

## Critical Thinking across the Curriculum: Process over Output

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### Abstract

*Critical thinking is the most valuable skill that schools can bequeath to their graduates. Teaching for critical thinking has always been a learning goal for teachers across all disciplines and levels. However, this outcome is not always accomplished. Critical thinking competence requires a philosophical shift from output to process, learning to thinking and subject isolation to subject integration. As a framework for understanding critical thinking across the curriculum, this article reviews traditional and contemporary theories that are relevant to this process, explores the nature of critical thinking and analyzes approaches to instruction and assessment that teachers may use to foster critical thinking. The analysis is supported by descriptions of pedagogical practices that have been used to motivate students to engage in the processes that characterize critical thinking.*

**Key words:** critical thinking, curriculum, inquiry, problem-solving, process, cognitive, theory

### Introduction

Globally, twenty first century governments and industries are seeking to grow their economies by identifying alternate sources of energy, improved products, creating new business and technological solutions, and finding quicker and more efficient ways to communicate. Schools are charged to respond to these and other societal needs. To do so, schools must re-think their focus and develop and implement curricula that will produce the necessary human capital to identify viable solutions for these needs (Shah, 2010.) Critical thinking is the most important skill for problem solving, inquiry and discovery. It is the systematic approach of skillfully evaluating information to arrive at the most feasible solution to a variety of structured and ill-structured problems (Laxman, 2010; Shah, 2010; Winch 2006). Yet teaching does not always result in this outcome. In fact research (Paul, Elder & Bartell, 1997) reveals that many teachers who include promotion of critical thinking skills as a learning outcome for their teaching could not define the construct nor distinguish between critical thinking and content coverage.

Teaching for critical thinking competence necessitates a philosophical shift in focus from learning to thinking (Chun, 2010), drill and practice to problem-based learning (Savery, 2009), subject isolation to subject integration, output to process, what is convenient to what is needed, and now to the future (Peddiwell, 1939). This paper presents multiple definitions for critical thinking so that this often abstract cognitive ability may appear less obscure to readers. It also discusses traditional and contemporary theories as they relate to critical thinking and information processing. Since this paper is intended for readers to improve teaching competencies and learner outcomes, the author has described some research-based approaches and strategies that have been successfully used to develop critical thinking competencies.

### Critical Thinking defined

Researchers have offered many definitions and ideas regarding the characteristics of critical thinking, the disposition of critical thinkers, as well as teacher and student behaviors that indicate some deficiency in good thinking (Lipman, 2003; Zhang, 2003, Pithers & Soden, 2000). Perhaps providing concrete ways of exemplifying critical thinking may make this process of inquiry less abstract to many educators. Lipman (2003) maintains that critical thinking relies on criteria, is self correcting, sensitive to context, and provides intellectual empowerment. “Critical thinking in any area involves being able to pursue one’s questions through self-directed search and interrogation of knowledge, a sense that knowledge is contestable, and being able to present evidence to support ones’ arguments” (Pithers & Soden, 2000 p. 239). This thinking can be applied in all disciplines by posing searching questions, directing students to conduct independent research, encouraging them to question or challenge assertions, and then present their own fact-supported positions. Meanwhile Zhang (2003) provides insight into the nature of critical thinking by identifying specific character traits or dispositions of critical thinkers.

According to Zhang (2003) “The ideal *critical* thinker is habitually inquisitive, well-informed, trustful of reason, open-minded, flexible, fair-minded in evaluation, honest in facing personal biases, prudent in making judgments, willing to reconsider, clear about issues, orderly in complex matters, diligent in seeking relevant

information, reasonable in the selection of criteria, focused in inquiry, and persistent in seeking results which are as precise as the subject and the circumstances the inquiry permit.” (p. 1). Further, as analytical beings critical thinkers are cognizant of potential barriers and difficulties and are always prepared to identify solutions to these problems. In doing so they are systematic and methodical in their approaches to solving problems.

Finally critical thinkers are intellectually curious. As mature individuals they realize that some situations require multiple approaches and that there are some questions for which there are no definite answers. Certainly, supporting students to develop the disposition of critical thinkers requires changes in pedagogy. Now that we have a clearer picture of what critical thinking is it may be imperative for us to re-examine our curricula to determine their effectiveness in stimulating critical thinking among our students. In the same vein we should reflect on our own practices to decide on the extent to which we model good thinking. It may also be useful for us to observe our students more carefully so that we may identify for diagnostic purposes, behaviors, and attitudes that allow us to make some judgment about the quality of their thinking. For example do students’ cues suggest that we should allow more time to invite questions, make connections or add new information? As teachers facilitate the development of problem solving skills, students must be taught more advanced information-gathering skills that will equip them to unearth the correct resources that are needed to solve complex problems.

### ***Theories that Support Critical Thinking***

Critical thinking has always been a goal of instruction and assessment. This cognitive skill has been buttressed by traditional theories including progressivism and idealism and more contemporary ones such as cognitive information processing and Bloom’s Taxonomy (Bloom, 1976). Since the decade following World War II, critical thinking has been promoted under the aegis of the progressive movement. The term encompassed problem solving, scientific inquiry, active learning, subject integration and self discipline (Dunn, 2005; Cross, 2004; Ornstein & Hunkins, 2004). Generally, the theory emphasizes how to think rather than what to think (Ozman & Craver, 2008; Tyler, 1949). John Dewey, a leading progressive thinker highlights the role of teachers in problem solving and inquiry (Tyler, 1949). As facilitators, teachers should support students to locate, analyze, interpret, and evaluate data. In fact several approaches to curriculum; including child-centered, activity-centered, and creative curricula have emerged from the progressive movement (Ozman & Craver, 2008; Dunn, 2005). The underlying tenets of progressivism and its hybrids have implications for the attitudes and skills that students must develop to contribute to an increasingly complex society.

Like progressives, idealists emphasize the mind over matter. They perceive people as thinking beings who read, ponder and write about the work of others for the purpose of improving the way they think as well as the quality of their ideas (Ozman & Craver, 2008). While not discrediting routine functions such as reading the newspaper or Internet news, idealists maintain that merely reading about the events does not help to comprehend what is happening in the world. They suggest that the reading be expanded to exploring why the events that are written about happen, to develop a deeper understanding of the problem (Ozman & Craver, 2008). As educators, the teachings of progressivism and idealism prompt us to reflect on whether we perceive this level of investigation in our disciplines as productive or do we delay these questions for the higher grades, or college or reserve them for gifted students? Training students to think should begin from the earlier grades. Too often students resist critical thinking exercises or perceive them as being difficult because they had not been socialized to probe, question, and analyze until the intermediate grades. Idealists are advocates of studies that provide depth. They do not subscribe to the view that things should be studied because they are new or available. Instead, idealists argue that practically any contemporary problem has its roots in the past.

This theory also promotes holistic learning or looking at the big picture rather than treating subjects as a disjointed collection of units. In practice a curriculum that is deep is more effective at facilitating quality thinking than one with a variety of under-developed topics. Additionally, examination of the past provides opportunities for students to analyze trends and therefore develop a better understanding of the current. They also have sufficient knowledge that will allow them to predict with reasonable accuracy what is likely to happen in the future. In a global society where industries are seeking to refine their operations, and create new products based on the anticipated need of more discriminating clients, equipping children for these functions has become more paramount. The more contemporary Cognitive Information Processing theory is also useful in helping educators to understand how students interact with information. Consequently, application of this theory may equip teachers to guide students to unpack, retrieve, and make meaning from new information.

Cognitive Information Processing theory is primarily linked to memory. Since memory is a pre-condition for more complex cognitive functions such as comprehension, analysis, and synthesis, this theory is worth exploring. Cognitive and information processing theorists believe that information progresses through a parallel series of units; the sensory register, short-term store or temporary working memory, and long-term or permanent store (Atkinson & Shiffrin, 1968). Meanwhile Baddeley (2007) argues that the assumption that retaining information in the short-term memory is adequate for the information to be transferred to the long-term store is inconclusive ( Craik & Watkins, 1973; Tzeng, 1973; Bjork & Whitten, 1974). Likewise holding information longer or increasing the probability for transfer may not necessarily lead to improved learning. More importantly, the depth and richness of how the material was encoded is a more powerful predictor for learning than the length of time for which the material was stored in the short term memory (Baddeley, 2007). The author's observation suggests that instruction that emphasizes rote learning, repetition, recall, and other forms of short term memory retrieval strategies may be less effective at promoting meaningful learning than instruction that incorporates ways of manipulating existing information such as using it to create a new product or verifying a hypothesis. Therefore while iconic representations and recall of basic information from short-term memory are important, using the information to identify solutions to problems and apply it in a new context is a feature of critical thinking that should be a learning outcome of every teaching episode.

Another variable that may be considered is students' cognitive readiness for tasks that involve abstract and deductive reasoning (Cotter & Tally, 2009). There is evidence (Byrnes 1988; Kuhn, Langer, Kohl & Haan, 1977) that formal operational thought may be underdeveloped even when young adulthood is reached. Consequently efforts to promote critical thinking skills may be unsuccessful if the cognitive apparatus is absent. However, since most children are born with natural curiosity, early introduction to learning and the environment should train them to explore, question, and problem-solve in informal learning settings. Children who have been immersed in learning climates of discovery are likely to enter college more cognitively-ready for critical thinking. With regard to mental processes, the widely-accepted Benjamin Bloom's taxonomy of the cognitive domain is a framework that is applied across all levels and disciplines to allow students to utilize a combination of lower and higher order thinking skills for instructional and assessment tasks. Central to the appropriate application of this taxonomy is teachers' questioning technique (Bucy, 2006; Caram & Davis, 2005). Research indicates that many teachers consistently pose patterns or sets of question that require students to merely memorize and recall factual information (Parker, 2009). While recollection of facts is a prerequisite for more complex cognitive functions, critical and analytic thinking is fostered when students are encouraged to frequently interpret, analyze, evaluate or synthesize. It is expedient to do something further with the retrieved information (Chiarelott, Davidman, Ryan, 1990).

Conversely, Lemov (2010) believes that memorization and learning of fundamental skills are crucial to critical thinking functions. "The more proficient you are at lower order skills, the more proficient you can become at higher order skills" (p.19). The logic is that automatic computation will result in cognitive or mental energy being reserved for identifying ways to solve complex problems. Although traditional and contemporary theories have provided a base for teaching for critical thinking, many schools are still graduating students who are ill-equipped to problem-solve. This may be due to a variety of factors including; how teachers interpret critical thinking (Jones, 2004, Kennedy, 1991), their feeling of self-efficacy to support students to develop problem solving competencies (Wheatley, 2002, Goddard & Goddard, 2001), the students' own self-efficacy regarding their critical thinking abilities (Caliskan 2010; Zimmerman, 2000; Bandura, 1993), students' inadequate information-searching skills (Laxman, 2010), and teachers' preference for more behaviorist than constructivist approaches to teaching.

### ***Embedding Critical Thinking in Curriculum***

Universally, learning goals of elementary, secondary, and tertiary education curricula emphasize the development of critically thinking. However, there seems to be inconsistencies in how the learning goals are interpreted. Students will speak, read, write, and listen for understanding is a goal for the teaching of English and Language Arts. One teacher may interpret this standard by using separate lessons to support students to master each skill. Another may integrate all the skills in one lesson or unit. Teachers may choose to reinforce the relationship between reading and writing by combining these outcomes in a student-driven assessment task. Although these are acceptable approaches for teaching reading and writing, the selected book and other resources and the criteria that teachers set for the different tasks will determine the rigor and quality of thinking that students apply when they perform the different functions. Indeed, teachers of all subjects and at all levels should teach with an eye toward critical thinking. However, sometimes this purpose is affected by a lack of clarity or understanding regarding what is critical thinking (Kennedy 1991). Jones (2004) explains the ambiguity this way. "Critical thinking as part of the academic discourse is internalized by those within the discourse and yet almost impossible to explicate" (Jones, 2004, p. 179).

There are various ways to teach critical thinking as well as embed it across the curriculum. As a process, it is the “intellectual process of actively conceptualizing, applying, analyzing, synthesizing and or evaluating information gathered from, or generated by observation, experience, reflection, reasoning or communication, as a guide to belief and action”(Center for Critical Thinking, 2004).

### ***Single Subject versus Infusion***

Educators’ approach to teaching critical thinking may depend on whether they view the process as a singular subject-specific discipline or a construct to be embedded or infused in other areas (Davies, 2006). This author concurs with (Davies, 2006) that critical thinking as a discipline is useful for educators to itemize for distinction, the steps and processes that characterize the process (Ikuenobe, 2001). “If you want to think well you must understand the rudiments of thought or the most basic structure out of which thinking is made.” These are; question at issue, information, interpretation and inference, concepts, assumptions, implications and consequences and point of view (Center for Critical Thinking, 2011). Ikuenobe (2001) concurs that learners should understand concepts of arguments, identify statements from non-statements, explain different kinds of evidential and inferential relationships as well as the underlying principle of each argument. They should also demonstrate the ability to analyze a range of arguments using Venn Diagrams or other appropriate graphic organizers. The Venn Diagram is useful in mapping the argument’s logic or specifically its reason, believability and consistency (Ramsay et.al. 2009).

Interestingly critical thinking as a process is linked to the constructivist mode of teaching and learning. However, Ikuenobe’s (2001) clear and hierarchical outcome statements serve as instructional guides for teaching critical thinking. The step by step process mirrors behaviorism. This indicates that a blend of teacher-centered and student-centered instruction is useful in teaching even a skill which to many, may seem abstract and complex. The approach that is described above may be applied either to teaching critical thinking as a subject or infusing or integrating generalist skills across disciplines. Solon (2001), one of the first researchers to design a controlled study to find out how best to teach critical thinking, conducted two studies with fairly homogenous groups of students. The three groups of students were taught critical thinking skills using three different models; general critical thinking instruction, general critical thinking instruction within a psychology course and a rhetoric class minus a critical thinking component. Of the three groups, the group that received general critical thinking instruction made the greatest gain in critical thinking.

The results of this study have implications for how critical thinking should be taught. While critical thinking should be embedded in every course, Solon’s (2001) study suggests that college students are likely to benefit when they enroll in a course that teaches critical thinking independently of other disciplines. It is imperative to use a cross-curricular approach to foster critical thinking among students at all levels. Additionally, teachers have the ethical responsibility to teach from multiple perspectives. They should also emphasize particular forms of reasoning within their disciplines and cite examples of how these forms of reasoning can be applied within and outside the discipline (Jones, 2004; Pithers & Soden, 2000). The development of critical thinking skills cannot be adequately addressed by individual subjects, courses or faculty. Yet rarely do individual subjects explicitly assess critical thinking skills that result from institution-wide efforts (Chun, 2010). Adapting a multidisciplinary approach to teaching requires teachers to broaden their knowledge base about specific topics. To foster this intellectual climate requires a shift from what is convenient to what is needed.

### ***Reading and Writing across the Curriculum***

Ramsay et al. (2009) supports infusing critical thinking with reading and writing across disciplines. For decades these teacher-scholars have successfully embedded critical thinking in reading and writing across the post-secondary curriculum in a university first year course. The course is developed around the premise that reading and writing are intertwined and both processes are manifestations of how college students interpret, process, and communicate information. Therefore it is imperative that first year college students constantly practice the meta-cognitive processes of reading and writing texts from various genres and discourse types from an array of disciplines (Ramsay et al., 2009). Students who have had this experience become adept at reading, writing, and speaking. They appreciate the dynamism of the process and making mental shifts as they read and write to fit their purpose, audience and context. They also develop the ability to analyze readings in and outside their disciplines. Generally they become better critical thinkers than post-secondary students who have not had this or similar experiences.

### ***Questioning***

Effective questioning is one of the most useful strategies that teachers can use to promote critical thinking. Good questions are those that guide thinking and encourage students to interpret, analyze, synthesize, critique, and reflect.

However for some, questioning is seen as being suspicious about the veracity or validity of their claim or viewpoint. Even Socrates, the father of questioning was despised for constantly raising probing questions. Nevertheless, questioning has been accepted among educators as an open-ended process of inquiry and a function of critical thinking (Ikuenobe, 2001). Therefore, teachers should develop the skills to spontaneously raise and respond to good questions since they are likely to nourish students' intellect (Shaunessy, 2005).

### **Student Engagement**

Teachers should resist their compulsion to tell and instead opt for strategies that engage students in ways that are both hands-on and minds-on (Wiggings & McTighe, 2005). During a lesson to reinforce the use of inquiry in social studies, a group of elementary education majors explored, *what caused Titanic to sink?* students watched a video clip from a movie to stimulate their interest and activate background knowledge. Students then recorded their hypotheses on chart paper. After reading more about the topic from a variety of sources including newspaper articles, non-fiction literature about the ship's design, the lifestyle of the captains and passengers on the luxury carrier, as well as information about the weather at the time of Titanic's maiden voyage, the students revised their hypotheses then wrote concluding statements based on the new information (Parker, 2009).

This lesson guided students through the process of thinking like researchers. Participating in this activity helped them to appreciate the importance of not jumping to conclusions (Parker, 2009). Role play is commonly applied in problem-based learning (Savery, 2009). Although problem-based learning is primarily used in the teaching of science and technology, students may also be encouraged to assume the role of linguists, paleontologists, cartographers, meteorologists, and archeologists to motivate them to unearth information that explains unfamiliar ideas. For the primary grades, teachers can make the simulations more realistic by allowing students to wear protective clothing and gadgets that are characteristic of these roles. For example an oversized white T-shirt cut open down the middle can be worn as lab coats. In addition to protecting their clothing students may be more motivated to "explore." "To encourage active engagement, teachers must design authentic tasks that reflect the complexity of the environment." (Mandernach, 2006, p. 4). A classroom culture that fosters inquiry is likely to nurture students to become intellectually curious.

### **Assessing critical thinking**

As teachers shift the pendulum from learning to thinking, they should select both formal and informal assessment tasks that enable students to apply problem-solving processes and other dimensions of critical thinking. The assignments should incorporate real-world scenarios such as devising a business plan to generate more income for local communities, research to explore the feasibility of operating a campus shuttle service, create artistic works for auction to support a local charity, manufacture an organic household product, write the script and perform a play based on a novel that was studied in class, and make a virtual field trip to a region that is studied in geography or social studies. Undoubtedly, by completing these projects students must plan around a time frame, gather information, collaborate, and consider feasible alternatives or trouble shoot when they encounter hurdles.

However, this does not suggest that a traditional pen and paper task would not require students to be intellectually challenged. Certainly a paper that requires students to annotate, outline, summarize, synthesize, contextualize, explore the use of figurative language, identify patterns of opposition and evaluate the logic of arguments before taking a reasoned perspective and arriving at a conclusion will engage students in similar critical thinking processes (Jonassen, 2010; Ramsey et al., 2009; Ikuenobe 2001). In addition to projects and written papers, verbal techniques such as argumentation, is an excellent way for students to demonstrate their ability to think critically. According to Jonassen (2010) argumentation is valued for its role in facilitating conceptual change particularly for less structured problems. That is, learners alter their comprehension or "adjust their frames of reference to accommodate new perspectives" (Jonassen, 2010, p. 440). Above all, a holistic approach to teaching for critical thinking should involve a set of appropriate goal-oriented assessment tasks that enable students to manipulate cognitive skills.

### **Using Visuals to Unpack Information**

De Bono (1999) in his work *Six Thinking Hats* offers an interesting approach to training students to dissect information and analyze it from different angles. De Bono (1999) suggests that teachers use a meta-cognitive and simulated approach to encourage thinking. The author recommends that teachers allow their students to wear hats of specific colors. Each color hat should be symbolic to a range of analyses including emotion, objectivity, critique, problem solving, and creativity. In applying De Bono's (1999) strategy, teachers should assign groups and pose focus questions that relate to the thinking that the colored hat represents.

Some common themes are white hat representing objective thinking about facts and figures, red symbolic of intuitive feelings and emotions, yellow indicative of the viability of suggestions, black denoting the feasibility of a plan, green a cue for exploring alternate ideas and blue alerting thinkers to develop an action plan. Clearly these components of thinking are separated for focus. However students will realize that to adequately address their assigned questions they must consider the ideas of wearers of other hats—a process that necessitates consultation. This activity should help students to understand more deeply, the multi-dimensional approach that good thinking requires. Additionally since it is worn on the part of the body that houses the brain, it is an appropriate metaphor for the process of thinking. More importantly, if they adapt the “colored hat” approach to analyzing situations, over time the quality of their thinking is likely to improve and they may begin to acquire the dispositions of critical thinkers.

### **Conclusion**

As part of their professional development teachers may examine more closely how they implement curricula or interpret educational standards and program goals and collaboratively agree on the applicability of critical thinking in and across their disciplines. In doing so, educators should adapt a good blend of teacher-centered and student-centered learning, focus on process rather than output, thinking rather than learning, what is needed rather than what is convenient and examine what happened in the past, how it affects what is occurring now as a basis for predicting what will be needed in the future. With this approach to curricula, students may be more likely to appreciate and develop the characteristics of critical thinkers equipped to function in and contribute to the development of a dynamic global society

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