Critical Thinking: A Literature Review

Research Report

Emily R. Lai

June 2011

About Pearson
Pearson, the global leader in education and education technology, provides innovative print and digital education materials for pre-K through college, student information systems and learning management systems, teacher licensure testing, teacher professional development, career certification programs, and testing and assessment products that set the standard for the industry. Pearson's other primary businesses include the Financial Times Group and the Penguin Group. For more information about the Assessment & Information group of Pearson, visit http://www.pearsonassessments.com/.

About Pearson's Research Reports
Pearson's research report series provides preliminary dissemination of reports and articles prepared by TMRS staff, usually prior to formal publication. Pearson's publications in .pdf format may be obtained at: http://www.pearsonassessments.com/research.

Abstract

Critical thinking includes the component skills of analyzing arguments, making inferences using inductive or deductive reasoning, judging or evaluating, and making decisions or solving problems. Background knowledge is a necessary but not a sufficient condition for enabling critical thought within a given subject. Critical thinking involves both cognitive skills and dispositions. These dispositions, which can be seen as attitudes or habits of mind, include open- and fair-mindedness, inquisitiveness, flexibility, a propensity to seek reason, a desire to be well-informed, and a respect for and willingness to entertain diverse viewpoints. There are both general- and domain-specific aspects of critical thinking. Empirical research suggests that people begin developing critical thinking competencies at a very young age. Although adults often exhibit deficient reasoning, in theory all people can be taught to think critically. Instructors are urged to provide explicit instruction in critical thinking, to teach how to transfer to new contexts, and to use cooperative or collaborative learning methods and constructivist approaches that place students at the center of the learning process. In constructing assessments of critical thinking, educators should use open-ended tasks, real-world or "authentic" problem contexts, and ill-structured problems that require students to go beyond recalling or restating previously learned information. Such tasks should have more than one defensible solution and embed adequate collateral materials to support multiple perspectives. Finally, such assessment tasks should make student reasoning visible by requiring students to provide evidence or logical arguments in support of judgments, choices, claims, or assertions.

Keywords: critical thinking, reasoning, problem solving

Acknowledgements

The author would like to thank Janet Fowler for assistance in conducting literature searches and the following reviewers for their helpful comments and suggestions on an earlier draft of this paper: Michael Bay-Borelli, Rob Kirkpatrick, Anli Lin, Changjiang Wang, and Hua Wei.

Critical Thinking: A Literature Review

Educators have long been aware of the importance of critical thinking skills as an outcome of student learning. More recently, the Partnership for 21st Century Skills has identified critical thinking as one of several learning and innovation skills necessary to prepare students for post-secondary education and the workforce. In addition, the newly created Common Core State Standards reflect critical thinking as a cross-disciplinary skill vital for college and employment. Despite widespread recognition of its importance, there is a notable lack of consensus regarding the definition of critical thinking. The purposes of this literature review are to (a) explore the ways in which critical thinking has been defined by researchers, (b) investigate how critical thinking develops (c) learn how teachers can encourage the development of critical thinking skills in their students, and (d) review best practices in assessing critical thinking skills.

Definition of Critical Thinking

Theoretical Background

The literature on critical thinking has roots in two primary academic disciplines: philosophy and psychology (Lewis & Smith, 1993). Sternberg (1986) has also noted a third critical thinking strand within the field of education. These separate academic strands have developed different approaches to defining critical thinking that reflect their respective concerns. Each of these approaches is explored more fully below.

The philosophical approach.

The writings of Socrates, Plato, Aristotle, and more recently, Matthew Lipman and Richard Paul, exemplify the philosophical approach. This approach focuses on the hypothetical critical thinker, enumerating the qualities and characteristics of this person rather than the behaviors or actions the critical thinker can perform (Lewis & Smith, 1993; Thayer-Bacon, 2000). Sternberg (1986) has noted that this school of thought approaches the critical thinker as an ideal type, focusing on what people are capable of doing under the best of circumstances. Accordingly, Richard Paul (1992) discusses critical thinking in the context of "perfections of thought" (p. 9). This preoccupation with the ideal critical thinker is evident in the American Philosophical Association's consensus portrait of the ideal critical thinker as someone who is inquisitive in nature, open-minded, flexible, fair-minded, has a desire to be well-informed, understands diverse viewpoints, and is willing to both suspend judgment and to consider other perspectives (Facione, 1990).

Those working within the philosophical tradition also emphasize qualities or standards of thought. For example, Bailin (2002) defines critical thinking as thinking of a particular quality—essentially good thinking that meets specified criteria or standards of adequacy and accuracy. Further, the philosophical approach has traditionally focused on the application of formal rules of logic (Lewis & Smith, 1993; Sternberg, 1986). One limitation of this approach to defining critical thinking is that it does not always correspond to reality (Sternberg, 1986). By emphasizing the ideal critical thinker and what people have the capacity to do, this approach may have less to contribute to discussions about how people actually think.

Definitions of critical thinking emerging from the philosophical tradition include

- “the propensity and skill to engage in an activity with reflective skepticism” (McPeck, 1981, p. 8);
- “reflective and reasonable thinking that is focused on deciding what to believe or do” (Ennis, 1985, p. 45);
- “skillful, responsible thinking that facilitates good judgment because it 1) relies upon criteria, 2) is self-correcting, and 3) is sensitive to context” (Lipman, 1988, p. 39);
- “purposeful, self-regulatory judgment which results in interpretation, analysis, evaluation, and inference, as well as explanation of the evidential, conceptual, methodological, criteriological, or conceptual considerations upon which that judgment is based” (Facione, 1990, p. 3);
- “disciplined, self-directed thinking that exemplifies the perfections of thinking appropriate to a particular mode or domain of thought” (Paul, 1992, p. 9);
- thinking that is goal-directed and purposive, “thinking aimed at forming a judgment,” where the thinking itself meets standards of adequacy and accuracy (Bailin et al., 1999b, p. 287); and
- “judging in a reflective way what to do or what to believe” (Facione, 2000, p. 61).

The cognitive psychological approach.

The cognitive psychological approach contrasts with the philosophical perspective in two ways. First, cognitive psychologists, particularly those immersed in the behaviorist tradition and the experimental research paradigm, tend to focus on how people actually think versus how they could or should think under ideal conditions (Sternberg, 1986). Second, rather than defining critical thinking by pointing to characteristics of the ideal critical thinker or enumerating criteria or standards of "good" thought, those working in cognitive psychology tend to define critical thinking by the types of actions or behaviors critical thinkers can do. Typically, this approach to defining critical thinking includes a list of skills or procedures performed by critical thinkers (Lewis & Smith, 1993).

Philosophers have often criticized this latter aspect of the cognitive psychological approach as being reductionist—reducing a complex orchestration of knowledge and skills into a collection of disconnected steps or procedures (Sternberg, 1986). For example, Bailin (2002) argues that it is a fundamental misconception to view critical thinking as a series of discrete steps or skills, and that this misconception stems from the behaviorist's need to define constructs in ways that are directly observable. According to this argument, because the actual process of thought is unobservable, cognitive psychologists have tended to focus on the products of such thought—behaviors or overt skills (e.g., analysis, interpretation, formulating good questions). Other philosophers have also cautioned against confusing the activity of critical thinking with its component skills (Facione, 1990), arguing that critical thinking is more than simply the sum of its parts (Van Gelder, 2005). Indeed, a few proponents of the philosophical tradition have pointed out that it is possible to simply "go through the motions," or proceed through the "steps" of critical thinking without actually engaging in critical thought (Bailin, 2002).

Definitions of critical thinking that have emerged from the cognitive psychological approach include

- "the mental processes, strategies, and representations people use to solve problems, make decisions, and learn new concepts" (Sternberg, 1986, p. 3);
- "the use of those cognitive skills or strategies that increase the probability of a desirable outcome" (Halpern, 1998, p. 450); and
- "seeing both sides of an issue, being open to new evidence that disconfirms your ideas, reasoning dispassionately, demanding that claims be backed by evidence, deducing and inferring conclusions from available facts, solving problems, and so forth" (Willingham, 2007, p. 8).

The educational approach.

Finally, those working in the field of education have also participated in discussions about critical thinking. Benjamin Bloom and his associates are included in this category. Their taxonomy for information processing skills (1956) is one of the most widely cited sources for educational practitioners when it comes to teaching and assessing higher-order thinking skills. Bloom's taxonomy is hierarchical, with "comprehension" at the bottom and "evaluation" at the top. The three highest levels (analysis, synthesis, and evaluation) are frequently said to represent critical thinking (Kennedy et al., 1991).

The benefit of the educational approach is that it is based on years of classroom experience and observations of student learning, unlike both the philosophical and the psychological traditions (Sternberg, 1986). However, some have noted that the educational

approach is limited in its vagueness. Concepts within the taxonomy lack the clarity necessary to guide instruction and assessment in a useful way (Ennis, 1985; Sternberg, 1986). Furthermore, the frameworks developed in education have not been tested as vigorously as those developed within either philosophy or psychology (Sternberg, 1986).

Areas for Agreement

Abilities included.

Despite differences among the three schools of thought and their approaches to defining critical thinking, there exist areas for agreement. First, researchers of critical thinking typically agree on the specific abilities encompassed by the definition, which include

- analyzing arguments, claims, or evidence (Ennis, 1985; Facione, 1990; Halpern, 1998; Paul, 1992);
- making inferences using inductive or deductive reasoning (Ennis, 1985; Facione, 1990; Paul, 1992; Willingham, 2007);
- judging or evaluating (Case, 2005; Ennis, 1985; Facione, 1990; Lipman, 1988; Tindal & Nolet, 1995); and
- making decisions or solving problems (Ennis, 1985; Halpern, 1998; Willingham, 2007).

Other abilities or behaviors identified as relevant to critical thinking include asking and answering questions for clarification (Ennis, 1985); defining terms (Ennis, 1985); identifying assumptions (Ennis, 1985; Paul, 1992); interpreting and explaining (Facione, 1990); reasoning

verbally, especially in relation to concepts of likelihood and uncertainty (Halpern, 1998); predicting (Tindal & Nolet, 1995); and seeing both sides of an issue (Willingham, 2007).

Dispositions.

Most researchers also agree that in addition to skills or abilities, critical thinking also involves dispositions (Facione, 1990). As early as 1985, researchers working in the area of critical thinking recognized that the *ability* to think critically is distinct from the *disposition* to do so (Ennis, 1985). Empirical evidence appears to confirm the notion that critical thinking abilities and dispositions are, in fact, separate entities (Facione, 2000). These dispositions have variously been cast as attitudes or habits of mind. Facione (2000) defines critical thinking dispositions as "consistent internal motivations to act toward or respond to persons, events, or circumstances in habitual, yet potentially malleable ways" (p. 64). Researchers tend to identify similar sets of dispositions as relevant to critical thinking. For example, the most commonly cited critical thinking dispositions include

- open-mindedness (Bailin et al., 1999; Ennis, 1985; Facione 1990, 2000; Halpern, 1998);
- fair-mindedness (Bailin et al., 1999; Facione, 1990);
- the propensity to seek reason (Bailin et al., 1999; Ennis, 1985; Paul, 1992);
- inquisitiveness (Bailin et al., 1999; Facione, 1990, 2000);
- the desire to be well-informed (Ennis, 1985; Facione, 1990);
- flexibility (Facione, 1990; Halpern, 1998); and

- respect for, and willingness to entertain, others' viewpoints (Bailin et al., 1999; Facione, 1990).

Importance of background knowledge.

Finally, most researchers working in the area of critical thinking agree on the important role of background knowledge. In particular, most researchers see background knowledge as essential if students are to demonstrate their critical thinking skills (Case, 2005; Kennedy et al., 1991; Willingham, 2007). As McPeck (1990) has noted, to think critically, students need something to think critically about. Similarly, Bailin et al. (1999) argue that domain-specific knowledge is indispensable to critical thinking because the kinds of explanations, evaluations, and evidence that are most highly valued vary from one domain to another. Facione (1990) notes the following:

> Although the identification and analysis of critical thinking skills transcend, in significant ways, specific subjects or disciplines, learning and applying these skills in many contexts requires domain-specific knowledge. This domain-specific knowledge includes understanding methodological principles and competence to engage in norm-regulated practices that are at the core of reasonable judgments in those specific contexts…Too much of value is lost if critical thinking is conceived of simply as a list of logical operations and domain-specific knowledge is conceived of simply as an aggregation of information. (p. 10)

Areas for Disagreement

Role of dispositions.

Much remains to be resolved regarding the definition of critical thinking. Although most researchers agree that critical thinking involves both skills and dispositions, there remains disagreement as to whether the disposition to think critically should be viewed in its normative sense in addition to its laudatory sense. In 1990, the American Philosophical Association (APA) formed a panel of critical thinking researchers for the purpose of coming to a consensus on a definition of critical thinking that could support future research efforts. Although most experts agreed that dispositions were an important component, they disagreed on the particular role of dispositions within the definition of critical thinking, with some arguing that dispositions have merely a laudatory role, and others maintaining that dispositions also have a normative role (Facione, 1990). In other words, most researchers agreed that critical thinking is synonymous with "good thinking," in the sense that truly critical thought can only be exhibited by those with both the ability and the disposition to think critically. By this standard, a person who is capable of thinking critically and chooses not to do so is not a critical thinker. However, a small minority of experts also argued that critical thinking must fulfill ethical standards to be truly critical. According to this argument, a defense attorney using critical thinking abilities and dispositions to get her guilty client acquitted would not be a critical thinker (Facione, 1990).

Domain specificity.

Another area for disagreement is the extent to which critical thinking skills are domain-specific. On one hand, some researchers argue that critical thinking skills can be generalized across different contexts and domains and can thus be taught in a generic way. On

the other side of the debate are those who argue that general critical thinking skills that transcend specific subjects do not exist. According to this argument, critical thinking skills can only be taught in the context of a specific domain. Ennis (1989) identifies a range of assumptions regarding domain specificity held by various theorists. For example, most researchers view background knowledge as a necessary but not sufficient condition for critical thinking. In addition, some researchers see the transfer of critical thinking skills across domains as unlikely unless students are provided with sufficient opportunities to practice these skills in a variety of domains and the students are explicitly taught to transfer. Finally, an even smaller number of researchers hold the view that general instruction in critical thinking skills is unlikely to be successful because critical thinking skills are inherently domain-specific (Ennis, 1989).

Proponents of domain specificity include Willingham (2007), who argues that it is easier to learn to think critically within a given domain than it is to learn to think critically in a generic sense. Similarly, Bailin (2002) argues that domain-specific knowledge is necessary for critical thinking because what constitutes valid evidence, arguments, and standards tends to vary across domains:

> For example, it makes no sense to refer to a process of interpreting which remains constant regardless of subject matter. Rather, what is involved in and even meant by interpreting varies with the context, and this difference is connected with the different kinds of knowledge and understanding necessary for successful completion of a particular task (p. 366).

Although McPeck (1990) concedes that there are a limited number of general thinking skills, he argues that the most useful thinking skills are those that are domain-specific. According to McPeck, the more general the thinking skill, the less helpful it is. Bailin (2002) concurs,

arguing that what is common and general to the concept of critical thinking is so generic that it is not useful.

Those who maintain that critical thinking skills and abilities are not domain-specific include Halpern (2001), who reviews evidence on the success of general instruction in critical thinking skills and concludes that such instruction has great potential. Lipman (1988) notes that critical thinking facilitates good judgment because it relies on criteria. These criteria may differ across domains, but the fundamental meaning of critical thinking remains the same. Van Gelder (2005, p. 43) argues that critical thinking is "intrinsically general in nature," which, paradoxically, is why critical thinking skills and abilities are notoriously difficult to transfer to new contexts.

There are also those who maintain that critical thinking includes both general and domain-specific elements. As Ennis (1989) notes, in math, deductive proof is the gold standard for reason, whereas in the social sciences statistical significance is most highly regarded, and in art subjectivity is usually acceptable. On the other hand, Ennis acknowledges that there appear to be aspects of critical thinking that are common across disciplines, such as the notion that a conflict of interest detracts from the credibility of a source. Facione (2000) has designed the California Critical Thinking Skills Test as a general test of critical thinking rather than one embedded within the context of a specific domain. Yet Facione (1990) also notes the importance of domain-specific knowledge in any application of critical thinking skills and abilities. Thus, Facione also falls into the category of researchers who acknowledge both general and domain-specific elements of critical thinking. Finally, Paul (1992) identifies critical thinking as learning to think within one's discipline by appropriating the standards and values embodied in that discipline. At the same time, however, Paul points out that critical thinking skills and abilities

can be taught using both general critical thinking courses and infusing critical thinking instruction into discipline-specific courses.

Transferability.

Another area of disagreement among critical thinking researchers is the extent to which critical thinking skills and abilities can be transferred to new contexts. For example, researchers have noted that students may exhibit critical thinking skills and abilities in one context, or domain, but fail to do so in another (Willingham, 2007). This issue is closely related to that of the domain-specificity of critical thinking. For example, those maintaining that critical thinking is completely domain-specific are more likely to be skeptical of students' abilities to transfer critical thinking skills from one domain to another (Ennis, 1989). Accepted wisdom within cognitive psychology holds that spontaneous transfer to new contexts is rare (Kennedy et al., 1991; Pithers & Soden, 2000; Willingham, 2007). Others, however, are more sanguine about the possibility of student transfer, particularly if students are given opportunities to practice critical thinking skills in multiple domains and contexts and if students are taught specifically to transfer those skills (Kennedy et al., 1991). McPeck (1990), a staunch proponent of domain specificity, notes that his approach does not preclude the transfer of critical thinking skills and abilities to real-world contexts, particularly when instruction emphasizes authentic learning activities that represent problems encountered in daily life.

Empirical evidence on transfer documents both successes and failures. Halpern (2001) describes the results of one study that sought to determine whether college students would transfer critical thinking skills acquired in the context of a specific discipline to an entirely new context several months after the course had ended. Most students in this study did indeed apply

the reasoning they had previously learned to a non-academic topic several months later. However, in his review of the research, Nickerson (1988) finds the empirical evidence on transfer to be mixed. He concludes that the success of any transfer method appears to depend on what is being taught and how it is being taught. For example, instructional programs aimed at improving students' metacognitive skills have demonstrated more successful transfer than training programs for basic cognitive processes, such as observing, measuring, and classifying. Moreover, stand-alone approaches to instruction in general critical thinking appear to be less successful than approaches in which critical thinking instruction is infused into discipline-specific courses alongside traditional academic content.

One problem with attempting to investigate the degree of transfer is the ambiguity surrounding the "distance" of such transfer (Bailin, 2002; Ennis, 1989). In other words, is transfer near or far? On one end of the spectrum, students may be asked to transfer skills to a new but similar task. On the opposite end of the spectrum, transfer could refer to application within an entirely new discipline. In addition, some have used the term "transfer" to describe the process of applying skills learned within an academic school setting to problems encountered in everyday life (McPeck, 1990). Clearly, the particular meaning a person imparts to the word "transfer" tends to affect the level of optimism regarding the potential for transfer. Transfer to new problems within the same domain is more likely to occur than transfer to new disciplines.

Role of criteria.

Another area for disagreement among critical thinking researchers is the role of criteria. This debate occurs primarily between the philosophical and psychological approaches, with most of the philosophers maintaining the importance of attending to criteria and most of the

psychologists ignoring the issue. From a philosophical perspective, critical thinking involves using criteria to make judgments or to support decisions (Case, 2005; Lipman, 1988). Criteria are needed for evaluating the arguments and positions of others, for evaluating evidence, and for evaluating one's own thoughts. These criteria may come in the form of standards—"standards for judging the adequacy of claims about meaning; the credibility of statements made by authorities; the strength of inductive arguments; and the adequacy of moral, legal, and aesthetic reasons" (Bailin et al., 1999, p. 291). The criteria may also come in the form of laws, regulations, norms, or ideals. The particular criteria that are relevant in a given situation will depend on the domain of interest (Lipman, 1988). For example, as Lipman (1988) points out, the criteria needed to evaluate a piece of architecture are different from those needed to assess the strength of a legal argument.

Criteria are also needed for evaluating one's own thought. As evidenced in Paul's (1992) "perfections of thought," these criteria communicate to students the qualities of thought they should strive to achieve: clarity, accuracy, precision, specificity, relevance, consistency, logic, depth, completeness, significance, fairness, and adequacy. Given the important role of criteria in critical thinking, philosophers tend to emphasize the need to communicate these criteria to students. Thus, Paul (1992) recommends being explicit about the intellectual standards used for evaluating student work. Similarly, Bailin et al. (1999) and Case (2005) include knowledge of criteria for judging the quality of thinking as one of five resources students need to think critically.

Relationships to Other Concepts

As a way of defining the concept of critical thinking, many researchers have drawn connections to other skills commonly identified as twenty-first century skills, including metacognition, motivation, and creativity. Each of these related concepts will be discussed separately.

Metacognition.

Metacognition has been defined most simply as "thinking about thinking." Other definitions include

- "the knowledge and control children have over their own thinking and learning activities" (Cross & Paris, 1988, p. 131);
- "awareness of one's own thinking, awareness of the content of one's conceptions, an active monitoring of one's cognitive processes, an attempt to regulate one's cognitive processes in relationship to further learning, and an application of a set of heuristics as an effective device for helping people organize their methods of attack on problems in general" (Hennessey, 1999, p. 3); and
- "the monitoring and control of thought" (Martinez, 2006, p. 696).

What is the relationship between critical thinking and metacognition? Kuhn (1999) sees critical thinking as being a form of metacognition, which includes metacognitive knowing (thinking that operates on declarative knowledge), meta-strategic knowing (thinking that operates on procedural knowledge), and epistemological knowing (encompassing how knowledge is produced). Likewise, Flavell (1979) sees critical thinking as forming part of the

construct of metacognition when he argues that “critical appraisal of message source, quality of appeal, and probable consequences needed to cope with these inputs sensibly” can lead to “wise and thoughtful life decisions” (p. 910). On the other hand, Van Gelder (2005) and Willingham (2007) appear to perceive metacognition as being subsumed under critical thinking when they argue that a component critical thinking skill is the ability to deploy the right strategies and skills at the right time, typically referred to as conditional or strategic knowledge and considered part of the construct of metacognition (Kuhn & Dean, 2004; Schraw et al., 2006). Halonen (1995) identifies metacognition as the ability to monitor the quality of critical thinking. Similarly, Halpern (1998) casts metacognition as monitoring thinking and strategy use by asking the following kinds of questions: What do I already know? What is my goal? How will I know when I get there? Am I making progress?

Some researchers have argued that the link between critical thinking and metacognition is self-regulation. For example, the APA Delphi report includes self-regulation as one component skill of critical thinking (Facione, 1990). Schraw et al. (2006) draw connections between metacognition, critical thinking, and motivation under the umbrella of self-regulated learning, which they define as “our ability to understand and control our learning environments” (p. 111). Self-regulated learning, in turn, is seen as comprising three components: cognition, metacognition, and motivation. The cognitive component includes critical thinking, which Schraw and associates explain consists of identifying and analyzing sources and drawing conclusions.

However, others have argued that critical thinking and metacognition are distinct constructs. For example, Lipman (1988) has pointed out that metacognition is not necessarily critical, because one can think about one’s thought in an unreflective manner. McPeck, on the

other hand, argues that the ability to recognize when a particular skill is relevant and to deploy that skill is not properly a part of critical thinking but actually represents general intelligence (1990). At the very least, metacognition can be seen as a supporting condition for critical thinking, in that monitoring the quality of one's thought makes it more likely that one will engage in high-quality thinking.

Motivation.

Critical thinking is also related to motivation. For example, most researchers view critical thinking as including both skills, or abilities, and dispositions. The disposition to think critically has been defined as the "consistent internal motivation to engage problems and make decisions by using critical thinking" (Facione, 2000, p. 65). Thus, student motivation is viewed as a necessary precondition for critical thinking skills and abilities. Similarly, Halonen notes that a person's propensity, or disposition, to demonstrate higher-order thinking relates to their motivation (1995). Halpern (1998) argues that effort and persistence are two of the principal dispositions that support critical thinking, and Paul maintains that perseverance is one of the "traits of mind" that renders someone a critical thinker (1992, p. 13). Thus, like metacognition, motivation appears to be a supporting condition for critical thinking in that unmotivated individuals are unlikely to exhibit critical thinking. On the other hand, several motivation researchers have suggested that the causal link goes the other way. In particular, some motivation research suggests that difficult or challenging tasks, particularly those emphasizing higher-order thinking skills, may be more motivating to students than easy tasks that can be solved through the rote application of a pre-determined algorithm (Turner, 1995).

Creativity.

Finally, many researchers have made connections between critical thinking and creativity (Bailin, 2002; Bonk & Smith, 1998; Ennis, 1985; Paul & Elder, 2006; Thayer-Bacon, 2000). At first glance, critical thinking and creativity might seem to have little in common, or even to be mutually exclusive constructs. However, Bailin (2002) argues that a certain amount of creativity is necessary for critical thought. Paul and Elder (2006) note that both creativity and critical thinking are aspects of "good," purposeful thinking. As such, critical thinking and creativity are two sides of the same coin. Good thinking requires the ability to generate intellectual products, which is associated with creativity. However, good thinking also requires the individual to be aware, strategic, and critical about the quality of those intellectual products. As the authors note, "critical thinking without creativity reduces to mere skepticism and negativity, and creativity without critical thought reduces to mere novelty" (p. 35). Paul and Elder (2006) point out that, in practice, the two concepts are inextricably linked and develop in parallel. Accordingly, the authors believe both creative and critical thinking ought to be integrated during instruction.

Development of Critical Thinking

This section reviews the empirical literature on the critical thinking capacities of the average person, followed by an investigation of critical thinking in young children. Finally, we review one theoretical approach to understanding how critical thinking might appear and develop over time.

Critical Thinking in the Average Person

Many researchers working in the area of critical thinking lament the poor state of critical thinking in most educated adults and children. For example, Halpern (1998) points to research

from the field of psychology, concluding that many, if not most, adults fail to think critically in many situations. Kennedy et al., (1991) and Van Gelder (2005) have likewise concluded that many adults lack basic reasoning skills. Halpern (1998) cites the example that large numbers of people profess to believe in paranormal phenomena, despite a lack of evidence in support of such things. Halpern attributes such failures not to the inability to reason well but to simple "bugs" in reasoning. She argues that human beings are programmed to look for patterns, particularly in the form of cause-and-effect relationships, even when none exist. Van Gelder (2005) echoes this sentiment, characterizing humans as "pattern-seekers and story-tellers" (p. 42). This inclination results in a tendency to jump to the first explanation that makes intuitive sense without carefully scrutinizing alternative possibilities, a phenomenon that Perkins, Allen, & Hafner (1983) have termed "makes-sense epistemology" (p. 286). Moreover, the general public often finds "personal experience" to be more compelling evidence than a carefully conducted, scientific study. Given these natural tendencies toward deficient reasoning, Halpern warns that we should not expect to see dramatic improvements in critical thinking over time as a result of instructional interventions. Improvements in critical thinking, when they do occur, are slow and incremental (Halpern, 1998).

One reason for this gap in basic reasoning skills may be deficient educational experiences. Paul (1992) argues that typical school instruction does not encourage the development of higher-order thinking skills like critical thinking. Paul explains that knowledge is coterminous with thinking, especially good or critical thinking. However, typical school instruction, with its emphasis on the coverage of content, is designed as though recall were equivalent to knowledge. This type of lower-order learning is simply learning by rote or association, with the end result that students memorize material without understanding the logic

of it. Students tend not to recognize that their assertions, beliefs, and statements have implications, and thus require evidence to support them. For most students, believing, not thinking, is knowing (Paul, 1992).

Despite evidence suggesting that the average person struggles to think critically, many researchers are sanguine about the capacity of humans to become critical thinkers with appropriate instruction. Kennedy et al. (1991) point out that empirical research suggests that students of all intellectual ability levels can benefit from critical thinking instruction. Similarly, Lewis and Smith (1993) argue that critical thinking skills are for everyone, not just the gifted.

Critical Thinking in Children

Early research in the Piagetian tradition tended to view the cognitive processes of young children as being deficient in relation to those of older individuals. Many following this tradition interpret Piaget's stages of development to mean that young children are incapable of formal operations (abstract reasoning), which are required for critical thought (e.g., see summary in Kennedy et al., 1991). However, more recent research has found that young children engage in many of the same cognitive processes that adults do, concluding that there is a place for critical thinking in the lower elementary curriculum (see, e.g., Gelman & Markman, 1986). Silva (2008) argues that there is no single age when children are developmentally ready to learn more complex ways of thinking. Furthermore, Willingham (2007) indicates that very young children have been observed thinking critically, whereas trained scientists occasionally fall prey to errors in reasoning. Kennedy, et al. (1991) surveyed the research literature and concluded that, although critical thinking ability appears to improve with age, even young children can benefit from critical thinking instruction. The authors speculate that many of the earlier gloomy conclusions,

vis-à-vis the limited critical thinking skills of young children, were spurious—due to a lack of relevant background or content knowledge needed to engage in a task.

Bailin et al. (1999) argue that critical thinking instruction at the primary grade levels can include teaching students to

- value reason and truth;
- respect others during discussion;
- be open-minded;
- be willing to see things from another's perspective;
- perceive the difference between definitions and empirical statements;
- use cognitive strategies, such as asking for examples when something is unclear; and
- use principles of critical thinking, such as considering alternatives before making a decision.

Similarly, the APA Delphi report recommends that "from early childhood, people should be taught, for example, to reason, to seek relevant facts, to consider options, and to understand the views of others" (Facione, 1990, p. 27). Moreover, the report maintains that explicit instruction dedicated to critical thinking skills, abilities, and dispositions should be built into all levels of the K–12 curriculum, rather than being limited to junior high or high school students.

Empirical evidence supports the notion that young children are capable of thinking critically. For example, Koenig and Harris (2005) have demonstrated that 3- and 4-year-old children will differentiate the credibility of various sources of information. In particular,

4-year-old children appeared to prefer the judgments of adult participants who had a history of being correct over those who were purposefully inaccurate. This finding was replicated in a number of other studies (e.g., Jaswal & Neely, 2006). Similarly, Lutz and Keil (2002) found that children as young as 4 years appeared to be aware that different people may possess differing domains of expertise and that these areas of expertise might be related to their credibility on certain topics. For example, a car mechanic's diagnosis of car trouble was found to be more credible than a doctor's. Finally, Heyman and Legare (2005) found that children between the ages of 7 and 10 became increasingly aware that people may have motives to distort the truth, whereas children younger than this were not consistently critical of the credibility of people with such motives.

Critical Thinking Over Time

Little is known about the development of critical thinking skills and dispositions over time. The APA, for example, has specifically cautioned that its framework for critical thinking should not be interpreted as implying any kind of developmental progression or hierarchical taxonomy (Facione, 1990). A few empirical studies have investigated the evolution of critical thinking skills and abilities as students proceed through college. O'Hare and McGuinness (2009) found that the critical thinking scores of third-year university students in Ireland were significantly higher than the corresponding scores of first-year students. The authors speculated that attending university exerts an independent effect on the development of critical thinking. In a meta-analysis of eight studies from 1991 to 2000, Gellin (2003) concluded that college students who engaged in activities such as interacting with faculty and peers, living on campus, and participating in college clubs or organizations increased their measured critical thinking skills by

0.14 standard deviations as compared to college students who did not participate in such activities.

One of the only researchers to postulate a developmental progression of critical thinking skills and abilities is Kuhn (1999), who synthesized a wealth of empirical research on cognitive development to construct such a progression. Kuhn's definition of critical thinking draws from the literature on metacognition, which she views as being related to critical thinking. She distinguishes three forms of metacognition, which represent successively more sophisticated ways of thinking. Metacognitive understanding is thinking that operates on declarative knowledge. In other words, it is concerned with cataloging what an individual knows and how that individual comes to know it. Meta-strategic knowing is thinking that operates on procedural knowledge. Thus, this type of cognition is concerned with monitoring and evaluating strategy use, as well as answering questions such as, "Am I making progress?" and "Is this strategy working?" Finally, epistemological understanding is concerned with philosophical questions, such as, "How does anyone know anything?"

According to Kuhn's (1999) theoretical framework, metacognitive knowing characterizes the first stirrings of critical thought in very young children. There are two distinct stages within metacognitive knowing. The first stage is called Realism and is typically achieved between the ages of 3 and 5. This stage is characterized by the belief that assertions are expressions of someone's belief, and as such, may depart from reality. Thus, the child is able to identify true and false statements. Prior to reaching this stage, children regard beliefs and assertions as isomorphic with reality. "In other words, the world is a simple one in which things happen and we can tell about them. There are no inaccurate renderings of events" (p. 19).

According to Kuhn's framework (1999), the second stage of metacognitive knowing, typically achieved by 6 years of age, allows the child to be aware of sources of knowledge and further, to distinguish between theory and evidence. In other words, prior to reaching this second stage, the child has difficulty distinguishing evidence for the claim that an event has occurred from the causal theory that makes occurrence of the event plausible. In other words, is something true because it makes intuitive sense or because there is empirical evidence for it? Kuhn describes a study (Kuhn & Pearsall, 1998) in which children were shown a series of pictures depicting two runners competing in a race. The last picture shows one of the runners holding up a trophy and smiling. When children were asked who won the race, most children correctly indicated that the runner represented in the final photo was the winner. However, when asked to justify this claim, younger children tended to cite causal theories ("because he is wearing fast shoes") rather than evidence in support of the claim ("because he is holding a trophy"). According to Kuhn, by the second stage of metacognitive knowing children are able to make this distinction.

Based on the empirical research in meta-memory, Kuhn's framework (1999) also portrays meta-strategic knowing in two stages. According to Kuhn, during the first stage, typically achieved during middle childhood, children begin to understand the value of cognitive strategies in aiding cognition. A child who has reached this stage recognizes that a memory strategy such as categorization will aid recall and tends to effectively manage and deploy cognitive resources during problem solving (Kuhn, 1999). The second stage of meta-strategic knowing may not be achieved at all. If it is attained, it is typically reached during adolescence and adulthood. According to Kuhn, this stage is characterized by consistent and appropriate strategy selection from a repertoire of available strategies. Thus, the individual monitors strategy

use, evaluates the success of strategies, and moderates use of such strategies accordingly. Individuals at this stage also tend to justify their knowledge claims (Kuhn, 1999).

Finally, Kuhn's framework (1999) posits epistemological understanding as the most sophisticated level of critical thought. According to Kuhn, this level is characterized by three distinct stages. The first stage, called the Absolutist position, is the norm during childhood and is common during adolescence, and can even persist into adulthood for some individuals. People who have reached this stage believe that absolute truth is either "known or potentially knowable, either through direct apprehension or the opinion of experts" (Kuhn, 1999, p. 22). All belief states can be evaluated in relation to this objective truth. In other words, all disagreements are ultimately resolvable.

According to Kuhn (1999), the second stage in epistemological understanding, labeled the Multiplist Epistemological position, tends to be prevalent during adolescence. During this stage, the individual acknowledges that experts can disagree and actually relinquishes the idea of certainty. A person in this stage moves to the opposite end of the subjectivity-objectivity continuum, vis-à-vis those in the Absolutist stance. Instead of viewing the world as inherently and objectively knowable, individuals in this stage perceive the world as a completely subjective place. In other words, "because all people have a right to their opinions, all opinions are equally right" (p. 22). Kuhn points out that many people become permanently stuck in this phase.

Finally, Kuhn (1999) argues that the last stage in epistemological understanding (and critical thinking), to which only a minority of people will ever progress, is known as Epistemological Metaknowing. According to Kuhn's framework (1999), at this stage the individual is able to balance the subjective and objective, recognizing a multiplicity of valid

representations of reality. This person uses judgment, evaluation, and argumentation to sift through opinions and arrive at those that are most valid. Not all opinions are valued equally; rather, reason, logic, and empirical evidence can be used to privilege certain positions over others (Kuhn, 1999).

Instructional Implications

This section explores the teachability of critical thinking, as well as the instructional implications of the empirical literature on critical thinking skills. Specific instructional recommendations for fostering the development of critical thinking will be summarized, as well.

The Teachability of Critical Thinking

Fortunately, many critical thinking researchers maintain that critical thinking skills and abilities can be taught. Halpern (1998) offers evidence of two instructional programs aimed at improving the critical thinking skills and abilities of college students. In one study, students who were taught general problem-solving skills improved on Piagetian-inspired measures of cognitive development. In the other study, college students instructed in a specific type of problem-solving strategy produced mental math representations that were more like those of experts than of novices. In their review of the literature, Kennedy et al. (1991) concluded that instructional interventions aimed at improving students' critical thinking skills have generally shown positive results. In a meta-analysis of 117 empirical studies examining the impact of instructional interventions on students' critical thinking skills and dispositions, Abrami et al. (2008) found that these interventions, in general, have a positive impact, with a mean effect size of 0.34. However, the distribution of effect sizes was highly homogeneous, with effect sizes varying

dramatically by type of intervention and sample characteristics. For example, effect sizes for students in K–12 settings were higher than those observed among undergraduates.

Domain Specificity

The debate about domain specificity has implications for critical thinking instruction. Ennis (1989) described four instructional approaches that vary in terms of the extent to which critical thinking skills are taught as a stand-alone course versus integrated into regular instruction. The general approach entails direct and explicit instruction in critical thinking skills as a separate course, where critical thinking skills and abilities are emphasized outside the context of specific subject matter. Typically, some content is involved to contextualize examples and tasks. However, the content is not related to discipline-specific knowledge, but tends to be drawn from problems that students are likely to encounter in their daily lives. Van Gelder (2005) appears to advocate for the general approach to critical thinking instruction. Drawing from the literature on expertise, Van Gelder argues that students need "deliberate practice" in exercising critical thinking skills and abilities. This type of practice can only occur when critical thinking is taught as a separate and explicit part of the curriculum. However, students must be taught to transfer critical thinking to a variety of contexts by providing them opportunities to practice applying critical thinking skills in diverse contexts. Similarly, Halpern (2001, p. 278) argues that instruction in general thinking skills, taught as a "broad-based, cross-disciplinary" course, is the most effective way of teaching critical thinking.

The infusion approach entails in-depth instruction in the subject matter plus explicit instruction on general critical thinking principles. This critical thinking instruction is provided in the context of specific subject matter. Ennis (1989) indicates that this approach is commonly

seen in the “across the curriculum” movements. Somewhat related to the infusion approach is immersion. In immersion instruction, students are engaged in deep subject-matter instruction. Although critical thinking skills and abilities are part of the content to be learned, critical thinking instruction is not made explicit. In other words, critical thinking skills and abilities are not the focus of direct and explicit instruction. Rather, students are expected to acquire these skills as a natural consequence of engaging with the subject matter (Ennis, 1989). Proponents of the infusion and immersion approaches appear to include both Bailin et al. (1999), who vigorously defend the domain specificity of critical thinking, and Lipman (1988), who views critical thinking skills as being somewhat general but who argues, nonetheless, that instruction in critical thinking must go hand-in-hand with instruction in basic skills, such as reading, writing, listening, and speaking. Silva (2008) echoes this viewpoint, maintaining that knowledge and thinking have to be taught simultaneously. Likewise, Case (2005) argues that critical thinking is a lens through which to teach the content and skills embedded in the curriculum; and Pithers and Soden (2000) reject the view that critical thinking could be taught as a separate subject. Rather, critical thinking should be viewed as a way of teaching and learning in any domain.

Finally, the mixed approach combines elements of both the general and subject-specific approaches. Teachers pair stand-alone instruction in general critical thinking principles with application of critical thinking skills in the context of specific subject matter. Explicit instruction in critical thinking skills can be incorporated into both the general and the specific components (Ennis, 1989). Facione (1990) appears to advocate for this approach when he notes that critical thinking can be taught in the context of domain-specific content, or content drawn from “events in everyday life” (p. 10). Paul (1992) recommends basic critical thinking skills courses, as well as including critical thinking within discipline-specific courses. Kennedy et al. (1991), after

reviewing extant research on the various approaches, conclude that the evidence does not support the superiority of any particular approach. Accordingly, they recommend using the mixed approach.

In their meta-analysis of 117 empirical studies on the effects of instructional interventions on students' critical thinking skills and dispositions, Abrami et al. (2008) found that a substantial amount of the variation in effect sizes across studies was driven by pedagogical grounding and by type of intervention. In other words, when instructional approach was categorized as general, immersion, infusion, or mixed, the mixed approach had the largest effect-sizes and the immersion approach had the smallest. This finding suggests that educators should approach critical thinking instruction both by integrating critical thinking into regular academic content and,by teaching general critical thinking skills as a stand-alone component. This finding reinforces the importance of providing explicit instruction in critical thinking rather than simply viewing critical thinking as an implicit goal of a course. The authors also found that interventions in which educators received special training in teaching critical thinking had the largest effect-sizes, compared to studies in which course curricula were simply aligned to critical thinking standards or critical thinking was simply included as an instructional objective. Thus, successful interventions may require professional development for teachers specifically focused on teaching critical thinking (Abrami et al., 2008).

Teaching for Transfer

As noted before, researchers disagree on the extent to which critical thinking skills learned in one context are transferrable to new contexts, domains, and disciplines. Most researchers tend to agree, however, that transfer is unlikely to occur unless students are taught

specifically to transfer. What does this mean from an instructional standpoint? First, students must be given opportunities to apply critical thinking skills and abilities in a wide range of contexts and subject areas. Second, instruction should emphasize executive functioning or metacognitive skills, such as setting goals, planning, and monitoring progress toward goals (Kennedy et al., 1991). Third, students should be sensitized to deep problem structure, because most students' thinking tends to focus on the surface structure of problems, or the superficial aspects of tasks (Halpern, 1998; Willingham, 2007). Hummel and Holyoak define structure sensitivity as the ability to "code and manipulate relational knowledge" (as cited in Halpern, 1998, p. 453). The goal of structure training is to enable students to recognize a particular problem structure whenever they see it—whether it appears in math, science, or social studies—so that they may deploy appropriate strategies. Structure training involves distributing practice in a variety of contexts and settings. Halpern points out that use of "authentic" or real-world learning activities helps to promote the transfer of critical thinking skills. Brown (1990) argues that domain-specific knowledge may also be necessary for young children to successfully transfer skills to new problems that display the same deep structure. She observes, "We conclude that even young children show insightful learning and transfer on the basis of deep structural principles, rather than mere reliance on salient perceptual features, when they have access to the requisite domain-specific knowledge to mediate that learning" (p. 130). Thus, teaching for transfer may also entail providing adequate instruction on relevant background information.

Specific Instructional Strategies

A number of researchers have recommended using particular instructional strategies to encourage the development of critical thinking skills and abilities, such as explicit instruction, collaborative or cooperative learning, modeling, and constructivist techniques. For example,

many researchers have noted that critical thinking skills and abilities are unlikely to develop in the absence of explicit instruction (Abrami et al., 2008; Case, 2005; Facione, 1990; Halpern, 1998; Paul, 1992). Facione points out that this explicit instruction should also attend to the dispositional or affective component of critical thinking.

Another method recommended by several critical thinking researchers is a collaborative or cooperative approach to instruction (Abrami et al., 2008; Bailin et al., 1991; Bonk & Smith, 1998; Heyman, 2008; Nelson, 1994; Paul, 1992; Thayer-Bacon, 2000). This recommendation appears to be rooted in Piagetian and Vygotskyian traditions that emphasize the value of social interactions for promoting cognitive development (as summarized in Dillenbourg et al., 1996). Piaget touted the instructional value of cognitive conflict for catalyzing growth, typically achieved by interacting with another person at a higher developmental stage. Along similar lines, Vygotsky identified the zone of proximal development as the distance between what an individual can accomplish alone and what he/she can accomplish with the help of a more capable other (either a peer or an adult). Each of these approaches highlights the potential for cognitive improvement when students interact with one another (as summarized in Dillenbourg et al., 1996).

Proponents of collaborative or cooperative learning include Thayer-Bacon (2000), who emphasizes the importance of students' relationships with others in developing critical thinking skills. Supporters also include Bailin et al. (1999), who argue that critical thinking involves the ability to respond constructively to others during group discussion, which implies interacting in pro-social ways by encouraging and respecting the contributions of others. Similarly, Heyman (2008) indicates that social experiences can shape children's reasoning about the credibility of claims. In their meta-analysis of 117 empirical studies on the effects of instructional

interventions for improving students' critical thinking skills and dispositions, Abrami et al. (2008) found a small but positive and significant effect of collaborative learning approaches on critical thinking.

Nelson (1994) provides some clues as to how collaboration can prompt cognitive development among college students. According to Nelson, students' misconceptions interfere with their ability to acquire new knowledge, despite appropriate instruction. Collaborations create opportunities for disagreements and misconceptions to surface and to be corrected. Collaboration also provides a vehicle for students to attain necessary acculturation to the college learning environment and helps to make tacit disciplinary expectations more explicit for students.

Nelson (1994) points out that collaboration must be scaffolded, arguing that this scaffolding process has three stages. First, students must be prepared for collaboration by providing them with a common background on which to collaborate, such as common assigned readings. Second, student groups should be provided with questions or analytical frameworks that are more sophisticated than they would tend to use on their own. Finally, collaborative activities should be structured by specifying student roles and by creating incentives for all group members to actively participate. Bonk and Smith (1998) identify a number of classroom activities that build on the potential for collaboration to enhance learning. These activities include think-pair-share, round-robin discussions, student interviews, roundtables, gallery walks, and "jigsawing."

In addition to explicit instruction and collaboration, several other strategies have been identified as helpful in promoting critical thinking. For example, teachers are urged to use

constructivist learning methods, characterized as more student-centered than teacher-centered (Bonk & Smith, 1998; Paul, 1992). Constructivist instruction is less structured than traditional instruction, amplifying students' roles in their own learning and de-emphasizing the role of the teacher. Educators should model critical thinking in their own instruction by making their reasoning visible to students. This could be accomplished by "thinking aloud" so that students can observe the teacher using evidence and logic to support arguments and assertions (Facione, 2000; Paul, 1992). Educators are also urged to use concrete examples that will be salient to students to illustrate abstract concepts like "conflict of interest" (Heyman, 2008; Paul, 1992). For example, Heyman found that children were more likely to be skeptical of another child's claim of illness when they learned that the child did not want to attend camp that day. Examples that rely upon common experiences are more likely to be intuitively obvious to students. Specific classroom learning activities believed to promote critical thinking include the creation of graphic organizers, such as concept maps and argument diagrams (Bonk & Smith, 1998; Van Gelder, 2005); KWL charts, which require students to identify what they already know about a topic, what they want to know, and what they have learned upon completing instruction; "in a nutshell" writings, which entail summaries of arguments; exit slips, which identify the most important thing learned and the areas of needed clarity; problem-based learning, particularly the use of ill-structured problem contexts; and mock trials (Bonk & Smith, 1998).

Assessment Implications

This section reviews challenges in assessing critical thinking and identifies specific recommendations from the literature for measuring critical thinking.

Challenges in Assessing Critical Thinking

There are a number of challenges in assessing critical thinking skills and dispositions in students. Researchers have pointed out problems associated with both reliability and validity of existing measures. For example, Moss and Koziol (1991) factor analyzed scores from a set of writing tasks intended to measure the critical thinking skills of students in grades 5, 8, and 11 in the context of social studies. Students who read a social studies passage either supported an inference with argumentation or evaluated an argument from the passage. The authors found no clear, common factor underlying performance across tasks that were designed to be parallel. Furthermore, students' abilities to use topic statements, evidence, explanations, conclusions, and logical organization did not generalize across tasks, suggesting that idiosyncratic and perhaps construct-irrelevant features of each passage or task were more salient aspects of student performance than any general ability to think critically. Silva (2008) has noted that performance-based assessments of creativity introduce, rather, subjectivity and error. Moreover, use of such performance tasks to assess the growth of critical thinking skills over time remains fraught with difficulties as long as individual tasks communicate more noise than signal (Moss & Koziol, 1991).

Norris (1989) argues that the fact that the degree of domain specificity in critical thinking remains unresolved makes assessment of critical thinking difficult. First, the type of inferences one is trying to make remains unclear to the extent that researchers cannot agree whether critical thinking is general or subject-specific. Second, it is difficult to assess critical thinking transfer, because transfer to other contexts is confounded with subject-specific knowledge that is necessary for exercising critical thinking. Thus, a student who fails to transfer to another subject either requires additional instruction in critical thinking or additional instruction in the subject

matter. Similarly, the disposition to think critically is confounded with the ability to do so. Thus, despite the fact that researchers have identified critical thinking skills and dispositions as distinct from one another, delineating their separate effects using an assessment is difficult in practice. Finally, Norris argues that traditional assessment formats are ill-suited for testing even limited aspects of the construct. Standardized instruments using multiple-choice formats to assess credibility judgment or deductive reasoning are as likely to reflect extraneous constructs—such as test-makers' empirical, religious, or political beliefs and judgments—as they are to reflect critical thinking.

Existing published assessments of critical thinking are numerous, and include the California Critical Thinking Skills Test (Facione, 1990), the Cornell Critical Thinking Tests (Ennis & Millman, 2005), the Ennis-Weir Critical Thinking Essay Test (Ennis & Weir, 1985), and the Watson-Glaser Critical Thinking Appraisal (Watson & Glaser, 1980). As Ku (2009) points out, these instruments vary widely in both purpose and item format. However, as Kennedy et al. (1991) note, none of these tests are intended for use with students below the fourth-grade level. Moreover, these assessments tend to be general critical thinking assessments rather than subject-specific.

Assessment Recommendations

Researchers have made several suggestions for designing assessments ideally suited to assess critical thinking skills. First, open-ended problem types may be more appropriate for assessing critical thinking than traditional multiple-choice formats. As Ku (2009) argues, available empirical evidence suggests that open-ended measures better capture the construct of critical thinking because they are more sensitive to the dispositional aspects of critical thinking

than are multiple-choice measures. For this reason, Ku recommends using tests of mixed item format, both multiple-choice and open-ended, to more completely represent both the cognitive and dispositional aspects of critical thinking. As Ku (2009) argues, “teachers should adopt different assessment methods, such as exercises that allow students to self-construct answers, assignments that facilitate the practice of strategic use of thinking skills in everyday contexts, and when adopting multiple-choice exercises, follow-up questions should be given to probe students’ underlying reasoning” (p. 75).

Assessment tasks should also reflect “authentic” problem contexts and performances (Bonk & Smith, 1998; Halpern, 1998). This means that assessments should be based on simulations that approximate real-world problems and issues. Assessments should also use ill-structured problems, which Moss and Koziol (1991) explain to mean that test questions should require students to go beyond the available information in the task to draw inferences or make evaluations. In addition, problems should have more than one plausible or defensible solution, and there should be sufficient information and evidence within the task to enable students to support multiple views (Moss & Koziol, 1991).

Fischer, Spiker, and Riedel (2009) argue that critical thinking is a “stimulus-bound phenomenon,” meaning that certain external task features may impact whether critical thinking is elicited in a given assessment context. The authors identify a number of context variables that affect one’s use of critical thinking. For example, stimulus characteristics focus on whether the stimuli present a set of materials that is orderly, well-organized, and coherent, or a set of materials that is uncertain, ambiguous, disorganized, and contradictory. In experimental studies that attempted to validate their model of critical thinking, Fischer et al. (2009) demonstrated that some contextual stimulus variables do seem to matter, whereas others do not. For example, the

level of substance of stimulus text—in terms of the number of unique propositions contained in that text—had no main effect on the subjects' propensity to use critical thinking, operationalized in this study as the number of questions of belief and checks on thinking observed during "think-aloud" procedures. However, the level of consistency, or lack of contradictions, within stimulus materials did have a main effect, with inconsistent or contradictory materials more likely to prompt critical thinking than consistent and coherent stimulus materials.

Moreover, Fischer et al. (2009) demonstrated that certain types of tasks are more likely to elicit critical thinking than others. For example, tasks requiring the exercise of judgment were better for assessing critical thinking than tasks focused on simply understanding material presented in stimulus text. In particular, a task requiring examinees to either accept or reject a manuscript for publication elicited more questions of belief and checks on thinking than a task asking examinees to identify the main topic of a set of materials or to explain a scientific study described in stimulus materials.

Moss and Koziol (1991) advocate for evaluating students on the basis of the quality of the arguments underlying their position, rather than the "correctness" of the answer. Lewis and Smith (1993) point out that assessment tasks must go beyond requiring simple recall of learned information. Rather, tasks should require students to manipulate what they learned in new or novel contexts. Another suggestion is that critical thinking assessments should make student reasoning visible. For example, Norris (1989) argues that testing validly for critical thinking requires that we observe an examinee's process of thinking. One recommendation for accomplishing this in the context of a multiple-choice test is to require students to provide a rationale or justification for their choice, an idea that was repeated by Kennedy et al. (1991).

Silva (2008) argued that new assessment modes are needed to measure higher-order skills, identifying several examples of recent critical thinking assessments that use novel item formats. For example, the College and Work Readiness Assessment (developed by the Council for Aid and the RAND Corporation) presents students with a 90-minute task and access to a variety of written materials on the topic, which typically represents a real-world problem. Students are then asked to make judgments and formulate a solution. River City Research Project (developed within Harvard's graduate school of education with National Science Foundation funding) is an assessment and instruction program that uses an interactive, virtual environment to present middle-school students with simulated, real-world problems that they must solve through the application of the scientific process: generating hypotheses, testing hypotheses, analyzing results, and drawing inferences and conclusions. Finally, PowerSource—developed by researchers at the National Center for Research on Evaluation, Standards & Student Testing (CRESST)—is a middle-school math assessment that combines higher-order thinking skills with mastery of basic math content in the form of narrative themes or graphic novels. Students are asked to apply math principles and to explain their reasoning.

Summary

Educators have long seen critical thinking as a desirable educational outcome. More recently, the Partnership for 21st Century Skills has identified critical thinking as one of several skills necessary to prepare students for post-secondary education and the workforce. Furthermore, the newly created Common Core State Standards reflect critical thinking skills. Although a concrete definition of critical thinking on which most researchers can agree remains elusive, common areas of overlap exist among the various approaches. Typically, critical thinking is believed to include the component skills of analyzing arguments, making inferences

by using inductive or deductive reasoning, judging or evaluating, and making decisions or solving problems. Background knowledge is believed to be a necessary, though not sufficient, condition for enabling critical thought within a given subject. Critical thinking entails cognitive skills, or abilities, and dispositions. These dispositions, which can be seen as attitudes, or habits of mind, include open- and fair-mindedness, inquisitiveness, flexibility, a propensity to seek reason, a desire to be well-informed, and a respect for and willingness to entertain diverse viewpoints. There appear to be both general and domain-specific aspects of critical thinking, which suggests two main conclusions. First, instruction should represent a fusion of preparation in general critical thinking principles, as well as practice in applying critical thinking skills within the context of specific domains. Second, transfer of critical thinking skills to new contexts is unlikely to occur unless students are specifically taught to transfer by sensitizing them to deep problem structures and are given adequate opportunities to rehearse critical thinking skills in a variety of domains.

Critical thinking skills relate to several other important student learning outcomes, such as metacognition, motivation, collaboration, and creativity. Metacognition (or thinking about thinking) supports critical thinking in that students who can monitor and evaluate their own thought processes are more likely to demonstrate high-quality thinking. In addition, the ability to critically evaluate one’s own arguments and reasoning is necessary for self-regulated learning. Motivation supports critical thinking in that students who are motivated to learn are more likely to persist at tasks that call for critical thinking. In turn, learning activities and assessment tasks that call for critical thinking may spark student motivation because they are more challenging, novel, or interesting. Students possessing critical thinking dispositions, such as willingness to consider diverse perspectives, may make better collaborators, and opportunities for collaboration

may promote higher-order thinking. Finally, creativity requires the ability to critically evaluate intellectual products, and critical thinking requires the open-mindedness and flexibility that is characteristic of creative thinking.

Although learning progressions of critical thinking skills and dispositions do not yet (and may never) exist, at least one researcher has tied the progression of critical thinking skills to cognitive development in general and metacognition in particular. Empirical research in the area of metacognition suggests that people begin developing critical thinking competencies at a very young age and continue to improve them (or not) over the course of a lifetime. Many adults exhibit deficient reasoning and fail to think critically. However, in theory, all people—from all intellectual ability levels and from the very young to the very old—can be taught to think critically. Empirical evidence suggests that children are, in fact, much more capable of critical thought than once predicted.

If teachers are to be successful in encouraging the development of critical thinking skills, explicit instruction in critical thinking needs to be included in the curriculum, whether that instruction occurs as a stand-alone course, is infused into subject-matter content, or both. Cooperative or collaborative learning methods hold promise as a way of stimulating cognitive development, along with constructivist approaches that place students at the center of the learning process. Teachers should model critical thinking in their instruction and provide concrete examples for illustrating abstract concepts that students will find salient.

Assessing critical thinking skills poses challenges that are similar to those in other measurement contexts. Standardized instruments that use multiple-choice items to measure limited aspects of critical thinking may meet reliability standards, but these standardized

instruments are vulnerable to criticisms of construct underrepresentation. Performance-based assessments (PBAs), which are seen as more valid representations of the construct, are susceptible to low reliability and a lack of generalizability across tasks when task development and administration cannot be standardized. When such standardization cannot be assured, PBAs should not be used to compare students to one another or to track student progress or growth over time. On the other hand, when PBAs are used for low-stakes, classroom assessment purposes, the need for strict standardization can be relaxed.

Educators are urged to use open-ended problem types and to consider learning activities and assessment tasks that make use of authentic, real-world problem contexts. In addition, critical thinking assessments should use ill-structured problems that require students to go beyond recalling or restating learned information and also require students to manipulate the information in new or novel contexts. Such ill-structured problems should also have more than one defensible solution and should provide adequate collateral materials to support multiple perspectives. Stimulus materials should attempt to embed contradictions or inconsistencies that are likely to activate critical thinking. Finally, such assessment tasks should make student reasoning visible by requiring students to provide evidence or logical arguments in support of judgments, choices, claims, or assertions.

References

Abrami, P. C., Bernard, R. M., Borokhovski, E., Wade, A., Surkes, M. A., Tamim, R., & Zhang, Dai. (2008). Instructional interventions affecting critical thinking skills and dispositions: A stage 1 meta-analysis. *Review of Educational Research, 78*(4), 1102–1134.

Bailin, S. (2002). Critical thinking and science education. *Science & Education, 11*(4), 361–375.

Bailin, S., Case, R., Coombs, J. R., & Daniels, L. B. (1999). Conceptualizing critical thinking. *Journal of Curriculum Studies, 31*(3), 285–302.

Bonk, C. J., & Smith, G. S. (1998). Alternative instructional strategies for creative and critical thinking in the accounting curriculum. *Journal of Accounting Education, 16*(2), 261–293.

Brown, A. L. (1990). Domain specific principles affect learning and transfer in children. *Cognitive Science, 14*, 107–133.

Case, R. (2005). Moving critical thinking to the main stage. *Education Canada, 45*(2), 45–49.

Cross, D. R., & Paris, S. G. (1988). Developmental and instructional analyses of children's metacognition and reading comprehension. *Journal of Educational Psychology, 80*(2), 131–142.

Dillenbourg, P., Baker, M., Blaye, A., & O'Malley, C. (1996). The evolution of research on collaborative learning. In E. Spada & P. Reiman (Eds.), *Learning in humans and machine: Towards an interdisciplinary learning science* (pp. 189–211). Oxford, England: Elsevier.

Ennis, R. H. (1985). A logical basis for measuring critical thinking skills. *Educational Leadership, 43*(2), 44–48.

Ennis, R. H. (1989). Critical thinking and subject specificity: Clarification and needed research. *Educational Researcher, 18*(3), 4–10.

Facione, P. A. (1990). *Critical thinking: A statement of expert consensus for purposes of educational assessment and instruction*. Millbrae, CA: The California Academic Press.

Facione, P. A. (2000). The disposition toward critical thinking: Its character, measurement, and relation to critical thinking skill. *Informal Logic, 20*(1), 61–84.

Fischer, S. C., Spiker, V. A., & Riedel, S. L. (2009). *Critical thinking training for army officers, volume 2: A model of critical thinking.* (Technical Report). Arlington, VA: U.S. Army Research Institute for the Behavioral and Social Sciences.

Flavell, J. H. (1979). Metacognition and cognitive monitoring: A new area of cognitive-developmental inquiry. *American Psychologist, 34*(10), 906–911.

Gellin, A. (2003). The effect of undergraduate student involvement on critical thinking: A meta-analysis of the literature 1991–2000. *Journal of College Student Development, 44*(6), 746–762.

Gelman, S. A., & Markman, E. M. (1986). Categories and induction in young children. *Cognition, 23*, 183–209.

Halonen, J. S. (1995). Demystifying critical thinking. *Teaching of Psychology, 22*(1), 75–81.

Halpern, D. F. (1998). Teaching critical thinking for transfer across domains: Dispositions, skills, structure training, and metacognitive monitoring. *American Psychologist, 53*(4), 449–455.

Halpern, D. F. (2001) Assessing the effectiveness of critical thinking instruction. *The Journal of General Education, 50*(4), 270–286.

Hennessey, M. G. (1999). *Probing the dimensions of metacognition: Implications for conceptual change teaching-learning*. Paper presented at the annual meeting of the National Association for Research in Science Teaching, Boston, MA.

Heyman, G. D. (2008). Children's critical thinking when learning from others. *Current Directions in Psychological Science, 17*(5), 344–347.

Heyman, G. D., & Legare, C. H. (2005). Children's evaluation of sources of information about traits. *Developmental Psychology, 41*(4), 636–647.

Jaswal, V. K., & Neely, L. A. (2006). Adults don't always know best: Preschoolers use past reliability over age when learning new words. *Psychological Science, 17*(9), 757–758.

Kennedy, M., Fisher, M. B., & Ennis, R. H. (1991). Critical thinking: Literature review and needed research. In L. Idol & B.F. Jones (Eds.), *Educational values and cognitive instruction: Implications for reform (pp. 11-40).* Hillsdale, New Jersey: Lawrence Erlbaum & Associates.

Koenig, M. A., & Harris, P. L. (2005). Preschoolers mistrust ignorant and inaccurate speakers. *Child Development, 76*(6), 1261–1277.

Ku, K. Y. (2009). Assessing students' critical thinking performance: Urging for measurements using multi-response format. *Thinking Skills and Creativity, 4*(2009), 70–76.

Kuhn, D. (1999). A developmental model of critical thinking. *Educational Researcher, 28*(2), 16–26.

Kuhn, D., & Dean, D. (2004). A bridge between cognitive psychology and educational practice. *Theory into Practice, 43*(4), 268–273.

Kuhn, D., & Pearsall, S. (1998). Relations between metastrategic knowledge and strategic performance. *Cognitive Development, 13*, 227–247.

Lewis, A., & Smith, D. (1993). Defining higher order thinking. *Theory into Practice, 32*(3), 131–137.

Lipman, M. (1988). Critical thinking—What can it be? *Educational Leadership, 46*(1), 38–43.

Lutz, D. J., & Keil, F. C. (2002). Early understanding of the division of cognitive labor. *Child Development, 73*(4), 1073–1084.

Martinez, M. E. (2006). What is metacognition? *Phi Delta Kappan, 87*(9), 696–699.

McPeck, J. E. (1990). Critical thinking and subject specificity: A reply to Ennis. *Educational Researcher, 19*(4), 10–12.

Moss, P. A., & Koziol, S. M. (1991). Investigating the validity of a locally developed critical thinking test. *Educational Measurement: Issues and Practice, 10*(3), 17–22.

Nelson, C. E. (1994). Critical thinking and collaborative learning. *New Directions for Teaching and Learning, 1994*(59), 45–58.

Nickerson, R. S. (1988). On improving thinking through instruction. *Review of Research in Education, 15*(1988–1989), 3–57.

Norris, S. P. (1989). Can we test validly for critical thinking? *Educational Researcher, 18*(9), 21-–26.

O'Hare, L. O., & McGuinness, C. (2009). Measuring critical thinking, intelligence, and academic performance in psychology undergraduates. *The Irish Journal of Psychology, 30*(3–4), 123–131.

Paul, R. W. (1992). Critical thinking: What, why, and how? *New Directions for Community Colleges, 1992*(77), 3–24.

Paul, R. W., & Elder, L. (2006). Critical thinking: The nature of critical and creative thought. *Journal of Developmental Education, 30*(2), 34–35.

Perkins, D. N., Allen, R., & Hafner, J. (1983). Difficulties in everyday reasoning. In W. Maxwell (Ed.), *Thinking: The frontier expands* (pp. 177–189). Hillsdale, New Jersey: Lawrence Erlbaum & Associates.

Pithers, R. T., & Soden, R. (2000). Critical thinking in education: A review. *Educational Research, 42*(3), 237–249.

Schraw, G., Crippen, K. J., & Hartley, K. (2006). Promoting self-regulation in science education: Metacognition as part of a broader perspective on learning. *Research in Science Education, 36* (1-2), 111–139.

Silva, E. (2008). *Measuring Skills for the 21st Century* [Report]. Washington, DC: Education Sector. Retrieved from http://www.educationsector.org/usr_doc/MeasuringSkills.pdf.

Sternberg, R. J. (1986). *Critical thinking: Its nature, measurement, and improvement* National Institute of Education. Retrieved from http://eric.ed.gov/PDFS/ED272882.pdf.

Stipek, D. J. (1996). Motivation and instruction. In D. C. Berliner & R. C. Calfee, (Eds.), *Handbook of Educational Psychology* (pp. 85–113). New York, NY: Macmillan.

Thayer-Bacon, B. J. (2000). *Transforming critical thinking: Thinking constructively*. New York, NY: Teachers College Press.

Tindal, G., & Nolet, V. (1995). Curriculum-based measurement in middle and high schools: Critical thinking skills in content areas. *Focus on Exceptional Children, 27*(7), 1–22.

Turner, J. C. (1995). The influence of classroom contexts on young children's motivation for literacy. *Reading Research Quarterly, 30*(3), 410–441.

Van Gelder, T. (2005). Teaching critical thinking: Some lessons from cognitive science. *College Teaching, 53*(1), 41–48.

Willingham, D. T. (2007). Critical thinking: Why is it so hard to teach? *American Educator,* 8–19.