

Developing Critical and Creative Thinkers

Editor's Note: Combs, L. B., Cennamo, K. S., & Newbill, P. L. (2009). Developing Critical and Creative Thinkers: Toward a Conceptual Model of Creative and Critical Thinking Processes. *Educational Technology*, 49(5), 3-14.

Critical and creative thinking skills are essential for students who plan to work and excel in the 21st-century workforce. This goal of the project reported in this article was to define critical and creative thinking in a way that would be useful for classroom teachers charged with developing such skills in their students. To accomplish their goals, the authors conducted an extensive literature review to distill critical and creative thinking skills into teachable components. Based on their findings, the authors developed a model of critical and creative thinking that is accompanied by a table of skills, objectives, and references. Future work will involve developing instructional materials and training teachers in critical and creative thinking skills for use in their classrooms.

Developing Critical and Creative Thinkers

If we think about a major goal of schooling as preparation for the world of work, “we need to be concerned about whether schooling requires and develops creative thinking, because for [students] to stay competitive in most jobs, it is and will be necessary for them to come up with their own ideas” (Sternberg & Spear-Swerling, 1996, p. 8). However, in their study of student abilities, Sternberg and Spear-Swerling concluded that while the students were “excellent at remembering and analyzing other people’s ideas, [they were] not very good at coming up with ideas of their own” (p. 8). In a recent report on skills of the American workforce, the National Center on Education and the Economy (NCEE) stressed the importance of students gaining skills beyond mere content knowledge. They state:

...strong skills in English, mathematics, technology, and science, as well as literature, history, and the arts will be essential for many; beyond this, candidates will have to be comfortable with ideas and abstractions, good at both analysis and synthesis, creative and innovative, self-disciplined and well organized, able to learn very quickly and work well as a member of a team and have the flexibility to adapt quickly to frequent changes in the labor markets as the shifts in the economy become ever faster and more dramatic. (NCEE, 2007, pp. xxiv-xxv)

Thus, the challenge among schools is to develop within students the ability to engage as 21st century thinkers.

To meet this challenge, critical thinking and creative thinking have surfaced as essential skills for all students, regardless of level or ability, to possess in order to position them to address the complex needs of the 21st century. These priorities are evidenced in changing educational standards, such as those defined by the International Society for Technology in Education (ISTE). The new, revised version of the National Educational Technology Standards (NETS) for students, teachers, and administrators “define what students need to know and be able to do with technology to learn effectively and live productively in an increasingly digital world” (ISTE, 2003a, inset). As such, the National Educational Technology Standards for Students emphasize (1) creativity and innovation; (2) communication and collaboration; (3) research and information fluency; (4) critical thinking, problem-solving, and decision-making; (5) digital citizenship; and (6) technology operations and concepts (ISTE, 2003a, inset). These standards are quite different than those established in 1998, which had an emphasis on (1) basic operations and concepts; (2) social, ethical, and human issues; (3)

technology productivity tools; (4) technology communication tools; (5) technology research tools; and (6) technology problem-solving and decision-making tools (ISTE, 2003b, paragraph 1).

In comparing the two versions of the technology standards, it is clear that the shift has been made from simply teaching students how to operate technology to using technology to encourage problem-solving, innovation, and collaboration. But how do we develop students who are critical and creative thinkers, able to

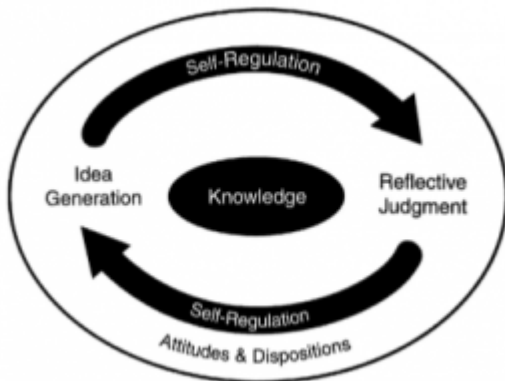


Figure 1. Conceptual model of critical and creative thinking processes.

meet the challenges of 21st century thinking, learning, and doing?

To reach these goals, we began with an extensive review of over 200 research articles and books written on critical thinking and creativity. As we reviewed the literature, we found that critical thinking and creativity were often defined and explained as complicated or vague concepts. For example, we understood that to be creative, one must be clever; but what does it mean to be clever, and how can you teach someone to be clever? If we simply listed clever as a characteristic of a critical and creative thinker, what could an educator do with that information? Recognizing this issue, the goal of our research is to *practically define critical and creative thinking by identifying a set of specific skills that contribute to such thinking and are teachable within any classroom*. Further, we set out to develop a set of instructional guidelines to help teachers transition their classrooms into ones that foster the development of critical and creative thinking skills among all their students.

Initially, we sought to review the literature on critical thinking and creativity separately; however, we soon recognized that there was a great deal of overlap in the skills required to be critical and creative thinkers and thus it began to make sense to combine the two skill sets into one comprehensive model. Whereas creativity is often defined as the generation of numerous original ideas, we recognize that creative thought involves the selection of appropriate ideas to move forward. Further, critical thinking is often thought of as the analysis, synthesis, and evaluation of ideas; however, critical thinking also involves the generation of ideas (Marzano *et al.*, 1988). So although critical thinking may emphasize the skills of reflective judgment, it involves idea generation as well. And although creative thinking may emphasize the generation of multiple original ideas, it involves reflective judgment as well as idea generation.

Through our year-long, team-wide review, analysis, and synthesis of literature, we were able to recognize recurring themes which led to a tentative conceptual model of the critical and creative thinking process. As we developed our conceptual model, we kept in mind our goals and target audience. With public educators as our focus, we felt strongly that we needed to represent each of these components as teachable skills. Thus, we developed a list of supporting skills and objectives that can be incorporated into any lesson plan or curriculum.

A Model of Critical and Creative Thinking

We have come to recognize that critical and creative thinking is an integrated process that involves the generation and refinement of ideas around a core of knowledge. The idea generation and refinement processes are monitored and controlled by self-regulatory behaviors that involve goal-setting as well as monitoring the obtainment of those goals, all while maintaining the necessary attitudes and dispositions. As Figure 1 illustrates, the relationship between these processes is in no way linear. The continuous, reciprocal relationship between *Idea Generation* and *Reflective Judgment* shows that there is no specific beginning or end to the thinking process. As ideas are generated, thinkers work with what they know and/or want to know to refine their ideas until they have something of value and worth. The movement between generating and refining ideas involves thinkers using analytical and evaluative measures to focus their understanding of the content and developing an outcome that most clearly and comprehensively addresses the identified problem or need.

As the thinker works to generate and refine knowledge, it is vital that he or she remains in control of both behavior and commitment to a task. The *Self-Regulation* component of the critical and creative thinking process ensures that the thinker remains active in the thinking and learning process, while monitoring progress toward identified goals. A critical component that encompasses all other processes is the exhibition of appropriate *Attitudes and Dispositions*. Sometimes referred to as learner characteristics, the essential attitudes and dispositions of motivation, flexibility, and confidence have been shown to be necessary for the development of and continuous involvement in critical and creative thinking (Black, 2005; Marzano, 1993; Rath, Wassermann, Jonas, & Rothstein, 1986). Each of the essential components of *Idea Generation*, *Reflective Judgment*, *Self-Regulation*, and *Attitudes and Dispositions*, as well as the accompanying instructional guidelines, is elaborated on below.

Idea Generation

A key process of critical and creative thinking, is that of idea generation. Black (2005) refers to this as productive thinking, where the thinker engages in activities encouraging the divergent process of taking previously acquired knowledge, simple ideas, and new information, and transforming those ideas into something that can be applied to a new situation or problem. The process of idea generation is supported by thinkers exhibiting skills such as fluency of ideas, originality of thought, and flexibility in thinking (see Table 1).

Fluent or prolific thinking refers to the thinkers' ability to generate a multitude of ideas and concepts. This skill can be encouraged and strengthened through activities involving brainstorming and conceptualization of ideas. *Brainstorming* allows students time to define and record as many possible solutions or ideas related to a topic as possible, while *conceptualizing* involves the use of a variety of methods to verbalize or represent ideas. Conceptualizing could include 2D and 3D representations, verbal or symbolic conceptualization, movement, or other forms of representation relevant to the context.

In addition to generating a multitude of ideas, thinkers must also generate ideas that are unique and novel. As such, key skills of the idea generation process of critical and creative thinking are producing ideas that are *original* and *flexible*. The concept of originality is demonstrated through the generation of ideas that are different, innovative, and unique. In order for a thinker to engage in the process of generating original ideas, he or she must also possess the ability to remain flexible and open-minded (Elder & Paul, 2002; Marzano *et al.*, 1988; Meyers, 1986; Sternberg & Baron, 1985). Flexibility, in this case, involves the thinkers' ability to think beyond the scope of what is already known and apparent and begin to develop their own ideas through consideration of other perspectives and methods of analysis. In being flexible, thinkers not only consider multiple perspectives, but use those perspectives as they develop their own arguments.

Original and flexible work can be accomplished through activities that encourage thinkers to generate ideas both by considering existing ideas and by establishing relationships among previously and newly acquired concepts. In order to determine these relationships, critical and creative thinkers engage in *exploring*, *thinking through analogies* and

metaphors, examining ideas in new ways, observing, elaborating, inferring, extrapolating, and generating remote associations.

Table 1 presents associated learning objectives that expand on each concept and lists the references on which we based our conclusions.

Reflective Judgment

In the reflective judgment component of critical and creative thinking, thinkers move through a convergent process of evaluating ideas and selecting a structured plan or solution based on the multitude of previously generated ideas. As they engage in reflective judgment, thinkers not only evaluate and select ideas from those generated through personal knowledge and experience, but also in the consideration of ideas gained through analysis and evaluation of other thinkers' ideas and resources. By combining such ideas, thinkers will determine the best and most feasible plan to pursue.

As shown in Table 2, the primary skills involved in reflective judgment are *analysis*, *synthesis*, and *evaluation*. As thinkers analyze knowledge and information, they work to break down information to determine relationships among elemental parts. This analytical process helps the thinker to develop the idea or concept, and occurs through activities involving *questioning* to seek clarity, *separating* information into relevant and irrelevant components, and *relating* to determine how ideas are associated.

Once relationships are determined, thinkers work to synthesize the information in order to draw conclusions. The synthesis process occurs through activities involving *organizing* information based on connections, *interpreting* to draw meaning from information, *summarizing* through combining information, and/or *generating hypotheses* that can be tested or used for explanatory purposes. For thinkers to express themselves at this point, they also engage in a process of *composing* which involves creating some form of visual or auditory representation of the information. This practice of composition helps thinkers support and justify their synthesis of information and increases the validity of their thoughts and ideas.

Table 1. Key skills and objectives of generating ideas.

Skill	Activity	Objective	References
Fluent	Brainstorming	Students will generate as many solutions or ideas related to a topic as possible within a given amount of time.	DeBono, 1985; Guilford, 1959, 1987; Isaksen & Gaulin, 2005; Jablin & Seibold, 1978; Osborn, 1963; Starko, 2005; Weisberg, 1999; Williams, 1970
	Conceptualizing	Students will verbalize or represent ideas using 2D and 3D representations, movement, or other forms relevant to the context.	Lubart, 2001; Starko, 2005; Torrance, 1962
Original and Flexible	Exploring	Students will explore a challenge using a variety of raw materials, stimuli, and experiences.	Piirto, 2004; Starko, 2005; Tardif & Sternberg, 1988; Torrance, 1962; Williams, 1970
	Analogical Thinking	Students will make associations and identify comparative relationships between two or more objects or ideas.	Black, 2005; Elder & Paul, 1996a, 1996b; Finke, Ward, & Smith, 1992; Guilford, 1987; Lubart, 2001; Marzano & Arrendondo, 1986; Partnership for 21st Century Skills, 2004; Raths <i>et al.</i> , 1986; Sternberg & Baron, 1985
	Metaphorical Thinking	Students will identify words or phrases that are symbolic or	Barron & Harrington, 1981; Black, 2005; Elder & Paul, 1996a, 1996b; Lubart, 2001; Partnership for

		representative of other ideas to which they are not literally applicable.	21st Century Skills, 2004; Raths <i>et al.</i> , 1986; Sawyer, 2006; Starko, 2005; Sternberg & Baron, 1985; Sternberg & Lubart, 1996; Tardif & Sternberg, 1988
	Examining ideas in new and varied ways	Students will engage in activities that provide others' perspectives on a challenge.	DeBono, 1985; Lubart, 2001; Starko, 2005; Wertheimer, 1938; Williams, 1970
	Observing	Students will observe things related to the challenge closely to identify details, procedures, and methods.	Raths <i>et al.</i> , 1986
	Elaborating	Students will develop ideas and information that expand on what is explicitly given.	Black, 2005; Bransford & Vye, 1989; Elder & Paul, 1997; Guilford, 1959; Lubart, 2001; Marzano & Arrendondo, 1986; Raths <i>et al.</i> , 1986; Resnick & Klopfer, 1989; Sternberg & Baron, 1985
	Inferring	Students will draw conclusions not explicitly stated based on evidence and reasoning.	Black, 2005; Elder & Paul, 2002; Marzano & Arrendondo, 1986; Marzano <i>et al.</i> , 1988; Paul & Elder, 2004; Raths <i>et al.</i> , 1986; Sternberg & Baron, 1985; Williams, 1970
	Extrapolating	Students will transfer knowledge of one topic to another.	Marzano & Arrendondo, 1986
	Remote Associating	Students will identify novel relationships among unrelated ideas.	Finke <i>et al.</i> , 1992; Guilford, 1959, 1987; Lubart, 2001; Williams, 1970

Table 2. Key skills and objectives of reflective judgment.

Skill	Activity	Objective	References
Analysis	Questioning	Students will identify missing or unclear information and ask questions to seek clarity.	Black, 2005; Elder & Paul, 1996a, 1996b, 2002; Halpern, 2007; Lemelson Center, 2007; Marzano <i>et al.</i> , 1988; Meyers, 1986; Partnership for 21st Century Skills, 2004; Paul & Elder, 2004; Starko, 2005; Sternberg, 2000; Sternberg & Spear-Swerlin, 1996; Williams, 1970
	Separating	Students will discard ideas that are not relevant to the context.	Finke <i>et al.</i> , 1992; Guilford, 1950, 1987; Lubart, 2001; Raths <i>et al.</i> , 1986; Sternberg & Baron, 1985; Sternberg & Spear-Swerling, 1996; Williams, 1970
	Relating	Students will identify associations between objects or ideas	Anderson, 1984 (cited in Marzano & Arrendondo, 1986); Black, 2005; Elder & Paul, 1996a, 1996b; Finke <i>et al.</i> , 1992; Guilford, 1959, 1987; Halpern, 2007; Lemelson Center, 2007; Lubart, 2001; Marzano & Arrendondo, 1986; Partnership for 21st Century Skills, 2004; Raths

			<i>et al.</i> , 1986; Sternberg & Baron, 1985; Sternberg & Spear-Swerling, 1996; Tardif & Sternberg, 1988
Synthesis	Organizing	Students will arrange information such that connections and relationships are made clear.	Black, 2005; Guilford, 1950; Halpern, 2007; Lubart, 2001; Marzano & Arrendondo, 1986; Meyers, 1986; Partnership for 21st Century Skills, 2004; Raths <i>et al.</i> , 1986; Sternberg & Spear-Swerling, 1996; Swartz & Perkins, 1990; The Lemelson Center, 2007
	Interpreting	Students will state the meaning of a situation, process, product, or information after considering all resources.	Black, 2005; Elder & Paul, 2002; Halpern, 2007; Nickerson, 1986; Palincsar & Brown, 1989; Paul & Elder, 2004; Raths <i>et al.</i> , 1986; Resnick & Klopfer, 1989; Sternberg & Baron, 1985; Sternberg & Leighton, 2004; Sternberg & Spear-Swerling, 1996.
	Summarizing	Students will condense multiple ideas into a cohesive comprehensive summary and restate it using personal connections and interpretations.	Black, 2005; Lubart, 2001; Meyers, 1986; Paul & Elder, 2004; Raths <i>et al.</i> , 1986
	Hypothesizing	Students will develop statements or conclusions to be tested or used for explanatory purposes.	Marzano, 1993; Nickerson, 1984; Raths <i>et al.</i> , 1986
	Composing	Students will use written, oral, and symbolic language to communicate a summary of thoughts, ideas, and solutions.	Marzano & Arrendondo, 1986; Raths <i>et al.</i> , 1986; Sternberg & Baron, 1985
Evaluation	Judging resources	Students will outline the degree to which the resources on which they based their conclusions are reliable, fair, and relevant.	Black, 2005; Elder & Paul, 1996a, 1996b, 1997; Halpern, 2007; Marzano & Arrendondo, 1986; Nickerson, 1986; Raths <i>et al.</i> , 1986; Sternberg, 2000; Sternberg & Baron, 1985; Sternberg & Leighton, 2004; Sternberg & Spear-Swerling, 1996
	Judging logic	Students will describe how their conclusions were derived and the extent to which they are supported by reliable sources.	Black, 2005; Elder & Paul, 1996a, 1996b, 1997; Halpern, 2007; Marzano & Arrendondo, 1986; Nickerson, 1986; Raths <i>et al.</i> , 1986; Sternberg, 2000; Sternberg & Baron, 1985; Sternberg & Leighton, 2004; Sternberg & Spear-Swerling, 1996
	Judging value	Students will state how their product is consistent with their personal values.	Black, 2005; Elder & Paul, 1996a, 1996b, 1997; Halpern, 2007; Marzano & Arrendondo, 1986; Nickerson, 1986; Raths <i>et al.</i> , 1986; Sternberg, 2000; Sternberg & Baron, 1985; Sternberg & Leighton, 2004; Sternberg & Spear-Swerling, 1996
	Judging worth	Students will describe the usefulness of their ideas to the context of the challenge.	Black, 2005; Elder & Paul, 1996a, 1996b, 1997; Halpern, 2007; Marzano & Arrendondo, 1986; Nickerson, 1986; Raths <i>et al.</i> , 1986; Sternberg, 2000; Sternberg & Baron, 1985; Sternberg & Leighton, 2004; Sternberg & Spear-Swerling, 1996
	Generalizing	Students will identify how particular ideas apply to situations other than	Finke <i>et al.</i> , 1992; Meyers, 1986; Nickerson, 1984

	the original challenge.	
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As they refine their ideas, thinkers take evaluative measures to determine the value and plausibility of ideas as related to the problem or context. Evaluation occurs through *judging* the *resources* on which conclusions were based, as well as the *logic*, *value*, and *worth* of the ideas generated. In addition, evaluation involves *generalizing* by simplifying information and developing principles and rules for applying that information to other situations.

Table 2 summarizes the skills, activities, learning objectives, and supporting references associated with reflective judgment.

Self-Regulation

Throughout the processes of generating and refining ideas, thinkers must monitor and maintain control of their thoughts, behaviors, and involvement. The skills within this self-regulative process are organized by how the learners set personal goals and *plan* how they will accomplish their goals; *monitor* attention, focus, and progress; and *evaluate* the process and results of their activities (see Table 3).

Critical and creative thinkers engage in active planning and forethought to set goals, outline strategies, and determine the best methods through which they can achieve their goals. Activities that support this planning include *recognizing the existence of a challenge*, *assessing personal knowledge*, *understanding one's own abilities*, and *allocating resources*.

Thinkers also must be skillful in monitoring the attention and focus they devote to a task as well as the results of their decisions. This occurs through actively focusing on the level and type of attention required to accomplish the task. In addition, they need to be aware of how they are *performing* and *progressing* toward meeting their goals. Monitoring also involves *identifying consequences* of possible actions in relation to the desired goals. *Revising* is a critical component of self-regulation; if through monitoring focus, performance, progress, and possible consequences, thinkers find that they are not making adequate progress toward achieving their goals, they must be willing to reconsider their course of action.

As thinkers continually monitor their attention, focus, and results, it may become necessary for them to make changes in beliefs about their level of attention, abilities, and the value of contributions being made. This process of *cognitive restructuring* occurs as thinkers make affirmative changes in their overall attitudes and seek to make alterations in personal beliefs and perceptions of the beliefs of others. Thinkers can accomplish this restructuring by making positive self-statements to help maintain awareness of such beliefs and make necessary changes.

The third and final skill of self-regulation is the need for thinkers to *evaluate* the results of their efforts. This occurs as the thinkers review the initial challenge, their goals, and the resulting products. By evaluating results, thinkers can ensure appropriate outcomes as well as value and worth of ideas as they relate to the problem or context. Through *evaluating the process* in which they engaged, critical and creative thinkers ensure that appropriate thinking processes were used to generate results. Through *evaluating the product*, they ensure that those final results are in line with the initial goal.

Table 3 further illustrates the skills within the process of self-regulation with related objectives and associated references.

Attitudes and Dispositions

In addition to engaging in idea generation, reflective judgment, and self-regulation, critical and creative thinkers must exhibit certain attitudes and dispositions; specifically this means they must be perceptive and flexible, motivated, and confident (see Table 4).

Thinkers maintain a *perceptive and flexible* attitude through *avoiding impulsivity, rejecting stereotypes and prejudices, embracing multiple points-of-view, judging their assumptions*, and *remaining sensitive* to the thoughts and actions of others. In addition, it is vital that thinkers allow many aspects of experiences to penetrate and influence their thinking by *remaining open-minded* to seeking alternative influences. *Tolerating ambiguity* is also essential, as, with any thinking process, vaguely established ideas will often penetrate their thinking.

Critical and creative thinkers must be *motivated* to solve the problem at hand. They must exhibit a general interest in their learning, recognize the value of their participation, and see the applicability of the task to their personal interests. This motivation is exhibited through *demonstrating autonomy, persisting* at the task, *maintaining intrinsic motivation*, and *recognizing the relevance* of their work to their personal interests.

Successful critical and creative thinkers are also *confident* in their involvement and position within the problem or context. In this context, confidence involves maintaining a positive perception of self-efficacy, exhibiting a high level of comfort in interacting with the thinking process, and exhibiting a general feeling of self-worth and certainty. Thinkers who do not fear being different and do not seek conformity are able to maintain high levels of confidence and become active participants in the critical and creative thinking process. Throughout, successful critical and creative thinkers demonstrate confidence by actively *identifying the worth or applicability of their ideas, exhibiting courage of convictions* that allows them to publicize their thoughts without fear of rejection, and the willingness to engage in *risk-taking* that allows them to work outside their comfort zone and engage in tasks in which success is not certain.

In Table 4, we summarize the attitudes and dispositions necessary for critical and creative thinking, list related learning objectives, and identify the references on which we based our conclusions.

Conclusions and Future Work

As we developed this model and supporting instructional guidelines, we became aware that we were going through the exact process we wanted to communicate to other educators. In reviewing the literature, we generated a multitude of ideas and conclusions about the critical and creative thinking process and practiced reflective judgment to refine those ideas. Throughout the process, we engaged in self-regulation and adopted the necessary attitudes and dispositions. The revelation that we were applying the critical and creative thinking process as we attempted to define it was exciting and empowered us to move toward our goal of informing educators about how to develop critical and creative thinking skills within their students.

We began by engaging in the planning stage of self-regulation. We clearly identified our challenge to define critical and creative thinking as a set of teachable skills, assessed our current knowledge on the topic, and mobilized our available resources. As we generated ideas to meet our goal, we explored the many ways others had described creative and critical thinking in order to generate a large number of possible solutions. We attempted to identify the relationships among the various concepts we had identified in order to see patterns and associations. As we generated ideas, we frequently diagramed our ideas and the relationships among them. These diagrams would often cause us to see connections among the ideas as well as gaps in our knowledge. As we refined our ideas, we engaged in reflective judgment. Guided by our goal, we attempted to look for gaps in our knowledge, and when we identified them, to explore further.

We engaged in the process of analysis by separating information into related and unrelated categories and looked for relationships among the ideas. As we attempted to synthesize our knowledge, we began to cluster, organize, and summarize our ideas. We also composed our thoughts using visual representations such as diagrams, tables, and written narratives. At a

Table 3. Key Skills and objectives of self-regulation.

Skill	Activity	Objective	Reference
Plan	Recognizing the existence of a challenge	Students will state the challenge and outline related conditions and scope.	Guilford, 1959, 1987; Halpern, 2007; Marzano <i>et al.</i> , 1988; Sternberg & Spear-Swerling, 1996; Tardif & Sternberg, 1988; Torrance, 1962
	Assessing knowledge	Students will identify prior knowledge and describe the degree of familiarity with that knowledge.	Marzano <i>et al.</i> , 1988; Nickerson, 1984
	Understanding ability	Students will identify personal abilities that are helpful to meeting goals.	Nickerson, 1984
	Allocating resources	Students will outline all available resources and develop a timeline for action.	Halpern, 2007; Sternberg & Spear-Swerling, 1996
Monitor	Focusing	Students will identify the level and type of attention they are devoting to a task, and describe any adjustments needed.	Marzano & Arrendondo, 1986; Marzano <i>et al.</i> , 1988; Nickerson, 1984; Paris & Winograd, 1990; Raths <i>et al.</i> , 1986; Swartz & Perkins, 1990; Tardif & Sternberg, 1988
	Performing	Students will outline steps they are taking/have taken to achieve their goals.	Nickerson, 1986; Paris & Winograd, 1990; Starko, 2005
	Progressing	Students will describe their progress related to goals and any adjustments needed.	Marzano & Arrendondo, 1986; Marzano <i>et al.</i> , 1988; Paris & Winograd, 1990; Starko, 2005
	Identifying Consequences	Students will list possible outcomes and their consequences as decisions are made and describe how they will affect goals and progress.	Black, 2005; Starko, 2005
	Revising	Students will evaluate progress regarding the plan of action and alter activity as needed.	Marzano <i>et al.</i> , 1988; Paris & Winograd, 1990
	Cognitive restructuring	Students will verbalize positive thoughts about their performance and abilities.	Baron & Harrington, 1981; Marzano & Arrendondo, 1986; Paris & Winograd, 1990; Sawyer, 2006
Evaluate	Evaluating the process	Students will identify the critical and creative processes used to generate results and describe how the process aligns with the goal.	DeBono, 1985; Starko, 2005
	Evaluating the product	Students will describe how the final product is relevant, appropriate, and valuable to the initial challenge and context. Students will make revisions to the product as needed to align with their goal.	DeBono, 1985; Marzano & Arrendondo, 1986; Williams, 1970

Table 4. Key skills and objectives of attitudes and dispositions.

Characteristic	Activity	Objective	References
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Perceptive and Flexible	Avoiding impulsivity	Students will exercise control over thoughts and reactions by pausing to think, ask questions, and talk through ideas.	Marzano, 1993; Marzano & Arrendondo, 1986; Marzano <i>et al.</i> , 1988; Meyers, 1986; Raths <i>et al.</i> , 1986
	Rejecting stereotypes and prejudice	Students will identify preexisting ideas and opinions regarding a challenge and how they might affect decisions and progress toward goals.	Arnabile, 1983; Guilford, 1987; Torrance, 1962
	Embracing multiple points-of-view	Students will present ideas and arguments through the lens of multiple perspectives.	Arnabile, 1983; Black, 2005; Elder & Paul, 1996a; 1996b, 1997, 2002; Greenlaw & DeLoach, 2003; Guilford, 1987; Landsman & Gorski, 2007; Lemelson Center, 2007; Marzano, 1993; Marzano <i>et al.</i> , 1988; Meyers, 1986; Partnership for 21st Century Skills, 2004; Raths <i>et al.</i> , 1986; Resnick & Klopfer, 1989; Richardson, 2007; Starko, 2005; Sternberg & Baron, 1985; Swartz & Perkins, 1990; Torrance, 1962; Williams, 1970
	Judging assumptions	Students will identify assumptions and describe their validity as they relate to the context.	Arnabile, 1983; Black, 2005; Guilford, 1987; Halpern, 2007; Marzano <i>et al.</i> , 1988; Paul & Elder, 2002, 2004; Raths <i>et al.</i> , 1986; Swartz & Perkins, 1990
	Remaining sensitive	Students will describe the thoughts, feelings, and perspectives of other students.	Black, 2005; Elder & Paul, 1997; Halpern, 2007; Marzano, 1993; Marzano <i>et al.</i> , 1988; Meyers, 1988; Nickerson, 1984; Palincsar & Brown, 1989; Paul & Elder, 2004; Raths <i>et al.</i> , 1986; Resnick & Klopfer, 1989; Starko, 2005; Sternberg & Baron, 1985; Swartz & Perkins, 1990; Torrance 1962
	Remaining open-minded	Students will identify how ideas from multiple experiences (to include senses, fantasy, aesthetics, feelings, and actions of others) influenced their ideas.	Colangelo & Davis, 2002; Runco, 2007; Starko, 2005; Sternberg & Lubart, 1991, 1995; Tardif & Sternberg, 1988; Torrance, 1962; Williams, 1970
	Tolerating ambiguity	Students will be receptive to all ideas and perspectives regardless of degree of completeness or complexity.	Arnabile, 1983; Barron & Harrington, 1981; Guilford, 1950, 1959, 1987; Marzano, 1993; Raths <i>et al.</i> , 1986; Sawyer, 2006; Starko, 2005; Sternberg, 2000; Sternberg & Lubart, 1991, 1995; Tardif & Sternberg, 1988; Torrance, 1962; Williams, 1970
Motivated	Demonstrating autonomy	Students will initiate activity and exercise self-direction and self-discipline.	Guilford, 1987; Starko, 2005; Torrance, 1962
	Persisting	Students will continue to work until goals are met.	Barron & Harrington, 1981; Black, 2005; Marzano, 1993; Marzano <i>et al.</i> , 1988; Paris & Winograd, 1990; Sternberg & Lubart, 1991, 1995; Tardif & Sternberg, 1988; Torrance, 1962

	Maintaining intrinsic motivation	Students will identify how the task or problem provides personal satisfaction.	Adams, 1951; Sawyer, 2006; Tardif & Sternberg, 1988; Torrance, 1962
	Recognizing relevance	Students will identify personal beliefs and values relating to the context.	Paris & Winograd, 1990; Torrance, 1962
Confident	Identifying worth/applicability of ideas	Students will make positive statements about the value of their ideas to the context.	Barron & Harrington, 1981; Colangelo & Davis, 2002; Sawyer, 2006; Torrance, 1962
	Exhibiting courage of convictions	Students will publicize thoughts or ideas and accept criticism from others.	Barron & Harrington, 1981; Sawyer, 2006; Starko, 2005; Sternberg & Lubart, 1991, 1995; Torrance, 1962; Williams, 1970
	Risk-taking	Students will describe how the challenges faced in the process of meeting their goal encouraged them to work beyond their comfort level.	Barron & Harrington, 1981; Colangelo & Davis, 2002; Rath et al., 1986; Sawyer, 2006; Starko, 2005; Sternberg & Lubart, 1991, 1995; Torrance, 1962; Williams, 1970

time our ideas made perfect sense, but at other times, our reflective judgment caused us to question what appeared to be gaps or inconsistencies in our ideas, stimulating another phase of idea generation, where we would look again to the literature to identify additional ideas, to clarify or refine our ideas, or to see things in new ways.

As we began to draw conclusions, we frequently revisited our resources to determine to what extent our conclusions were consistent with the literature, and to look for information that confirmed or disputed our conclusions. We would attempt to evaluate the value and worth of our ideas by “mentally testing” our conclusions by using the ideas generated to think through an incident of critical and creative thinking. As we refined our ideas, we investigated the extent to which they would generalize to multiple creative domains by discussing them with experts in visual design and theater arts.

Throughout, our self-regulation processes guided our work. We quickly recognized the importance of maintaining awareness of our overall goal of *defining critical and creative thinking as a set of teachable skills*. As we engage in the idea generation and reflective judgment processes, we continually monitored whether we were making progress toward solutions that were appropriate for our goal. We often recognized and accepted when we came to a problem, sought clarity of our thoughts and ideas, and engaged in constant revision of our plans and processes to reach our goal.

As we neared our goal of developing a conceptual model and instructional guidelines, we were able to evaluate all the work we had done and the process we went through to achieve this goal. Our work continued as we evaluated how the end result, or our product, addressed our original goal. We made several revisions, continuing the analysis, synthesis, and evaluation of our ideas until each team member was comfortable with the resulting work.

As we reflected on the processes of generating the model and associated instructional guidelines, we found that the attitudes and dispositions we identified in the literature were essential to our progress. Throughout the struggle to analyze, synthesize, and evaluate an abundance of ideas, we found that it was critical to remain motivated by our belief in the value of our goals and to proceed with the confidence that we would be able to solve the problem through persistence. Additionally, working as a team, we often encountered ambiguity in our ideas and conclusions, yet we recognized the importance of accepting this ambiguity and remaining flexible in our thinking.

More specifically, this flexibility enabled us to work as a team. We easily recognized that each of us brought a different type and level of expertise to the conversation and had differing perspectives, assumptions, and opinions. Through this recognition, we knew it was important that all of us remained open-minded to the thoughts, ideas, and interpretations of other team members.

Our current work is focused on the idea that in order to successfully develop these skills in their students, educators will need experience at developing their own critical and creative thinking skills. Our future plans include workshops for educators in which they will practice using and developing their own critical and creative thinking skills. In addition, we are in the process of developing instructional materials intended to foster critical and creative thinking skills through engagement with the arts and emerging technologies.

Ultimately, it is our hope that by fostering these skills among educators, and by providing teachers with a variety of materials and resources they can use to develop these skills in their students, teaching and learning will begin to address the need for students who are able to solve problems, think critically, and excel as global competitors in the 21st century through their creativity and ingenuity.

Authors' Note: We gratefully acknowledge Miriam Larson and Sunha Kim, for their contributions to the literature reviews and lively debates that ultimately led to this model, and Somiah Muslimani, for her expert graphic design work and insight in refining the instructional guidelines.

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