).

The second stage in critical thinking, according to Paul and his colleagues, is the assessment of thinking (Elder & Paul, 2008; Foundation for Critical Thinking, 2009). These researchers argue that, ideally, critical thinkers assess their thinking based on universal intellectual standards of clarity, precision, accuracy, consistency, relevance, depth, breadth, logic, and fairness. In order to monitor whether thinking adheres to these standards, skilled critical thinkers will systematically ask questions to target these areas. For example, “Can you give me an example of your point?” (clarity); “How can we check that to see if it is true?” (precision); “Does this really make sense?” (logic). By analyzing and assessing thinking, a person is able to thereby improve thinking and make important distinctions between accurate and inaccurate thoughts, determine fair and unfair conclusions, and develop ethical reasoning skills.

The stages of critical thinking proposed by Paul and his colleagues (Elder & Paul, 2008; Foundation for Critical Thinking, 2009) closely parallel a model of metacognition, defined as thinking about thinking (see also Chapter 11 on “Learning to Self-Monitor and Self-Regulate”). While a great deal of metacognition is involved in critical thinking, the critical-thinking process also employs regular thought processes such as analysis, comparison, justification, critique, and application. Swartz et al. (2008) described the metacognitive process using the metaphor of climbing a ladder. The first rung of the ladder involves an awareness of what kind of thinking is being done; the second rung of the ladder involves describing how the thinking is being done from a
procedural perspective (as opposed to an evaluative one); and the third rung of the metacognitive ladder involves thinking that becomes more evaluative, in terms of the student focusing on whether the way the thinking is being done is effective. Finally, the fourth (and final, or top) rung of the ladder involves metacognitive thinkers planning how they will engage in this same type of thinking in future situations, and utilize the previous rungs. The authors suggest that this type of deliberate commitment to think metacognitively eventually leads to a consistent habit of self-correcting one’s thoughts and becoming a skillful thinker.

As Swartz et al. state, “The teaching of skillful thinking does not just help our students to learn some forms of skillful thinking, it is also a transformative process of developing independence of thought and continued reflection on the part of our students” (p. 101). Just as an athlete needs to practice to master his or her sport, metacognition—and similarly, critical thinking—takes effort, study, and reflection for one to be able to do consistently and efficiently. The metacognitive ladder, as depicted by Swartz et al., may seem like an idealized depiction of the metacognitive process; as such, it should be considered more of a competence model rather than a performance model. A competence model generally separates an idealized capacity (in this case, the gradually developed and honed mastery of skillful thinking strategies) whereas a performance model refers to real events, or the actual use of metacognitive strategies in a learning context.

It is important to note that critical-thinking skills cannot be utilized, nor should they be considered, in the absence of knowledge; nor is just knowledge of facts and concepts necessarily sufficient. People must be able to use the knowledge in such a way as to make it effective and worthwhile (Halpern, 2007; Sternberg, 1987). They need something about which to think critically (Case, 2005; Lai, 2011). Conversely, if an individual does not have a base of knowledge in the area about which he or she is trying to think critically, the analysis and assessment phases are unlikely to yield much, as novices in a given domain are much less likely to know even what questions to ask of their own thinking.

Developmental Considerations

When the topic of teaching critical-thinking skills is discussed, it is important to take developmental considerations into account. Teaching critical-thinking skills to elementary school-aged children is necessarily different than teaching critical-thinking skills in college classrooms. The following section reviews some of the research done on developmental considerations in teaching and learning critical-thinking skills.

Elementary Education

For young children, critical-thinking activities are necessarily different than for older children, adolescents, and adults. The process of inquiry generally focuses on simple description, categorizations, and measurement. As students progress through elementary school, they may be better equipped to move onto such tasks as identifying cause and effect (Kuhn, Black, Keselman, & Kaplan, 2000), being willing to see things from another’s perspective, and considering alternative possibilities before making a decision (Bailin, Case, Coombs, & Daniels, 1999). Schauble (1990) conducted an experiment investigating the extent to which elementary school-aged children (10–12 years old) were able to set up a series of experiments testing five different design features on
racecars through a computer module. Each car that was designed with varying features (e.g., various engines, wheels, tailfins, mufflers, and colors) could be “test-driven” on the computer, producing an outcome of the experiment. Most of the children were able to make some progress in drawing certain conclusions about the “microworld” of racecars; for example, that muffler and color did not affect speed, but that engine and wheel size did matter.

Nevertheless, children’s methods of experimentation were rather haphazard, and did not usually follow a systematic pattern of using evidence from one experiment to inform the next experiment. They often tested cars with the same features repeatedly, or designed experiments from which conclusions about design features could not necessarily be drawn. Piaget’s (1952) theory of cognitive development asserted that children are not capable of the abstract and critical-thinking skills necessary for such scientific inquiry before they reach the formal-operational stage of cognitive development. Piaget hypothesized that most children would reach this stage around 11 or 12 years of age, which falls within the age range of Schauble’s (1990) subjects. Consequently, this may explain why some of the students performed better than others with respect to experimental design. If the students in this study ranged in age from 10 to 12 years of age, it is possible that some of the children (i.e., those who performed better on the tasks) may have already reached the formal-operational stage whereas the others (i.e., those who performed poorly) may still have been in the concrete-operational stage. However, other researchers have reported success in teaching critical-thinking skills to elementary school children and to those that Piaget (1952) would have argued could not grasp such skills and techniques (Chen & Klahr, 2008; Klahr & Nigam, 2004).

Lipman’s (1995, 1998) Philosophy for Children program is one such example in which young children can be taught to engage in deliberative inquiry and reasoning. This program is a K–12 curriculum, in which communities of inquiry are utilized to foster critical, creative, and caring thinking, which results in better reasoning, comprehension, and evaluation. Instruction in critical-thinking skills looks, out of necessity, qualitatively different for young children than for older children. Trying to provide direct instruction on inquiry styles is not necessarily developmentally appropriate for younger students (cf. Klahr & Nigam, 2004). Therefore, the Philosophy for Children program engages models to show children what needs to be done (Lipman, 1998).

The use of scaffolding and modeling for strategy instruction can be an effective teaching tool for students as young as first graders learning to reflect, interpret, and elaborate on written responses (Wollman-Bonilla & Werchadlo, 1999). Once children have seen and heard examples of critical thinking, they are better equipped to emulate the kinds of thinking to which they have been exposed. Philosophy for Children uses a text-as-model approach, in which a narrative, whether a novel, short story, or even a comic strip, presents a fictional community of inquiry that parallels what the students themselves could and should be doing in their own learning community. The children in the narratives have various thinking styles, ask questions to clarify ambiguities, point out analogical relations, and listen to each other. Students, by modeling the children in the narratives, are eventually supposed to develop their own thinking style and critical-thinking behaviors. They engage in thoughtful discussions within their own communities of inquiry. Engaging in philosophy is seen as the ideal tool in getting elementary-aged children to engage in critical thinking. Although philosophy is often viewed as an individual pursuit, the Philosophy for Children program is designed to encourage children not only to develop their own critical-thinking skills, but it also teaches them how to think with others.
Trickey and Topping (2004) reviewed ten studies of the *Philosophy for Children* program, and found that on outcomes of reading, reasoning, cognitive ability, and other curriculum-related abilities, all studies showed positive outcomes with moderate effect sizes. Similarly, Fields (1995) reported that 7- and 8-year old students involved in the *Philosophy for Children* program were able to engage in philosophical dialogue regarding cutting down the rainforests; what implications it may have on humans, animals, and the environment; and whether the intrinsic value of trees outweighed the lives of human beings. Kim’s (2012) fifth-grade students engaged in discussions that allowed them to share personal life experiences and learn from other students’ varied thoughts, ideas, and beliefs. They learned to question assumptions and ask for clarification of questions and comments, demonstrating inquisitiveness and creativity in thinking skills. These exhibitions of logical thought, reasoning about hypothetical situations, and considerations of possible outcomes and consequences of actions are all characteristics of formal-operational thought, which Piaget argued would not have been possible before 11 or 12 years of age.

The need to learn critical evaluation skills in elementary schools is not limited just to science inquiry or philosophy. Brown and Campione (1990) also reviewed several studies in which they targeted reading comprehension and literacy skills in elementary school children. The authors argued that, whereas elementary school is the period when students learn how to read, they must also learn how to learn from reading. Students must be able to decode, comprehend, and critically evaluate the content of reading, as well as to be able to utilize the information they read in new and varied contexts. They used the term *intelligent novices*, defined as those who may not necessarily possess prior knowledge in a given field, but who know how to go about gaining that knowledge (Brown & Campione, 1990, p. 110). Intelligent novices possess the necessary skills to learn, and often utilize a wide variety of learning strategies, rather than just engaging in rote memorization when faced with a novel task (Brown, Bransford, Ferrara, & Campione, 1983). This can lead to learning at a faster rate, as well as performing better on tests of problem solving, conceptual understanding, transfer, and retention (Mathan & Koedinger, 2005).

Ann Brown and her colleagues (Brown & Campione, 2002; Brown & Palincsar, 1989) have done extensive research involving reciprocal teaching to encourage reading comprehension. Reciprocal teaching involves guided practice in applying text comprehension strategies, during which an adult teacher and a group of students take turns “being the teacher” (i.e., leading discussions about material they have read, asking questions and summarizing what has been learned). Brown, Campione, Reeve, Ferrara, and Palincsar (1991) utilized reciprocal-teaching reading groups with at-risk third graders over a period of 20 days, during which they witnessed a dramatic improvement in students’ reading comprehension (from 35% to 80% correct) compared to a variety of control groups, who did not witness significant improvements. These levels of improvement for students in the reciprocal reading groups were maintained even a year later. Students were able to transfer and apply knowledge and concepts from one reading passage to others, and retained the reciprocal teaching skills and *content* of lessons one year later.

More recently, several researchers have found evidence to suggest that young children can be taught strategies to monitor their comprehension and assess their own learning, both important components of critical thinking. Heyman (2008) reviewed research that indicated children as young as three years old are able to critically evaluate sources. LeFevre, Moore, and Wilkinson (2003) provided a reciprocal teaching intervention to
nine-year-old students whose decoding skills were weak. Students receiving the intervention showed improved use of cognitive and metacognitive strategies, and increased comprehension, compared to students who did not receive the intervention.

In another study with third and sixth graders, Rubman and Waters (2000) taught students a technique for helping children perform the necessary integrations for detecting inconsistencies in stories. Children instructed in utilizing this technique, which involved creating storyboard representations of the story, were more likely to detect internal and external inconsistencies compared to children who simply read the stories. The researchers contend that explicitly instructing children how to integrate information from a story to create a coherent representation makes it more likely that they will attend to details in the text, reflect on those details, and evaluate the content for consistency.

Lederer (2000) conducted a study in which the reciprocal teaching technique was used with students with learning disabilities in fourth-, fifth-, and sixth-grade inclusive classrooms during social studies lessons. Lederer found that not only did reciprocal teaching help improve students’ reading comprehension, but that students in the fourth- and sixth-grade experimental conditions exhibited significant gains in comprehension after 30 days, compared to students in the comparison group. These findings suggest that reciprocal teaching methods can significantly improve the quality of students with learning disabilities’ reading comprehension and monitoring skills, and not just in the content area in which reciprocal teaching was originally designed (language arts).

Murphy, Wilkinson, Soter, Hennessey, and Alexander (2009) highlight the importance of discussion and discourse in the development of critical-thinking skills for reading comprehension, which they refer to as critical literacy (see also Chapter 20 in this volume, “Instruction Based on Discussion”). The authors argue that high-level reasoning involves the ability to have several different perspectives represented in one’s head on a particular issue, and that this ability to take more than one perspective into account arises from participating in discussions with others who hold different perspectives. To this end, Murphy et al. (2009) conducted a meta-analysis on studies—the majority of which were conducted on elementary-aged children—investigating the relationship between various discussion practices and students’ critical thinking and text comprehension. The researchers found that although many of the studies they examined were effective at increasing students’ literal and inferential comprehension of texts, not all discussion-based practices are equally effective at increasing students’ critical literacy; in fact, very few of the approaches they investigated produced significant gains. Although an increase in student talk was related to increases in critical literacy, this relation was not automatic, and the kind of talk in which students engaged was important to consider. In other words, increasing the amount of student discussion is a means and not an end.

Specifically, the programs that Murphy et al. (2009) found to be most effective at increasing students’ critical literacy (i.e., Collaborative Reasoning, Philosophy for Children, Junior Great Books Shared Inquiry, and Questioning the Author) took either a critical-analytic stance (encouraged discussion that prompts questions geared toward a more subjective response to the text) or an efferent stance (discussion was focused on reading as a way to acquire particular information about ideas, directions, or conclusions), as opposed to an expressive stance that focused on the reader’s affective response to the text. Collaborative Reasoning and Philosophy for Children were categorized as taking a critical-analytic stance, and were discussed in greater detail earlier in this paper.
The researchers suggest that the effects of the types of discussions were moderated by the study design (i.e., stronger effects were found in single-group design studies than in multiple-group design studies), and the nature of outcome measures (i.e., outcomes were weakened when researchers used commercially available standardized measures compared to researcher-developed measures). The authors conclude that although discussion does appear to have a positive influence on developing students’ critical literacy, teachers should pay close attention to the congruence between their instructional goals and the stated goals and outcomes of a particular program, and that researchers should consider designing future studies using multiple-group designs, commercially available assessments of outcome measures, and as many indicators of text comprehension as possible.

Critical-thinking activities in middle school can continue to build on the skills learned in elementary school; for example, identifying which variable is responsible for a particular outcome, or evaluating how changing one variable leads to changes in other variables (Kuhn et al., 2000). As discussed in the earlier section with Schauble and Glaser’s (1990) research, students around this age may still be struggling with these types of scientific-reasoning skills.

Kuhn et al. (2000) advanced this argument by demonstrating how middle-school students (sixth through eighth grade) may still be struggling with multivariable systems, and that such critical thinking and reasoning skills that might be required for successfully engaging in such activities cannot be assumed to be present. Researchers in this study randomly assigned classrooms to an experimental or control condition, in which students were asked to be builders for a construction company charged with building lakefront cabins. Students were informed that the area around the lake is prone to flooding, so the cabins must be built on supports that raise them above the ground. The students used a multimedia research program which helped them predict, based on several variables and outcomes, the optimal height for the supports to be built, so that costs would not be too high (i.e., supports were not built too high) nor would cabins be subject to flood damage (i.e., supports were not built too low). All students investigated the effects of the five variables (water pollution, water temperature, soil depth, soil type, and elevation) on flooding using the multimedia program. However, the students in the experimental condition also participated in paper-pencil exercises about the flood tasks with peers, focusing on controlled or confounded comparisons of variables.

Kuhn et al. (2000) found that students in the experimental condition exhibited greater improvement from the pretest to the posttest regarding multivariable systems (i.e., making appropriate inferences based on controlled comparisons of variables), but that a clear understanding of investigatory strategies was still lacking in several students, even if they were able to make correct inferences. The authors suggest that although authentic scientific inquiry is important for promoting good science education, the skills required to engage in inquiry learning may not be assumed present in early adolescence.

However, Kuhn et al. (2000) are quick to dispel any notion that critical-thinking and inquiry activities should therefore not be taught at the elementary and middle-school levels. Instead, they propose that curricula should be designed with the incorporation of cognitive competencies that are necessary for learning how to think critically. In
essence, critical-thinking and strategy skills can be enhanced through explicit instruction (Bauman, 1984; Guthrie & Davis, 2003; Klahr & Nigam, 2004). By engaging students in roles that require critical-thinking skills to be used (e.g., continually asking them such questions as “Why are we doing this?” and “What did we gain from doing it?”), educators can help shift their thinking orientations from merely producing outcomes (e.g., complete this assignment) to include analysis and understanding (Kuhn, 2005).

Secondary Education

Teaching critical-thinking skills in high school is challenging, even if students have already mastered basic cognitive skills and reasoning abilities that might prevent elementary and middle-school students from doing so. As discussed, teaching critical thinking requires students to have prior knowledge in the domain in which they are to think critically. Students must have something to think about (Grant, 1988). High-school teachers’ content knowledge is often under scrutiny, especially under recent policy initiatives that differentiate “highly qualified” teachers from those without the requisite training and credentials to be labeled so. The content specialization of secondary-school teachers usually necessitates extensive training and credentials in a specific subject area, which in turn influence student achievement (Clotfelter, Ladd, & Vigdor, 2007; Noddings, 2006).

Grant (1988) contends that secondary school is essentially the only place that critical-thinking skills are expected to be taught, because no other establishment in our society (i.e., peer groups, family, religion, work) systematically requires such thinking. “If higher order thinking is not promoted in the course of learning to read, compose, and calculate, a student may never have an opportunity to move beyond the literal interpretation of information” (p. 3). Consequently, reform efforts are often aimed at improving students’ higher-order processing and critical-thinking skills, and for enhancing teachers’ ability to teach these skills through pre-service teacher training or professional development.

Just as teachers’ content knowledge influences the assignments and tasks they give to students, so does teachers’ understanding of the critical-thinking process influence their instruction (Grant, 1988). High-school students are generally more cognitively advanced than middle-school students, and are more likely to be able to comprehend abstract thoughts and metaphorical representations. Secondary-school teachers can rely more heavily on different representations of content, such as visual imagery (drawings, charts) and numerical abstractions (models, graphs), in addition to linguistic representations of material (voice, narrative). Explicit instruction on critical thinking has also been shown to significantly impact high school students’ critical-thinking skills compared to imbedded instruction (Marin & Halpern, 2011). By using multiple instructional methods that complement and capitalize on their students’ cognitive development and capabilities, teachers can better facilitate student learning (Bonner, 1999; Francisco, Nicoll, & Trautmann, 1998; Harvey & Hodges, 1999).

Higher Education

Valanides and Angeli (2005) investigated the effects of critical-thinking instruction on college students’ epistemological beliefs. Students were assigned to one of three experimental groups, each group receiving a different type of instruction on critical
thinking. One group (general group) was asked to watch a lecture on the five general critical-thinking principles, namely, “(a) Analyze the problem, (b) Generate solutions, (c) Develop the reasoning for your solutions, (d) Decide which is the best solution, and (e) Use criteria to evaluate your thinking” (p. 322). They were then paired off to develop an outline for a position paper on a given topic.

The second group (infusion group) was given time to work on their outline first, then watched a lecture on the critical-thinking principles, and engaged in a discussion led by the researcher asking them to reflect on and evaluate their thinking for their position papers. Students were then given time to complete their outlines. The third condition (immersion group) was similar to the infusion condition, except that students were not necessarily given direct instruction on the critical-thinking principles, but rather, were engaged in Socratic questioning by the researcher, which challenged them to reflect on and evaluate their reasoning for their point of view on the issue. Therefore, although they did not explicitly learn the five principles, students in the immersion condition were asked relevant questions such as, “Have you analyzed the problem in depth?” and “What are your reasons for supporting this view?” Student epistemological beliefs were assessed before and after these sessions.

Researchers found that students in the infusion group witnessed significantly higher improvements in their epistemological beliefs, compared to the general group. The authors conclude that critical-thinking instruction in combination with a process by which students are given the opportunity to reflect upon, question, and evaluate their thinking based on explicitly stated principles can have important effects on their epistemological beliefs. It is not enough simply to teach the critical-thinking principles in a decontextualized setting. The sequence of instructional tasks can have an impact, especially with college students, whose epistemological beliefs may be strongly affected by educational experiences (Baxter Magolda, 1992; Kuhn, 1991; Perry, 1970).

The ADAPT (Accent on Developing Abstract Processes of Thought) program at the University of Nebraska, Lincoln, began in 1975 and was based on Piagetian principles of developing formal operational thought, or what the founding ADAPT faculty referred to as “scientific reasoning” (Fuller, 1998, p. 2). Freshmen were invited to enroll in the ADAPT curriculum, which incorporated critical-thinking instruction across a variety of disciplines (e.g., anthropology, economics, literature, mathematics, or sociology). Faculty teaching in the ADAPT program were volunteers interested in teaching students to develop their thinking skills. In order to teach critical-thinking skills in college classrooms, some faculty found that they needed to decrease the amount of content they covered, some by as much as 40 percent. However, they also reported that seeing the measurable gains students made in critical-thinking abilities outweighed the loss of content (Fuller, 1977). Specifically, one measure utilized by the ADAPT program to assess gains in critical-thinking abilities was the Watson-Glaser Critical Thinking Appraisal Test. Pre- and post-tests were compared for students enrolled in the ADAPT curriculum and two control groups. ADAPT students improved as much as one standard deviation over the control groups in critical-thinking abilities (Fuller, 1977). Cutting content by this much is clearly not an option for primary and secondary school teachers today, who have very strict curricula to follow in preparation for standardized exams. However, the implications for college faculty as suggested in these findings by the ADAPT program, who have considerably more leeway in what content is covered, are interesting to consider.

Heijltjes, van Gog, Leppink, and Paas (2014) conducted an experiment with 193 economics students who received either one of three types of critical-thinking instruction,
or were assigned to a control group. The three experimental groups received critical-thinking instruction via a 15-minute computer-based presentation. During subsequent practice of critical-thinking skills, one group received prompts to provide brief written explanations of how and why they chose a particular answer, and one group received activation prompts that highlighted and drew attention to relevant information. One group did not receive any prompts after viewing the critical-thinking presentation, and the control group viewed a 15-minute video on an unrelated topic and received no prompts during the subsequent practice session. The researchers found that students who received critical-thinking instruction performed better than did students who did not receive any instruction, and of those who did receive instruction, those who received self-explanation prompts during subsequent practice sessions performed best on reasoning tasks.

**Motivational Considerations**

There can be no mental development without interest. Interest is the *sine qua non* for attention and apprehension. You may endeavor to excite interest by means of birch rods, or you may coax it by the incitement of pleasurable activity. But without interest there will be no progress.

(Whitehead, [1929] 1967, p. 37)

Whitehead’s assertion is indeed central to motivation. Nonetheless, the question remains: *How* can teachers foster interest and motivation in their students? The best-intentioned and most-prepared teachers may still find challenges in educating their students when faced with structural obstacles (e.g., 50-minute lecture sessions, which rarely allow enough time for serious engagement in a topic), or obstacles presented by the students themselves (e.g., negative preconceptions about a particular topic or about their education in general; Meyers, 1986).

We will not necessarily go into particular strategies for motivated learning, as there is another chapter that addresses this topic (see Chapter 12 on Learning with Motivation). Instead, we will discuss here some of the motivational implications for teaching and learning critical thinking. This is certainly not meant to be an exhaustive discussion of all motivational factors that have implications for critical thinking; however, we hope to address a few areas to which those teaching critical thinking, as well as those learning to think critically, should pay attention.

Whether students are intrinsically or extrinsically motivated, how interested they are in the topic or task, and whether they have a fear of failure or making mistakes will affect their willingness and ability to think critically. Sternberg (1988) points out that intrinsically motivated individuals, or those who work because they want to, or engage in a task for the sake of learning or enjoyment, are more likely to persist compared with extrinsically motivated individuals. These are the people who are motivated by external factors or rewards (e.g., grades, money, recognition); while they may perform as well as intrinsically motivated individuals, the performance and persistence often cease when the rewards stop, too.

The notion of intrinsic motivation is related to the idea of interest, such that individuals who are intrinsically motivated will engage in a task for no other reward than the interest and enjoyment of the activity (Frederickson, 1998; Malone & Lepper, 1987). In other words, interest is generally used as an indicator of intrinsic motivation, through its effect on sustained attention and effort (Renninger, 2000). For critical thinking to
occur, students need time thoroughly to engage in the material, and if students are not interested or intrinsically motivated to engage in the material in the first place, critical thinking and inquiry is unlikely to occur (Meyers, 1986; Paul, 1992).

As mentioned, there may be structural obstacles like time-limited class formats, which may prevent providing enough time for thorough investigation of material; however, other student-driven obstacles must be overcome as well. Research on fostering student interest can be described as focusing on two types of interest: individual or personal interest, or an actualized state that develops slowly but tends to be long-lasting; and situational interest, or that which is triggered by something in the environment or situation and may or may not have a lasting impact on personal interest or learning (Hidi, 1990; Hidi & Anderson, 1992; Krapp, Hidi, & Renninger, 1992). For example, students may read a passage that has interesting qualities (e.g., a surprise ending or seductive details) and therefore may be situationally interested in the task; however, this does not necessarily mean that they are personally interested in the topic or find relevance or value in it as a learning tool. Nevertheless, situational interest may be used as a hook for getting students engaged in material in order to allow for critical thinking to occur, and possibly even leading to a more internalized state of personal interest in a task or topic (Hidi & Anderson, 1992; Krapp, 2002).

By incorporating critical-thinking tasks into activities and topics that are interesting to children, teachers can thus ensure that those skills and abilities will indeed be used (Sternberg, 1987). As Facione (2000) asserts, “We are best at learning what we most need and want to know” (p. 79). Conversely, Rugutt and Chemosit (2009) found that student-to-student relations, student-faculty interaction, and critical-thinking skills were all statistically significant predictors of student motivation. Similarly, Miele and Wigfield (2014) suggested that when students engage in critical thinking, they process information more deeply and are more likely to use sophisticated cognitive strategies and cognitively engage at higher levels.

Even if students have the necessary ability to think critically, it is irrelevant if the student is not motivated or interested in using those skills. Low performance on a critical-thinking task may reflect a lack of ability or a lack of motivation or disposition to engage in critical thinking. Giancarlo, Blohm, and Urdan (2004) tested the validity of the California Measure of Mental Motivation (CM3) as an assessment of critical-thinking disposition among adolescents. The four scales of the CM3 focus on the extent to which students perceive themselves to be willing to use reasoning skills in a “systematic, innovative, open-minded, and inquisitive way” to increase their knowledge base (p. 360). They were able to demonstrate that the CM3 is a valid measure of critical-thinking disposition and suggested that critical-thinking assessment should not be focused just on thinking and reasoning skills alone, but also should incorporate assessments of disposition and motivation to engage in critical-thinking activities.

Fear of failure is another consideration when discussing motivational aspects of critical thinking (Sternberg, 1988). If people are afraid they will fail, they may avoid attempting any challenging tasks for fear that they will make a mistake, or not succeed in their attempt (Atkinson, 1964; Covington, 1998; De Castella, Byrne, & Covington, 2013; Elliot & Harackiewicz, 1996; McClelland, Atkinson, Clark, & Lowell, 1953). Although people who do not have a fear of failure may also make a mistake or not succeed, the important distinction is that those with a fear of failure perceive that mistakes represent their incompetence, whereas others view making mistakes as part of the learning process and therefore, not necessarily detrimental to their sense of well-being (Dweck, 1986; Dweck & Elliott, 1983; Dweck & Leggett, 1988; Midgley et al., 2000;
Nicholls, 1984; Sternberg, 1988). Critical thinking necessitates that students take risks by asking questions, generating ideas, and critically assessing their own thoughts and assumptions. If a student fears failure or fears making mistakes, the student may avoid the challenge of learning to think critically, and may view the critical-thinking process as detrimental to his or her ego.

**Role of the Student**

The process of learning how to think critically must take into account the developmental and motivational considerations discussed earlier; however, the role that the students, teachers, and learning context play are also vital to the critical-thinking process. With respect to the role of the student in the critical-thinking process, Stout (2007) suggests that critical thinking may be viewed as requiring certain dispositions; that the critical thinker “must be willing to use appropriate reasons and principle and use them accordingly” (p. 45). Such principles include intellectual values of fairness, consistency, impartiality, desire for truth, acknowledging standards and criteria for evaluating arguments, and rejecting arbitrariness. Ennis (1987) provided a list of 14 critical-thinking dispositions, in addition to five basic areas of critical-thinking abilities, asserting that the ability to think critically is not enough, but that one must also possess critical-thinking dispositions as well, in order to pursue clarity and criteria for evaluation.

Similarly, Facione (2000) discussed the necessity of nurturing critical-thinking dispositions in conjunction with developing thinking skills in order to yield educational and professional success, because “being skilled does not assure one is disposed to use [critical thinking]. And, being disposed toward using [critical thinking] does not assure that one is skilled” (p. 81).

Halpern (2014) describes six dispositions or attitudes of critical thinkers, including willingness to plan, flexibility, persistence, willingness to self-correct, metacognition, and consensus-seeking. Although the term, dispositions, lends itself to the idea of stable, internal traits, Stout (2007) acknowledged that critical thinking is not necessarily something that one with these qualities does in every situation. As she states, “critical thinking may involve problem solving, assessing standards, applying principles—indeed a variety of skills, procedures, or attitudes—but these will likely differ qualitatively in each context” (p. 45). It is important to note that thinking dispositions focus on what an individual would tend to do in a given situation; whereas thinking abilities focus on what an individual is capable of doing (Perkins & Grotzer, 1997). Just because someone has a critical-thinking disposition does not necessarily mean that they have the ability to do so, and vice versa (Facione, 2000; Facione & Facione, 1992; Stupnisky, Renaud, Daniels, Haynes, & Perry, 2008). Also, even if people have the ability to think critically, their mindfulness of their metacognitive disposition includes a conscious awareness of the way they are thinking and monitoring their thinking process (Halpern, 2014; Snyder & Snyder 2008).

Not only will one person’s critical thinking look differently in different contexts because of qualitative differences in what is required, but also because the individual’s background knowledge and familiarity with necessary principles may differ by context as well. In order to engage in critical thinking, he or she must have prior knowledge in that area about which to think critically (Kuhn, 2005; Paul, 2005; Sternberg, Grigorenko, & Zhang, 2008; Stout, 2007). Therefore, before students can learn how to think critically in a given domain, they must first attain a certain level of background knowledge and understanding of the topic.
While prior knowledge is certainly an important factor in the learning of and instruction for critical thinking, there is some evidence to suggest that students’ learning styles also play an important role (Kieft, Rijlaarsdam, & van den Bedge, 2008; Myers & Dyer, 2006; Sternberg, Grigorenko, Ferrari, & Clinkenbeard, 1999). Sternberg et al. (2008) discussed two types of learning and thinking styles, defined as “individual differences in approaches to tasks that can make a difference in the way in which and, potentially, in the efficacy with which a person perceives, learns, or thinks” (p. 486).

First, people generally balance three kinds of abilities: analytical, creative, and practical thinking. Creative skills are needed to generate ideas, analytical skills are needed to assess whether they are good ideas, and practical skills are needed to implement the ideas and convince others of the value of the ideas.

Ability-based styles, therefore, are learning and thinking styles based on the abilities or strengths of individuals in these areas. Personality-based styles, on the other hand, are not abilities themselves, per se, but individual preferences for how to use one’s abilities. For example, there is a difference between how creative a student is (ability-based style) and how much the students like to be creative (personality-based style). Although these learning styles can be assessed only at the level of the individual student, they have important implications for the role of the teacher, which will be further discussed in the next section.

Role of the Teacher

There is a long-standing debate as to what role a teacher should play in the classroom, as well as how teachers are supposed to manage the numerous constraints on their time (Ben-Peretz, 2001; Cotton, 1991; Egan, 2000; Helsby, 1999; Smyth & Shacklock, 1998; Webster, 1997). Whether teachers, and the education of children in general, should focus on curriculum coverage, deeper understanding, learning strategies, or preparing competent citizens and productive workers for society, is certainly not a new debate. The balance between teaching content and teaching students’ thinking skills is a difficult one to achieve for many teachers (Snyder & Snyder, 2008). Although college faculty have considerably more leeway in the amount of content covered in their courses (e.g., what span of time is covered in an Introductory History course, or which concepts/theories are taught in an Introductory Psychology course), elementary, middle, and high school teachers do not necessarily have the same freedom, thanks to state standards and high-stakes accountability tests. The teacher, then, must decide how to incorporate critical-thinking instruction into content lessons in such a way as to not sacrifice significant time. Specific strategies that teachers can use to this end are discussed later in the chapter.

Once teachers have figured out what content they will teach, and how they will balance that with critical-thinking instruction, another important step to consider is whether the teachers have a clear idea of what critical thinking is, and how they can teach it. Paul (2005) discussed the state of critical-thinking instruction, lamenting findings from a study that revealed many college faculty lack a substantive concept of what critical thinking is, and could only provide vague responses when asked to elaborate on what critical thinking involved (Paul, Elder, & Bartell, 1997). Paul (1995) concludes that if faculty lack the proper conceptual framework, they cannot be expected to effectively teach their students critical-thinking skills.

Lipman (1988) agrees, asserting that critical thinking in schools cannot be fostered unless educators have a clear idea that critical thinking “is skillful, responsible
thinking that facilitates good judgment because it (1) relies upon criteria, (2) is self-correcting, and (3) is sensitive to context” (p. 39). Lipman (1988, 1989) further argues that when teachers have a firm grasp of these concepts and can incorporate them into the classroom, the shift from learning to thinking at all levels—elementary, secondary, and higher education—will result not only in intellectual empowerment, but also in students who are able to make good judgments. Snyder and Snyder (2008) reviewed research that indicates the most effective instructional methods of teaching critical-thinking skills are modeling, questioning, and guided student practice. In order to engage in these instructional practices, teachers must have not only a strong understanding of the content they are teaching, but also must be critical thinkers themselves (Willingham, 2007).

Further, a teacher should be aware of factors that can influence students’ learning of critical-thinking skills. Pedagogical content knowledge (PCK) is defined as knowing what instructional strategies would be developmentally appropriate, having a repertoire of examples, metaphors, and analogies to which students might relate in order to help them learn the principles of critical thinking (Yeh, 2004; Zohar, 1999). Several researchers have examined the extent to which PCK for critical-thinking instruction can be taught, as well as how it relates to teachers’ existing content knowledge of thinking skills.

Zohar (1999) investigated Israeli middle- and high-school science teachers’ content knowledge and PCK of thinking skills during in-service courses (held over a period of several months) for professional development. Through the use of audi-taped discussions, notetaking during in-service courses, and analysis of teachers’ written work, the researcher found that although many teachers had intuitive notions of what critical-thinking skills and metacognition were, their declarative knowledge of such concepts was lacking, and therefore their implementation of critical-thinking instruction in their classes had been informal and unstructured. The in-service course—which consisted of discussions on basic theoretical concepts related to critical thinking, metacognition, and transfer; as well as workshops focused on creating new learning activities and reflecting on their teaching—not only highlighted to teachers the importance of teaching critical thinking as a distinct educational goal, but also helped develop teachers’ declarative (or content) knowledge about critical-thinking instruction and helped them develop more explicit critical-thinking lessons and instructional strategies.

Although the initial goal of the study was to focus on teachers’ PCK of critical thinking, it became clear to Zohar over the course of the in-service courses that teachers’ declarative knowledge of critical thinking must be solidified before that knowledge can be effectively used for instruction. While it might be generally assumed that content knowledge must be in place before PCK, Zohar (1999) proposed that because teachers often have an intuitive and informal content knowledge base about critical thinking, it may be an effective training tool to draw upon teachers’ PCK and informal content knowledge of critical thinking to help develop more formal, declarative knowledge of critical thinking. In other words, Zohar (1999) suggested utilizing teachers’ prior informal content knowledge and pedagogical knowledge to strengthen and structure declarative and pedagogical content knowledge of critical-thinking instruction.

Yeh (2004) developed a computer program called the Computer Simulation for Teaching General Critical-Thinking Skills (CS-TGCTS) to help cultivate reflective teachers and support critical-thinking instruction, by guiding teachers through simulated critical-thinking lessons. Yeh identified two types of professional knowledge (content
knowledge and PCK) and three categories of effective teacher behavior for teaching critical thinking (increasing students’ prior knowledge, enhancing students’ critical-thinking dispositions, and modeling and encouraging critical-thinking skills and techniques), and assessed the extent to which the CS-TGCTS program helped increase this knowledge and behaviors.

In this study, the researcher assumes that an increase in teachers’ reflective teaching would manifest itself in enhanced teacher behaviors, which, in turn, would lead to increases in improved pedagogical development and PCK. Therefore, Yeh (2004) hypothesized that the CS-TGCTS program’s focus on cultivating reflective teaching would result in enhanced content knowledge and PCK for critical-thinking instruction; however, the number of intermediate steps assumed in this relationship between the computer program and PCK development may have been too large to yield significant results. As such, reflective teaching and content knowledge were directly addressed by the computer program, and teachers did indeed witness significant enhancements from pre- to post-test assessments. However, PCK was not directly addressed by the CS-TGCTS program and was not significantly improved over the course of the experiment. This may suggest that efforts to improve teachers’ PCK for critical-thinking instruction may need to be more explicit in terms of not just identifying good pedagogy and teacher behaviors, but how to select the most effective of these strategies for teaching specific groups of students.

Park and Oliver (2008) also propose a model of PCK, one that implies that a teacher develops PCK through reflection. However, they do not assume that reflective teaching necessarily results in PCK, or that it is the only component. They point out that teachers’ abilities to recognize and identify students’ misconceptions and confusions is also vital to the development of their PCK, and assert that “only when teachers grasp their students’ cognitive and affective status with regard to the learning of a particular topic can they apply pedagogically adjusted procedures in order to facilitate learning” (p. 279). In other words, PCK should not be viewed simply as knowledge possessed by the teacher, but should also take into consideration the reciprocal influence of student learning on PCK and teacher reflections.

**Role of Context**

Context plays an important role in the teaching and learning of critical-thinking skills. As already discussed, the student comes to the classroom with certain abilities, dispositions, and prior knowledge, which all play a role in learning to think critically in a given domain. Teachers further play a vital role in ensuring they themselves have the requisite content knowledge, pedagogical content knowledge, and conceptual framework for critical thinking, in order effectively to teach critical-thinking skills. Nevertheless, there are factors within the environment that are not at the student- or teacher-level, which will affect children’s classroom performance, and their abilities to transfer knowledge and skills from one context to another (Okagaki & Sternberg, 1990).

Okagaki and Sternberg (1990) defined context according to Bronfenbrenner’s (1979) lifespan development model: that an individual’s context consists of the “structures and processes in both the immediate and more remote environment [which shape] the course of human development throughout the lifespan” (p. 11). Therefore, in this domain of learning to think critically, relevant immediate environments might be considered the school or home, and the more remote environment might include societal and cultural influences on the individual.
Okagaki and Sternberg (1990) proposed a model depicting the way factors outside of school might influence children’s development of thinking skills and school performance. They primarily focused on parental influence and the home environment; however, it is clear that even when looking only at how one factor, parental beliefs, can impact children’s thinking and learning, the implications of examining how any potential number of environmental and contextual factors can influence critical thinking are nearly overwhelming. The authors therefore attempted to provide guidance on how we could be sensitive to contextual influences.

First, they argued that teachers must discern what prior ideas and beliefs students have regarding what is considered good problem solving and good thinking, in order to confirm how congruent students’ and teachers’ beliefs are. Students’ beliefs are influenced by a variety of contexts that may or may not correspond with contexts to which their teachers have been exposed. Second, critical-thinking skills and strategies must be explicitly taught, and no assumptions can be made about how students will approach various problems and tasks. Third, rules regarding social behavior and roles in the classroom must also be made explicit, because no assumptions can or should be made regarding students’ prior understanding of the school learning context. Finally, it should be understood that the rules of “good thinking” may differ, and that there is not only one set of rules that can be applied. As Okagaki and Sternberg asserted, the focus in critical-thinking instruction “should not be [on] a complete replacement of one set of rules for good thinking with another set. Rather, we should take advantage of the diversity in our school settings to stretch our concepts of good thinking” (p. 76).

The impact that contextual factors have on learning is important to consider, just as the impact that the context in which learning occurs is also important. The notion of transfer is an important one, because learning that occurs in one context does not necessarily translate or carry over into other contexts or domains (Perkins & Grotzer, 1997). Lipman (2003) lamented the state of present-day education as teaching students isolated bits of knowledge that, “like ice cubes frozen in their trays, remain inert and incapable of interacting with one another” (p. 54). Consequently, in the realm of critical thinking, a student who engages in critical thinking in one subject area does not necessarily engage in critical thinking in other subjects as well, even if he/she possesses the necessary critical-thinking dispositions and abilities. The challenge, then, becomes one in which teachers must not only teach students how, but also when to think critically and in what situations they can apply their critical-thinking skills of analyzing, reasoning, and evaluating their thoughts. This is not an easy feat, and one that requires a solid foundation in reasoning, intellectual flexibility, and resourcefulness, for students to be able to make such connections from one domain to another (Lipman, 2003).

As we have already discussed, thinking skills are often tied to the context in which they were learned, and transfer to other contexts does not usually occur (Dean & Kuhn, 2003; cf. Halpern, 1998; Perkins & Salomon, 1989); therefore, teaching critical thinking must be done across subjects and in a variety of settings, to encourage transfer of skills (Meyers, 1986; Swartz, 1987; Swartz et al., 2008). For elementary school teachers who teach across the curriculum, this can be an easier task than for secondary school teachers, who may only teach one subject and must then coordinate with other teachers in different subject areas to continue critical-thinking instruction. This type of follow-up instruction across subjects may include continued direct instruction on the critical-thinking principles, using the same critical-thinking language consistently to help students bridge the applications of critical thinking across subjects, and scaffolding
Meyers (1986) pointed out that critical thinking across contexts need not only be limited to different academic subjects, but ideally, would also extend into students’ personal lives and their involvement with their communities and society in general. Historically speaking, the brightest individuals have not always been the best thinkers, because while they might have possessed a vast array of knowledge, they lacked the ability to evaluate the best uses of that knowledge (p. 118). While Meyers cited such political examples as the Watergate scandal, the Vietnam War, and the threat of nuclear war in space to support his argument, the idea of transferring critical-thinking skills to outside the classroom does not apply simply to politics. “While we may not be able to teach our students wisdom and virtue, we can at least—by openly incorporating appropriate subjective elements of wonder, beauty, and passion in our courses—expose them to the caring side of knowledge” (p. 118). Meyers went on to suggest that teaching students to think critically about issues facing their communities may encourage them to find solutions to problems and empower them to make a difference. Sternberg’s (2001) balance theory of wisdom supports this argument, suggesting that implementing a wisdom-related curriculum in schools can help foster skills in students, such that “wisdom might bring us a world that would seek to better itself and the conditions of all the people in it” (p. 242).

**CURRENT TRENDS AND ISSUES**

*Implications for Teaching and Learning*

Now that we have discussed the definitions, features, developmental and motivational considerations, and roles of the student, teacher, and context in critical thinking, let us now look at what this all means for teaching and learning how to think critically. As Sternberg and Grigorenko (2007) stated: “The goal of teaching for analytical skills is to encourage students to formulate and ask questions, not just to answer them” (p. 40). However, the question becomes how can teachers encourage analytical skills and critical thinking in their students? There are generally two models that educators employ to this end: stand-alone instruction, in which thinking skills are taught as a separate unit or course; and infused instruction, in which teaching thinking skills are integrated into the curriculum across subjects and lessons (Sternberg & Williams, 2010).

*Stand-Alone vs. Infused Instruction*

One example of stand-alone instruction is Lipman’s (1995, 1998) *Philosophy for Children* program. As described earlier, this K–12 curriculum teaches critical-thinking skills and promotes discussion within communities of philosophical inquiry. Within this program, children learn specific sets of critical-thinking skills through reading a narrative as a group, which serves as a model for how children should engage in thinking and discussions. Therefore, the children learn by modeling and “doing philosophy,” and the cognitive skills they acquire (e.g., inquiry, reasoning, translating) help foster critical-thinking dispositions, which influence learning across domains, and not just within philosophy (Stout, 2007). As Lipman (1995) contended, “This is what makes philosophy the discipline that prepares children to think in the disciplines” (p. 69).
A typical *Philosophy for Children* session generally involves students reading aloud or acting out a story depicting fictional children exploring and reasoning out philosophical issues. Students then identify issues from the story that they find interesting, and purposefully and thoughtfully discuss these issues in a community of philosophical inquiry. This community of inquiry is viewed as one of the more effective methods for engaging students, because it encourages them to clarify their ideas and language, ask for and give good reasons for their arguments, question assumptions, and draw inferences. These discussions may culminate in tangible projects, but ultimately should at least result in students’ self-correction of their previously held beliefs, values, and attitudes.

Another example of stand-alone instruction is the *Instrumental Enrichment* (IE) program, which was developed by Reuven Feuerstein and his colleagues (Feuerstein et al., 1986; Feuerstein, Rand, Hoffman, & Miller, 1980; Rand, Tannenbaum, & Feuerstein, 1979). The IE program stems from Feuerstein’s structural cognitive modifiability theory, which assumes that peoples’ levels of cognitive functioning are directly related to the types of mediated learning experiences (MLE) they have had. MLEs are defined as special interactions between learners and mediators. Mediators are not necessarily teachers, but are individuals who are mostly concerned with how a learner *approaches* solving a problem, as opposed to being concerned only with solving the problem itself. MLEs are focused on understanding and reflecting on the learning and thinking processes. Therefore, if a student has been deprived of sufficient MLEs because of low socioeconomic status, poverty, cultural differences, or other factors, his or her cognitive functions and intellectual abilities may be deficient. The IE curriculum is designed to act as a substitute for MLEs, thus compensating for any deficiencies in an individual’s learning experiences.

The IE program consists of content-free exercises and tasks, which are generally presented concurrently with the student’s regular curriculum for three to five hours a week, over a span of two years. A typical lesson involves an introduction to a problem that must be solved, independent work, a group discussion with peers, and a summary statement of what was accomplished during the lesson. Students are helped by a teacher to identify necessary vocabulary, concepts, and appropriate rules and strategies to help in their problem solving. Students are also asked to provide examples from other academic and non-academic areas that relate to the exercises and tasks they do, in order to demonstrate the particular concept in a variety of contexts. This bridging technique serves to encourage transfer, and bridges the IE learning to students’ everyday lives. Throughout the lesson, the teacher serves as a mediator, providing feedback to students, modeling appropriate critical-thinking behavior, encouraging peer interaction, and guiding tasks to ensure various subgoals of the program are attained.

The program focuses on developing cognitive functions and skills necessary to complete various tasks, and the relatively content-free program is designed as a stand-alone program so that the lessons and strategies learned may be more easily generalizable to other academic, vocational, and personal areas (Feuerstein et al., 1986). In a review of the IE program, Shayer and Beasley (1987) found that among a group of 12–13 year olds who all exhibited school performance in line with those of average eight- or nine-year olds, fluid intelligence for students randomly placed in the experimental group showed an effect size of over one standard deviation—roughly equivalent to a difference of 20 months of development, compared to students in the control group that did not participate in the IE program.

Also, the zone of proximal development (ZPD) for the experimental group increased from 9.5 years to 11.2 years at the post-test, compared to the ZPD of the control group.
increasing only from 10.5 to 10.7 years, reflecting a very large effect size. As Sternberg and Williams (2010) suggest, stand-alone instruction tends to be more intensive, and is taught in a more systematic and sequential manner, which positively influences students’ skill building. The implications of the IE program on the teaching and learning of critical-thinking skills are such that cognitive modifiability may be possible to achieve, allowing individuals to better cope with their ever-changing environments.

Within models of stand-alone instruction, there are several strategies teachers might use to teach critical-thinking skills to students. Ku, Ho, Hau, and Lai (2014) conducted a study in which secondary students were taught critical-thinking skills using various modes of instruction, including direct instruction, and inquiry-based approaches. Compared to students in the control condition who did not receive any training, students who did receive critical-thinking instruction showed greater improvement on critical-thinking assessments. The study also demonstrated that students who received mixed-method critical-thinking instruction (i.e., half direct instruction, half inquiry-based instruction) showed improvement in both critical-thinking assessments and the transfer of learning skills to other domains, which was not necessarily the case with the other critical-thinking training conditions. This suggests that mixed-method approaches to critical thinking instruction, which combines direct instruction with more inquiry-based approaches, may be most beneficial for students.

The second model that educators employ to teach critical thinking skills involves infused instruction, which integrates critical-thinking instruction across the curriculum. Swartz (1987) described the instruction of teachers who restructured their classroom instruction to incorporate and infuse critical-thinking lessons throughout. In one example, an American History teacher utilized conflicting eyewitness accounts of the Battle of Lexington to generate discussions about examining evidence, evaluating the reliability of sources of information, and evaluating criteria for making judgments. In another example, a social studies teacher used two contrasting accounts describing the role of women in the !Kung society. The students explored the influence of values, attitudes, and expectations on authors’ frames of reference, such that they discussed in depth the implications of bias on the presentation of otherwise seemingly factual information.

Another example of infused instruction comes from the Cognition and Technology Group at Vanderbilt (CTGV) and their work on what is referred to as anchored instruction (e.g., Barron, Vye, Zech, Schwartz, Bransford et al., 1995; Bransford et al., 1988). In several of their studies, researchers used video-based scenarios to encourage problem comprehension. For example, in a series of studies, students were shown clips of the film, Raiders of the Lost Ark, in which Indiana Jones travels to South America to retrieve the golden idol. Students are then asked to imagine that they are to return to the South American jungle to obtain some of the other artifacts left behind. In so doing, students must learn about potential obstacles and mathematically based problems that could be derived from the film clip they observed. For example, the width of the pit they would have to jump, the height of a cave, the width of a river in relation to the size of the seaplane, etc., can all be estimated by studying freeze-frame shots from the movie and using known standards (e.g., the height of Indiana Jones) to deduce other pieces of information.

CTGV has also developed a series called The Adventures of Jasper Woodbury, consisting of 12 videodisc-based adventures that highlight mathematical problem finding and problem solving, geared toward students ages 10 and older (Barron et al., 1995; Cognition and Technology Group at Vanderbilt, 1992). Each videodisc contains a short
video adventure that concludes with a complex challenge. All data needed to solve the adventure are contained within the video, as well as embedded models of teaching particular approaches to solving problems.

In both the stand-alone and infused instruction models, the process of examining and evaluating evidence, as well as identifying potential biases in thinking and writing, are important skills in critical thinking. However, they were embedded within the content lessons. Over the course of several lessons, consistent infusion of such critical-thinking lessons into instruction is intended to lead to a greater likelihood of students transferring the use of these skills across domains. Stout (2007) contended that critical thinking must be made a priority in classrooms, and that educators should employ a number of methods to encourage critical inquiry among their students, including encouraging both vertical (analytical) and lateral (creative) thinking, identifying assumptions in arguments, generating questions, and working on both open-ended and closed problems. These methods can all be utilized to infuse critical-thinking skills with instruction.

It is difficult to evaluate whether stand-alone or infused instruction is better for teaching critical-thinking skills, in large part because no studies have directly compared the two approaches in a controlled fashion. Williams and Worth (2001) conclude that “specialized courses in critical thinking have generally been successful in promoting this skill, but recent attempts to infuse critical-thinking activities into subject-matter courses have yielded marginal results” (p. 13). Van Gelder’s (2001) Reason! Project at the University of Melbourne developed the Reason!Able computer program as a stand-alone method of teaching and enhancing critical-thinking skills. The software makes use of argument maps or trees (built up and manipulated by the user) to display and represent the relationships between claims and evidence. The “building” and “evaluation” modes of the program provide guidance and scaffolding for the user throughout the process. Students using the Reason!Able program exhibited improvement with large effect sizes from pre- to post-tests on critical thinking, and also demonstrated the largest gains when compared to other stand-alone methods or approaches; however, to our knowledge, there have been no controlled studies examining the impact of the Reason! method on critical-thinking skills.

Hatcher (2006) attempted to investigate the question of whether stand-alone courses in critical-thinking instruction or infused instruction was more effective, and found that college freshmen participating in a two-semester-long infused program performed significantly better on critical-thinking assessments. However, his comparison groups were two stand-alone critical thinking and logic courses at other institutions. Other researchers have also found similar positive support for the infused instruction model, although their comparison/control groups received no critical-thinking instruction (Reed & Kromrey, 2001; Solon, 2001, 2007). It should be noted that these comparison studies were all conducted with college-aged students; as such, not only should studies utilizing more controlled comparisons between stand-alone and infused instructional models be conducted, but also studies investigating students at different developmental stages.

**Beyond Critical Thinking**

While there does not seem to be much disagreement about the importance of students learning how to think critically, there is consideration of the idea that critical-thinking instruction is simply one piece of the puzzle. Feuerstein et al. (1986) asserted
that teaching critical-thinking skills and employing *Instrumental Enrichment* to compensate for deficiencies in mediated learning experience is important for helping individuals to adapt within society; however, they also pointed out that “the acquisition of thinking skills is important, [but] it is not sufficient for adaptation to new and complex situations. Such adaptation requires an internal flexibility” (p. 76). Therefore, the goals of cognitive modifiability should be such that individuals should be enabled not only to think critically, but also flexibly in order to adapt and thrive. Stout (2007) agreed, as evidenced by her inclusion in her list of possible critical-thinking-infusing methods, “developing lateral as well as vertical thinking” (italics added, p. 57). Accordingly, Schwartz (2015) asserted that as part of learning how to think and to become good students, professionals, and citizens, students must also develop certain intellectual virtues, including love of truth, honesty, fair-mindedness, humility, perseverance, courage, good listening skills, perspective-taking and empathy, and wisdom.

**Successful Intelligence**

Sternberg and his colleagues also agree, and have offered theoretical and empirical evidence that teaching for critical thinking, while important, is not enough, and that practical and creative skills, as well as wisdom, should be fostered in schools to ensure optimal student success (Stemler, Sternberg, Grigorenko, Jarvin, & Sharpes, 2009; Sternberg, 2003, 2008, 2013; Sternberg & Grigorenko, 2007; Sternberg et al., 1998, 2008). Sternberg’s (1997, 1999, 2012) theory of successful intelligence proposes that an integrated set of abilities, namely critical thinking—generally referred to as analytical skills—along with creative and practical skills, are needed to attain success. Successful intelligence is the result of recognizing and capitalizing on one’s strengths, while identifying and compensating for one’s weaknesses. This ability to adapt to or shape one’s environments requires a balanced use of all three sets of abilities.

Schools have traditionally taught for and assessed analytical intelligence, since modern intelligence tests have focused primarily on this construct. However, the idea of intelligence and how it is conceived needs to be defined more broadly, so that success and intelligence take into account a greater range of criteria (Sternberg, 2003; Sternberg et al., 2014). Indeed, success in life requires not only the ability to think critically and analytically about one’s own ideas and thoughts; it is also necessary to think creatively in the generation of those ideas and thoughts, as well as to have the practical abilities to be able to implement those ideas and convince others of their value. For example, in the realm of education, a student must be able to think of an essay topic, and cogently write the essay, arguing a particular point of view.

Flexibly adapting to the environment, as Feuerstein et al. (1986) proposed, is an important quality in society, and having the flexibility to modify oneself to suit the environment (adaptation), modify the environment to suit oneself (shaping), and find a new environment that is more congruent with one’s skills or desires (selection) are all indicators of successful intelligence (Sternberg, 2003; Sternberg & Grigorenko, 2007; Sternberg et al., 2008).

According to the theory of successful intelligence (Sternberg, 1997, 1999, 2003), a common set of universal mental processes underlies all aspects of intelligence. These processes are made up of metacomponents, performance components, and knowledge-acquisition components. *Metacomponents*, or executive processes, are used to plan, monitor, and evaluate problem solving. *Performance components* implement or execute the plans dictated by the metacomponents. *Knowledge-acquisition components*
are the processes that are used to learn how to problem-solve in the first place. The three processes are interdependent, and all must be used depending on the situation or problem at hand, whether it requires analytical, creative, or practical thinking skills. For example, analytical thinking is appropriate for a situation in which the components are relatively familiar problems extracted from everyday life, whereas creative thinking skills may be better suited for novel problems or tasks. Practical skills are used when the components must be applied and implemented to adapt to, shape, and select one’s environment.

The research that we have discussed thus far in this chapter on critical thinking draws a parallel to the metacomponential processes involved in problem solving. In learning how to analyze, assess, and evaluate their thinking, students are improving the facility of their metacomponential processes. Also, just as prior knowledge is vital for critical thinking, so are knowledge-acquisition components important for knowing what information is needed to solve problems and how the information can be used. While performance components are necessary to execute the instructions of the metacomponents, so are creative and practical intelligence needed to be able to effectively implement a sound solution.

Teaching triarchically, or infusing all three types of intelligence (analytical, creative, and practical) into instruction and assessment, has been found to be not only a valid and theoretically sound method, but it has also been successful in improving students’ abilities and achievement. In the context of the classroom, teaching for analytical intelligence manifests itself through tasks that involve analyzing, judging, evaluating, comparing and contrasting, and critiquing. Teaching for creative intelligence involves having students create, invent, discover, imagine, and speculate. Finally, teaching for practical intelligence involves having students implement, use, apply, and find relevance (Sternberg, 1994; Sternberg et al., 1998). Teaching and assessing should be done in a variety of ways, in order to capitalize on students’ varying learning styles (Sternberg, 1997; Sternberg & Grigorenko, 2007; Sternberg et al., 2008).

Among 225 third and 142 eighth graders in science and social studies classes in North Carolina, students were assigned to one of three instructional conditions: (a) Students were taught in a way that emphasized analytical thinking; (b) students were taught in ways that emphasized analytical, creative, and practical thinking; and (c) students were not taught any differently than usual (i.e., the emphasis was mostly on memorization). Students in the successful intelligence condition (the group emphasizing all three ability-based styles) outperformed students in the other groups, even on memory-based multiple-choice assessments (Sternberg et al., 1998; cf. Sternberg et al., 2014). Similar findings were found in middle- and high school language arts classes (Grigorenko, Jarvin, & Sternberg, 2002); as well as in a sixth-grade mathematics class for Alaskan Eskimos (Sternberg, Lipka, Newman, Wildfeuer, & Grigorenko, 2007).

These findings should serve to highlight the importance of using a wide variety of teaching methods and approaches to capitalize on students’ strengths and compensate for their weaknesses, and allow them to learn and encode material in a variety of interesting ways. When students are taught in ways that highlight all ability-based styles, this method of teaching serves not only to create better thinkers, but also to help students perform better on assessments, no matter what form they take (Sternberg et al., 1998), and on motivational measures (Zadeh, Abedi, Yousefi, & Aghababaei, 2014).

In another set of studies, researchers explored whether traditional schools and schooling favor students with analytical abilities at the expense of those with perhaps creative and practical abilities (Sternberg, Ferrari, Clinkenbeard, & Grigorenko, 1996;
Sternberg et al., 1999). Students who were identified by their schools as gifted were given the Sternberg Triarchic Abilities Test (STAT; Sternberg, 1993), which measures students’ analytical, creative, and practical skills in a variety of ways. Students who, based on their STAT performance, fell into one of five ability groupings (high analytical, high creative, high practical, high in all three abilities, and low in all three abilities) were invited to a summer program at Yale University in college-level psychology, where they were divided into four instructional groups. All four groups used the same textbook and listened to the same lectures, but their afternoon discussion sections emphasized rote memory, analytical skills, creative skills, or practical skills, respectively. Student performance was evaluated the same across all students, regardless of the instructional group, and was based on homework, a midterm and final exam, and an independent project.

Several interesting findings resulted, supporting the utility of the theory of successful intelligence. First, when students first arrived at Yale, it was observed that those in the high creative and high practical groups were more ethnically, racially, socioeconomically, and educationally diverse than students in the high analytical group. Therefore, while traditional conceptions of intelligence (i.e., focusing solely on analytical abilities) may have yielded low correlations with the demographic characteristics of these creative and practical students, expanding the range of abilities measured helped identify students that otherwise might not have been deemed as intelligent.

In addition, all three ability tests significantly predicted student performance during the summer program, and there was an aptitude-treatment interaction, such that students who were assigned to an instructional group that matched their pattern of abilities were most advantaged and performed the best. For example, students who were identified as being high in creative skills and who were placed in the high-creativity instructional group outperformed other highly creative students who were placed in another instructional group. The relative lack of creative and practical instructional strategies in schools highlight the disadvantage that highly creative or practical students may be at, when they are never taught or assessed in a way that matches their patterns of abilities (Sternberg, 2015; cf. Zhang, Sternberg, & Fan, 2013).

This work shows that it is not only important to teach in ways that emphasize all three types of abilities, but also that assessments that focus on analytical, creative, and practical skills allow students to maximally take advantage of their strengths while making up for their weaknesses. Stemler et al. (2009) worked with a group of Advanced Placement Physics teachers and readers to develop a series of AP Physics test items that not only assessed content knowledge, but also targeted memory, analytical, creative, and practical skills. The newly developed items were examined for validity and reliability, and were found to be statistically sound measures of physics knowledge, as well as measuring a broad range of cognitive skills.

Profiles of student achievement indicated that only 38% of students exhibited profiles associated with strong memory and analytical skills, meaning that many students’ abilities are not necessarily assessed with traditional tests that focus only on these aspects of learning. By incorporating items that assessed creative and practical skills as well, ethnic differences in achievement on several subscales were witnessed, such that the usual achievement gap seen on such exams was reduced. Similar studies on other AP subject tests—psychology and statistics—have been conducted, with remarkably similar findings (e.g., Stemler, Grigorenko, Jarvin, & Sternberg, 2006), indicating the utility of expanding traditional assessments to include cognitive-processing areas that have been largely ignored. This expansion allows educators and researchers to make...
more valid inferences about student learning and understanding, and also allows students whose skills have largely been ignored and dismissed to demonstrate their particular patterns of abilities.

The Rainbow Project was a collaborative effort, in which analytical, creative, and practical measures were developed as a supplement to the SAT in predicting college success (as measured by grade point average [GPA]). Data were collected from 15 schools across the country (eight four-year colleges, five community colleges, and two high schools), including baseline standardized test scores (SAT) and high school GPA, as well as STAT scores to assess measures of successful intelligence. Researchers found that not only did Rainbow measures predict college freshman-year GPA, but they also roughly doubled the predictive power versus the SAT alone (Sternberg & The Rainbow Project Collaborators, 2006). In addition, the Rainbow measures appeared to reduce ethnic-group differences relative to those usually found with assessments such as the SAT. This research, like that done on AP tests (Stemler et al., 2009), has implications for reducing group differences in measures used to inform college admissions.

The WICS Theory—An Augmentation of the Theory of Successful Intelligence

Recently, Sternberg has augmented his theory by incorporating wisdom into the foundation of successful intelligence (Sternberg, 2003, 2005). The theory of Wisdom, Intelligence, and Creativity Synthesized (WICS) views intelligence (analytical and practical), creativity, and also wisdom as necessary components of successful intelligence (Sternberg, 2010a, 2010b). In the WICS model, analytical skills are equated with critical-thinking skills. As we discussed earlier, while creative skills are needed to come up with new ideas and thoughts, analytical skills are necessary to evaluate whether those thoughts and ideas are good. Practical skills are needed to implement and execute such ideas, and wisdom is viewed as the essential component that allows one to determine whether and how the ideas can be implemented in the service of a common good, through the infusion of positive ethical values. This kind of thinking requires a balancing of intrapersonal, interpersonal, and extrapersonal interests over both the short and long terms.

Therefore, a wise person often listens to others, weighs advice, and knows how to deal with a variety of people. “In seeking as much information as possible for decision making, the wise individual reads between the lines as well as making use of the obviously available information” (Sternberg, 2003, p. 180). Wise individuals learn not only from their own mistakes, but from the mistakes of others; and they are not afraid to change their minds as experience prescribes.

As a theory of educational leadership, WICS indeed has its roots in the theory for successful intelligence; however, it became clear that although a convergence of analytical, practical, and creative intelligence led to many positive academic outcomes for students, they were not necessarily enough for a happy and successful life (Sternberg, 2005). A person may be practically intelligent. However, he or she may use those practical skills toward selfish ends. Similarly, individuals with creative intelligence may not utilize their abilities for a common good.

The implications of the WICS theory for education are that schools should foster wisdom, in addition to knowledge and intelligence (Sternberg, 2008). Just as teaching students to think critically is not sufficient if they lack the ability to practically and creatively implement their critically developed ideas and thoughts, so is their intelligence
deficient if they lack the wisdom or ethical reasoning skills needed to put their ideas into practice in a manner that is for the common good. A wisdom-based approach to education would look similar to a constructivist approach in that students would take an active role in constructing their understanding. However, they would also be encouraged to construct knowledge from the point of view of others, in order to attain a more balanced comprehension.

For example, the American History teacher discussed earlier who provided his students with conflicting accounts of the Battle of Lexington was indeed using a wisdom-based approach to teaching his class. Not only was he encouraging his students to think critically about sources of information and the validity of evidence, but by presenting both the American and British perspectives on the battle, he exposed his students to the importance of balanced information and was supported in efforts to seek multiple points of view (Swartz, 1987).

Project Kaleidoscope at Tufts University examined the impact of the WICS theory on college admissions and success (Sternberg et al., 2010; Sternberg, Bonney, Gaborra, & Merrifield, 2012; Sternberg et al., 2008). Its roots stem from the Rainbow Project; however, the construct of wisdom was added to its measures. The Tufts admission application was amended to include optional essay questions designed to elicit analytical, creative, practical, or wise responses from applicants. Students are encouraged to answer just one question out of a selection of 10–13 options. For example, a creative question asks students to write a short story with a title such as, “Seventeen Minutes Ago” or “No Whip Half-Caf Latte.” A wisdom question might ask students to describe what inspires their original thinking or how they might apply their ingenuity to serve the common good and make a difference in society. Admissions officers are trained with rubrics to assess the Kaleidoscope essays as well as the rest of the application on measures of analytical skills, creativity, practical skills, and wisdom, and applications are rated on each dimension.

Since the integration of the Kaleidoscope framework with the existing Tufts admission process in 2006, the total number of applications to the school has increased. The quality of applicants has increased as well, both as a function of an increase in high-quality students applying and a decrease in low-quality students submitting applications. Acceptance rates have remained consistent; however, the percentage of ethnic minorities admitted to Tufts has increased dramatically (up 14% for Hispanic American students, and up 26% for African American students), suggesting that it is possible to increase academic quality and ethnic diversity on a large scale (Sternberg et al., 2008, 2009). Furthermore, when controlling for students’ academic rating scores (SATs and high school GPAs), students who received a Kaleidoscope rating on their application performed significantly better than students who did not receive a Kaleidoscope rating, as measured by first-year college GPA (Sternberg et al., 2010).

It can be argued that college GPA is not the only measure of success or educational leadership that can or should be measured. Project Kaleidoscope also conducted follow-up studies with students after they enrolled at Tufts, in order to assess students’ ratings of satisfaction with various aspects of their life during the school year; ratings of personal growth on different dimensions during the school year; listings and details of extracurricular activities with which they became involved, including the extent to which their involvement gave them the opportunity to cultivate wisdom, creativity, practical skills, analytical skills, and leadership skills; and ratings of the appropriateness of various descriptors of extracurricular experiences and what they gained from the experience. Students who received high ratings on Kaleidoscope measures on their
admissions application reported greater satisfaction with their interactions with other students, reported becoming more socially active, reported more meaningful involvement in their extracurricular activities, and were more likely to describe their extracurricular experiences as enabling them to think practically, compared to students who received low ratings on Kaleidoscope measures (Sternberg et al., 2010). Further investigation is certainly warranted to examine the impact and implications of these subjective differences in experiences among individuals who are cultivating the qualities of successful leadership and preparing themselves for leadership roles in tomorrow’s society.

**FUTURE DIRECTIONS**

According to Bloom’s taxonomy, evaluation is the highest level of cognition, which involves making judgments based on criteria and standards through a process of monitoring and critiquing (Bloom & Krathwohl, 1956). Critical thinking indeed entails a high level of cognition, but as a recent revision to the taxonomy suggests, it is not necessarily the pinnacle of cognition (Anderson, Nguyen-Jahiel et al., 2001). The revised taxonomy now concludes with creating, which entails putting together cognitive elements to form a functional whole, or reorganizing elements into a new model. This final step cannot be performed without the requisite evaluation or critical-thinking process; however, this amendment recognizes the need for critical-thinking instruction to be a means to a greater end, and not an end in and of itself.

The inclusion of a creative step in the taxonomy supports our proposition that not only are analytical and practical intelligences necessary components of academic success and leadership, but also, perhaps, creativity and wisdom are. Similarly, Stout (2007) proposed that imagination (which is associated with creativity) “allows us to hypothesize about what is possible; critical thinking helps us reason through those possibilities, and evaluation both helps us assess the quality of those processes and tells us whether our hypothesizing and reasoning are directed toward productive ends” (p. 58).

Just as Stout called for an inclusion of imagination into the critical-thinking model, so do we recommend a focus on critical and analytical thinking as being only the first step in maximizing student learning and understanding in the classroom, while simultaneously investigating and promoting the role of practical, creative, and wisdom skills.

**REFERENCES**


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