



# MEASURING STUDENT SUCCESS SKILLS: A REVIEW OF THE LITERATURE ON CREATIVE THINKING

---

December 2023

---

*W. Christopher Brandt, Ph.D.  
National Center for the Improvement  
of Educational Assessment*



[www.nciea.org](http://www.nciea.org)



1. The Center for Assessment completed this work on behalf of the International Baccalaureate® (IB) in its effort to conceptualize future competencies as a goal for learning and measurement.
2. I acknowledge the terrific feedback on previous drafts from my colleagues at the Center for Assessment. Any errors and omissions are my own.
3. This work is licensed under the Creative Commons Attribution 4.0 International License (CC BY). To view a copy of this license, visit <http://creativecommons.org/licenses/by/4.0/>.
4. Brandt, W. C. (2023). *Measuring student success skills: A review of the literature on creative thinking*. Dover, NH: National Center for the Improvement of Educational Assessment.

# TABLE OF CONTENTS

INTRODUCTION .....	3
DEFINITIONS .....	4
• What is Creative Thinking? .....	4
• What is the Relationship Between Creative Thinking and Creativity? .....	5
• Are Creative Thinking Skills Generic or Discipline-Specific? .....	9
• What is the Relationship between Creative Thinking and other 21st Century Skills? .....	11
DEVELOPMENT .....	13
• How Does Creative Thinking Develop? .....	13
• What is Malleable with Respect to Creative Thinking as a Result of Instruction? .....	15
• What Might Be Distinct about Creative Thinking Across Contexts and Cultures? ..	15
INSTRUCTION .....	16
• What Are Some Instructional Approaches to Teaching Creative Thinking?.....	16
• What Do We Know About the Effects of Instruction on the Development of Creative Thinking Skills?.....	20
MEASUREMENT/ASSESSMENT .....	22
• How is Creative Thinking Typically Measured or Assessed? .....	22
• What are the Measurement and Assessment Issues Related to Creative Thinking? .....	25
• What are the Implications of Previous Research for Assessment Design and Use? .....	27
CONCLUSION.....	30
REFERENCES.....	31
APPENDIX A .....	37
APPENDIX B .....	39
APPENDIX C .....	44

# MEASURING STUDENT SUCCESS SKILLS: A REVIEW OF THE LITERATURE ON CREATIVE THINKING



## INTRODUCTION

*Creative thinking is not a mystical talent. It is a skill that can be practiced and nurtured.*  
~Edward De Bono

Creative thinking is essential for career success in the information age. According to the World Economic Forum (WEF, 2023), creative thinking ranks as the fastest growing and second-most important skill among employers. Creative thinking also ranks above artificial intelligence (AI) and big data in terms of companies' skills-training priorities for workers.

Universal access to information expands opportunities, opens new doors, and improves quality of life. At the same time, it creates new and more complex challenges as knowledge creation and change accelerate at an unprecedented pace. Consider, for example, that two thirds of jobs in the U.S. and Europe, and about one quarter of all work currently being done by humans, will be replaced by generative AI ([Hatzius et al., 2023](#)). Such a monumental shift suggests that an unprecedented number of new occupations will emerge, requiring skills that likely do not exist today. Such challenges are why creative thinking has become such a coveted skill.

Creative thinking was once thought to be a skill that could not be learned. Beliefs that people are born either creative or uncreative, that creative people are the misfits of society, and that creative thinking was enmeshed in pop psychology were common myths. Several decades of empirical research on the creative process debunked these myths. Today, well-defined cognitive models describe how the creative process unfolds. Moreover, robust collections of research studies have established that creative thinking is instructionally malleable. Indeed, interrelated skills required for creative thinking can develop through deliberative practice and improved environmental conditions and supports. Teachers and mentors can be trained to facilitate, assess, and use assessment information to develop individuals' creative thinking abilities.

This report distinguishes creative thinking from the more general concept of creativity. The terms creativity and creative thinking often are used interchangeably. Although they share characteristics, they differ in significant ways. Definitions of creativity tend to emphasize *outcomes* while creative thinking emphasizes *process*. More specifically, novelty and usefulness characterize the creativity of a product. Creative thinking, on the other hand, represents the process one engages in to produce something novel and useful. Creative thinking is characterized by the generation, manipulation, and experimentation of ideas, followed by thoughtful analysis and critical examination, and then the effective communication of those ideas to solve a problem or achieve a purpose. This report focuses on the process of creative thinking as one aspect of creativity.

Creative thinking is a complex skill that incorporates other higher-order skills and social/emotional dispositions, such as critical thinking, communication, curiosity, collaboration, and persistence. Empirical research conducted on these related skills and dispositions is considered below when it serves to comprehensively address a question in this report.



This literature review (a) provides a working definition of creative thinking, (b) describes how the creative thinking process develops for K-12 students, (c) examines different conceptions of how creative thinking is taught, (d) discusses specific instructional practices that support the development of creative-thinking strategies, and (e) analyzes how creativity has been assessed. This review concludes with implications for the design and use of creative thinking assessments in K-12 schools.

## DEFINITIONS

### What is Creative Thinking?

**Creative thinking** is an iterative process in which a person generates and manipulates ideas; tests, refines, and modifies those ideas through critical analysis and evaluation; and communicates ideas to solve a problem, improve problem solutions, or advance knowledge in novel ways.

Creative thinkers are characterized by their sensitivity to problems, fluency of ideas, mental flexibility, divergent and convergent thinking skills, ability to redefine familiar objects and concepts, and ability to effectively communicate novel ideas (Guilford, 1950). Creative thinkers also are characterized by their ability to exercise dispositional qualities (i.e., habits of mind) as they engage in the creative process.

The creative thinking definition listed above was developed for the International Baccalaureate by synthesizing 12 widely cited definitions and reviewing prominent frameworks on creativity and creative thinking (see Appendix A). Definitions of creativity, creative learning, and creative thinking were included in the synthesis because these constructs overlap and often are used interchangeably. Definitions were selected for review if they met at least two of three criteria:

- The definition reflects the field's most current conceptions of creative thinking.
- The definition is widely cited in the research literature.
- The definition is widely cited in research literature and informs the field's most prominent definitions, frameworks, and conceptualizations in education contexts.

Although the included definitions are not exhaustive, they were selected with the intent to comprehensively represent the salient features and characteristics of creative thinking.

Distinguishing features of each selected definition were coded against Rhodes' 4P model of creativity (Rhodes, 1961), a frequently cited model in the research literature on creativity. This model presents the general construct of creativity using four distinct lenses (described in the next section) and, by doing so, provides a helpful way to distinguish creative thinking from the more general construct of creativity. Moreover, the 4P model provided a systematic method for excluding definitions of creativity that did not explicitly address the creative thinking process. When a definition described aspects of creativity through a particular lens, it was coded as such. Findings from this analysis, included in Appendix A, reveal that definitions of creativity and creative thinking incorporate multiple lenses. Notably, all 12 seminal definitions explicitly addressed the creative thinking process.

Next, an inductive content analysis of the 12 selected definitions was conducted, in which key words and phrases were pulled verbatim from each definition and grouped according to the representative codes. The codes were then grouped into larger descriptive categories. The larger categorical codes were counted each time they emerged in a definition and, in turn, summed across the 12 selected definitions. Finally, each emergent category was then integrated into this synthesis definition of creative thinking.

## What is the Relationship Between Creative Thinking and Creativity?

To understand the relationship between creativity and creative thinking, it is helpful to unpack the broader construct of creativity. Definitions of creativity tend to incorporate two or more of four distinct components, which Rhodes (1961) defined as follows:

- **Person:** personality features and dispositions of an individual.
- **Process:** the observable learning and thinking involved in a creative act.
- **Product:** something that gets produced as a result of the creative process.
- **Press:** the environment and other social factors that influence the creative process.

Each component includes sub-components that can be taught and learned (Patston et al., 2021) and that influence creative potential. For example, each *person* has individual attributes that influence the development of creative skills and capacities: curiosity, resilience, openness to new experiences, willingness to take sensible risks, and tolerance for ambiguity, to mention a few. The creative *process* involves concrete skills and strategies set into motion by an initial problem or question. A person generates, and later selects, possible solutions through divergent (idea generation) and convergent (critical analysis, refinement, and selection of the best ideas) thinking strategies. Throughout the process, ideas are analyzed from multiple perspectives, new or unexpected connections are established, and alternative solutions are considered and selected for implementation. The *product* is the artifact that is produced through the creative process. It provides evidence for evaluating a person's creativity in a social context. Understanding how social and contextual factors influence judgments of creative products is important in developing creative potential. Finally, creative *press* refers to the interaction between a person's physical environment and their individual psychology. Environmental factors are manipulated to either enhance or inhibit creativity. Table 1 includes the emergent categories and definition descriptors from the content analysis of creativity and creative thinking definitions.

Definitions of creativity tend to incorporate two or more of four distinct components, which Rhodes (1961) defined as follows:

- **Person:** personality features and dispositions of an individual.
- **Process:** the observable learning and thinking involved in a creative act.
- **Product:** something that gets produced as a result of the creative process.
- **Press:** the environment and other social factors that influence the creative process.

**Table 1.**  
**Content Analysis of Creativity and Creative Thinking Definitions**

EMERGENT CATEGORIES	CREATIVE THINKING DESCRIPTORS	CREATIVITY DESCRIPTORS
Achieving a Specific Purpose	<ul style="list-style-type: none"> <li>• Generate, apply, and improve ideas/ solutions</li> <li>• Advance knowledge</li> <li>• Meet a given purpose</li> <li>• Communicate results</li> <li>• Generate a positive outcome</li> </ul>	<ul style="list-style-type: none"> <li>• Produce a novel and useful product</li> </ul>
Acknowledging Context Dependencies	<ul style="list-style-type: none"> <li>• In real-world settings</li> <li>• In specific contexts</li> <li>• Related to a problem</li> </ul>	<ul style="list-style-type: none"> <li>• Within a social context</li> </ul>
Reflecting Dispositional Capacities	<ul style="list-style-type: none"> <li>• Perseverance</li> <li>• Experimentation</li> <li>• Imagination</li> <li>• Engagement</li> <li>• Sensitivity to problems</li> <li>• Intuition</li> </ul>	<ul style="list-style-type: none"> <li>• Imagination</li> </ul>
Generating Ideas (Divergent Thinking)	<ul style="list-style-type: none"> <li>• Imagine and generate new ideas</li> <li>• Apply a range of idea-creation techniques</li> <li>• Search for solutions</li> <li>• Make guesses; formulate hypotheses</li> <li>• Identify alternative explanations</li> <li>• Discover possibilities</li> <li>• Construct theories and objects</li> </ul>	<ul style="list-style-type: none"> <li>• Engage in imaginative activity</li> </ul>
Connecting and Manipulating New and Existing Ideas	<ul style="list-style-type: none"> <li>• Elaborate ideas</li> <li>• Integrate and manipulate ideas in unusual ways</li> <li>• Make connections; combine parts</li> <li>• See situations in a new way</li> </ul>	<ul style="list-style-type: none"> <li>• Not explicitly included</li> </ul>
Analyzing and Refining Ideas (Convergent Thinking)	<ul style="list-style-type: none"> <li>• Refine, analyze, evaluate, and improve ideas</li> <li>• Modify and retest hypotheses</li> <li>• Sift and refine ideas</li> </ul>	<ul style="list-style-type: none"> <li>• Critically select ideas</li> </ul>
Communicating or Expressing Ideas	<ul style="list-style-type: none"> <li>• Communicate results</li> <li>• Express imagination</li> </ul>	<ul style="list-style-type: none"> <li>• Expressing something not there before</li> </ul>
Producing Novel Solutions	<ul style="list-style-type: none"> <li>• Make something novel or individual</li> <li>• Create original solutions</li> </ul>	<ul style="list-style-type: none"> <li>• Make something not there before</li> <li>• Produce outcomes that are original</li> </ul>
Producing Useful Solutions	<ul style="list-style-type: none"> <li>• Create effective solutions</li> <li>• Create worthwhile ideas</li> </ul>	<ul style="list-style-type: none"> <li>• Create a product that is useful</li> <li>• Create outcomes of value</li> </ul>

Definitions of creativity and creative thinking often overlap. However, a comparison of creativity and creative thinking descriptors reveals a few distinct differences between the two constructs.

**Distinct Purposes.** Both creativity and creative thinking prioritize their application to achieve a particular purpose. Creativity definitions focus on applying the creative thinking process for the purpose of producing a product or achieving a given outcome that is both novel and useful.<sup>1</sup> In contrast, creative thinking definitions tend to focus on applying the process for the purpose of *developing, iterating, or improving* the products, ideas, and outcomes produced.

**Process vs. Outcome Emphasis.** Creativity prioritizes the novelty and usefulness of an outcome. Creative thinking is less concerned about the outcome and more concerned about the process used to develop the outcome. More specifically, creative thinking definitions address process more comprehensively by explicitly addressing its prominent features, such as idea generation, manipulation of new and existing ideas, analyzing and evaluating ideas, and improving on ideas. Notably, although creative thinking does not include the notion of product per se, it nonetheless is outcome-focused. Creative thinking is purposeful: to achieve an outcome that can be experienced through the senses. For example, a person applies creative thinking to answer a question, develop solutions, generate new ideas or possibilities, or develop a tangible product.

**Dispositional Emphasis.** Definitions and frameworks of creative thinking emphasize the role of personality traits and dispositional qualities. For example, Figure 2 presents the five-dimensional model of creativity, which emphasizes five essential dispositions of creative thinking: imagination, discipline, collaboration, persistence, and inquisitiveness (Lucas, 2016). Similarly, the Lansing-Stoeffler and Daley (2023) model of creative thinking for ACT incorporates three traits that support idea generation and original or innovative ideas: openness to experience, tolerance of ambiguity, and tolerance to risk. The PISA creative thinking framework identifies several “individual enablers” of creative thinking, which include dispositional qualities such as goal orientation and beliefs, openness, task motivation, and collaboration with others (OECD, 2019).

Despite these differences, the terms are inter-related because creativity leads to something novel and useful while creative thinking is the process that leads to that tangible something. Additionally, creative thinking happens in a variety of contexts—it is present in all areas of life—and its development depends on specific habits of mind (perseverance, experimentation) and skills (critical thinking, collaboration).

Creativity definitions focus on applying the creative thinking process for the purpose of producing a product or achieving a given outcome that is both novel and useful.<sup>1</sup> In contrast, creative thinking definitions tend to focus on applying the process for the purpose of *developing, iterating, or improving* the products, ideas, and outcomes produced.

Creativity prioritizes the novelty and usefulness of an outcome. Creative thinking is less concerned about the outcome and more concerned about the process used to develop the outcome.

Definitions and frameworks of creative thinking emphasize the role of personality traits and dispositional qualities.

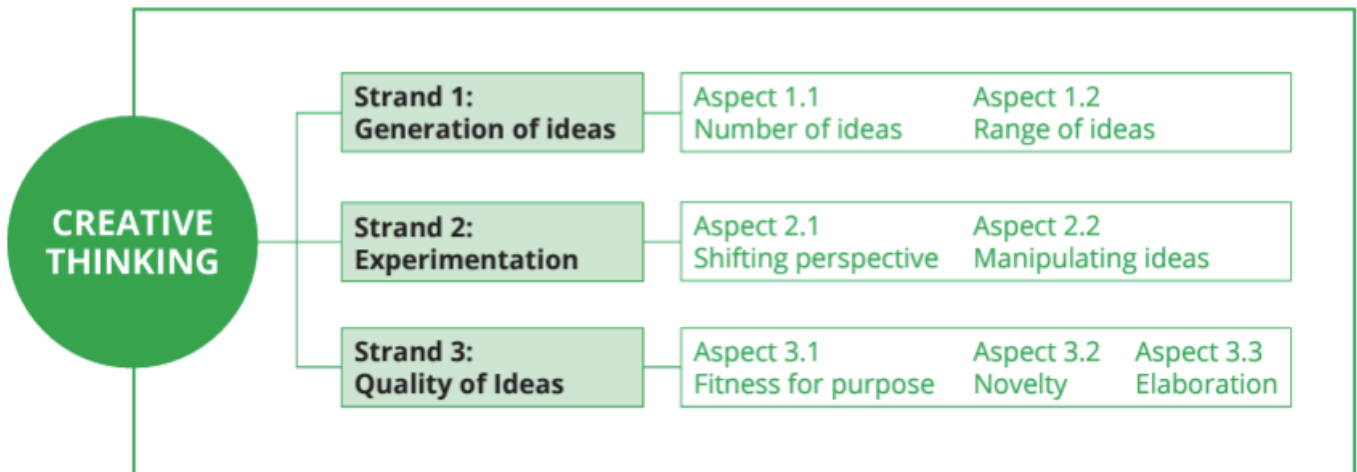
<sup>1</sup> The term “outcome” refers to tangible products and intangible outcomes generated through the creative thinking process. Examples include ideas, problem solutions, possibilities, or answers to questions.

**Distinct Developmental Frameworks.** A few prominent definitions of creativity are frequently referenced in education research (e.g., Plucker et al., 2004; Runco & Jaeger, 2012), However, there is no broadly accepted definition of creative thinking. Similarly, research-based developmental frameworks of creative thinking and creativity vary. Concurrent with definitions of creative thinking, creative thinking frameworks tend to focus on process, while the broader creativity frameworks incorporate various aspects of the creative person (personality features and dispositions), product (the result), and press (social and environmental factors that influence creativity).

Researchers studying creative thinking tend to conceptualize the construct distinctly from creativity.

Researchers studying creative thinking tend to conceptualize the construct distinctly from creativity. They also tend to align with different research traditions and cite different, if overlapping, bodies of research. As shown in Figure 1, for example, the Australian Council for Education Research (ACER) developed a Creative Thinking Skill Development Framework (Ramalingham et al., 2021). ACERs framework focuses primarily on the cognitive skills that support creative thinking,<sup>2</sup> whereas the Centre for Real World Learning (CRL) focuses on the habits of mind, or dispositions, and how development of these dispositions influences a person’s creativity generally. Each framework carries different implications for how to influence creative thinking development. While ACER’s framework focuses on activities that promote the cognitive aspects of creative thinking such as divergent thinking, experimentation, and elaboration, CRL focuses on activities that develop dispositions associated with high quality creative output. Although this review concerns the creative thinking process from a cognitive perspective, dispositional characteristics are nonetheless essential for developing creative thinking. Other notable models of creative thinking include those from PISA (OECD, 2019), the Torrance Tests of Creative Thinking (Kim, 2006), and the Creative Thinking and Innovation Framework (Lansing-Stoeffel & Daley, 2023). These and other models are included in Appendix B.

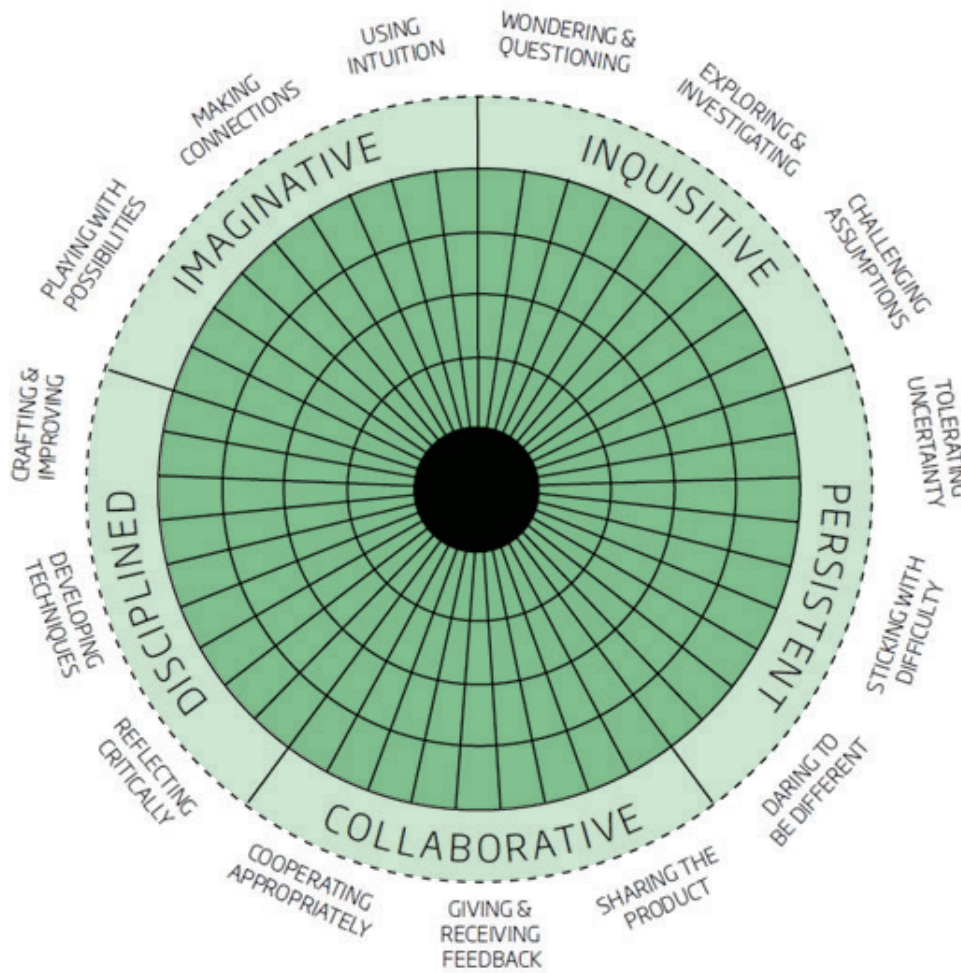
**Figure 1.**  
**ACER Creative Thinking Skill Developmental Framework (Ramalingham et al., 2020)**



<sup>2</sup> More specifically, ACER’s framework focuses on cognitive skills associated with generating ideas (strand 1) and experimenting with ideas (strand 2). Additionally, strand 3 includes the cognitive skill of elaboration.



**Figure 2:**  
**Centre for Real World Learning Five-Dimensional Model of Creativity (Lucas, 2016)**



### Are Creative Thinking Skills Generic or Discipline-Specific?

When someone is highly creative in one content area, do they tend to be creative in all content areas? Or does the ability to apply creative thinking skills depend on one's depth of knowledge and skills within a specific content area? From an empirical standpoint, this question has not been settled. There are three dominant positions on this question.

**Domain-General.** The domain-general position holds that a set of general attributes influence creative thinking abilities and creative activities (Kim, 2011). For example, early research on creative thinking related scores on divergent thinking assessments to creative output. Additionally, numerous studies have found that tests of general intelligence and creative thinking predict creative achievement and performance on general creativity measures (Cramond, 1994; Plucker, 1999). Runco et al. (2010) reported moderate correlations between Torrance Tests of Creative Thinking scores and personal and public achievements 50 years later. Results from these studies suggest that dimensions of creative thinking, such as divergent thinking, are related to long-term career success.

**Domain-Specific.** The domain-specific position holds that the cognitive skills underlying creative thinking are specific to content domains (Baer, 1998). Studies in the 1990s found low correlations among creativity products made by the same person across multiple content areas. Additionally, several studies demonstrated that task-specific creativity-relevant skills increased creative performance only on tasks directly related to the training. From their meta-analysis of studies examining the domains of creativity, moreover, Julmi and Scherm (2016) pointed to the existence of a math/scientific domain distinct from other domains of creativity. Researchers holding the domain-specific view of creative thinking contend that each domain, or content area, requires different theoretical and operational definitions of creative thinking (Hong & Milgram, 2016).

**Confluence Approaches.** A confluence approach holds that creative thinking is a multi-dimensional phenomenon incorporating both domain-general and domain-specific skills (Lucas, 2016). For example, learning experiences in specific content areas raises general intelligence which, in turn, contributes to better performance in school work and creative output. Across a series of studies, Hong and Milgram (2016) found that domain-general and domain-specific creative thinking skills were distinguishable. That is, children performed better on a task when they had prior experience with it. Moreover, domain general creative thinking ability had a causal effect on domain-specific creative thinking ability. In other words, a person who is highly skilled at generating problem solutions is likely to perform well on any task of this type. They will perform well regardless of whether the problem is ill-structured or highly specific and contextually bound. Essentially, the study's findings suggest that both domain-general and specific knowledge influence creative thinking ability. These findings were demonstrated among students at the preschool, elementary, high school, and college levels.

Confluence approaches of creativity also posit that creative thinking requires self-regulatory skills and environmental conditions that support the creative process (OECD, 2019). Domain-specific knowledge and technical skills provide the foundation for creative output. A set of general processes is necessary to combine these content-specific knowledge and skills in new ways, and intrapersonal skills such as motivation and resilience are needed to persist in the process and complete the creative task. Furthermore, this approach suggests that environmental factors such as social support can serve to facilitate or inhibit creative thinking and engagement (Amabile, 1983; Lucas, 2016).

Continued debate notwithstanding, the bulk of research evidence supports the confluence approach to creative thinking: Both domain-specific and domain-general skills influence creative thinking abilities and general creativity. Content-specific knowledge and experience matter because they influence how adeptly a person can apply creative thinking skills. Compared with a novice, for example, a content expert can more easily draw on relevant knowledge and experiences as they apply creative thinking process to produce the most novel and useful problem solutions. Moreover, greater expertise allows a person to hold more in working memory. An expert can more easily draw upon, manipulate, and experiment with relevant bits of knowledge and information. But domain-general skills also matter. Again, general divergent thinking skills are associated with higher creative performance (Kim, 2011). Higher general intelligence also is associated with greater capacity to store, retrieve, and manipulate information in working memory. A person of high intelligence may find it easier to retrieve information, recognize patterns and relationships, and transfer knowledge from one domain to another, especially with training and deliberate practice to improve these skills.

Continued debate notwithstanding, the bulk of research evidence supports the confluence approach to creative thinking: Both domain-specific and domain-general skills influence creative thinking abilities and general creativity.

## What is the Relationship between Creative Thinking and other 21st Century Skills?

Creative thinking includes a range of cognitive activities and processes that overlap with other 21st century skills. For example, the National Research Council (2012) report categorizes creativity as a cognitive competency; however, this report acknowledges the influence of other intrapersonal and interpersonal skills in shaping the creative thinking process. Similarly, the Binkley et al. (2012) review of 21st century skill definitions categorizes “creativity and innovation” along with three related skills—critical thinking, problem solving, and metacognition—under a broader “ways of thinking” category. Some definitions of creative thinking explicitly incorporate one or more of these thinking skills. For example, the Durham Commission’s definition of creative thinking names critical thinking as one of several skills underpinning creative thinking. So, how is creative thinking related to these thinking skills, and what makes them distinct?

**Creative Thinking and Critical Thinking.** Critical thinking plays an important role in the creative thinking process, and school curricula and assessment rubrics often group these two skills together (Vincent-Lacrin, 2019; [Australian Curriculum Assessment & Reporting Authority \[ACARA\], 2018](#)). Creative and critical thinking are linked by the convergent thinking each requires. Creative thinking emphasizes both divergent and convergent thinking (Guilford, 1950) through the process of idea generation (divergent thinking) and then choosing and developing the best ideas (convergent thinking). Critical thinking requires convergent thinking by assessing the strength and appropriateness of each idea through questioning, analytic reasoning, and perspective-taking, which, in turn, facilitates evaluation and selection of the best ideas (Vincent-Lacrin et al.).

The OECD Centre for Educational Research and Innovation recently completed the project “Fostering and Assessing Creativity and Critical Thinking in Education” (Vincent-Lacrin et al.), which developed a shared professional language for both concepts—creative and critical thinking—to facilitate the teaching, learning, and formative assessment of these skills. Vincent-Lacrin et al. (p. 20) argue that creativity and critical thinking are distinct but nonetheless related:

- Both creativity and critical thinking require a certain level of openness and curiosity.
- Both may lead to challenging authority, values, or accepted norms.
- Critical thinking requires scientific integrity; creativity requires discipline and judgment.
- Both pursue the deeper understanding of knowledge and solutions.

As part of its project, OECD constructed domain-general and domain-specific rubrics that operationalize the development of creativity and critical thinking. This operationalization entails four subskills common to both: inquiring, imaging, doing, and reflecting (Vincent-Lacrin et al., 2019, p. 14). Table 2 presents OECD’s domain-general and comprehensive rubric for creativity and critical thinking. Although the rubric focuses on creativity rather than creative thinking per se, the categories and claims in this rubric reflect the creative thinking process.

Critical thinking plays an important role in the creative thinking process, and school curricula and assessment rubrics often group these two skills together (Vincent-Lacrin, 2019; [Australian Curriculum Assessment & Reporting Authority \[ACARA\], 2018](#)).

**Table 2.**  
**OECD Domain-General Rubric on Creativity and Critical Thinking**

	<b>CREATIVITY</b> Coming up with new ideas and solutions	<b>CRITICAL THINKING</b> Questioning and evaluating ideas and solutions
<b>INQUIRING</b>	<ul style="list-style-type: none"> <li>• Feel, empathize, observe, and describe relevant experience, knowledge and information.</li> <li>• Make connections to other concepts and ideas, and integrate other disciplinary perspectives.</li> </ul>	<ul style="list-style-type: none"> <li>• Understand the context, frame and boundaries of the problem.</li> <li>• Identify and question assumptions, check accuracy of facts and interpretations, analyze gaps in knowledge.</li> </ul>
<b>IMAGINING</b>	<ul style="list-style-type: none"> <li>• Explore, seek and generate ideas.</li> <li>• Stretch and play with unusual, risky, or radical ideas.</li> </ul>	<ul style="list-style-type: none"> <li>• Identify and review alternative theories and opinions, and compare or imagine different perspectives on the problem.</li> <li>• Identify strengths and weaknesses of evidence, arguments, claims and beliefs.</li> </ul>
<b>DOING</b>	<ul style="list-style-type: none"> <li>• Produce, perform, envision, or prototype a product, a solution or a performance in a personally novel way.</li> </ul>	<ul style="list-style-type: none"> <li>• Justify a solution or reasoning on logical, ethical or aesthetic criteria.</li> </ul>
<b>REFLECTING</b>	<ul style="list-style-type: none"> <li>• Reflect and assess the novelty of the chosen solution and of its possible consequences.</li> <li>• Reflect and assess the relevance of the chosen solution and of its possible consequences.</li> </ul>	<ul style="list-style-type: none"> <li>• Evaluate and acknowledge the uncertainty or limits of the endorsed solution or position.</li> <li>• Reflect on the possible bias of one's own perspective compared to other perspectives.</li> </ul>

Note: Table reproduced from Vincent-Lacrin et al., 2019, p. 14

**Creative Thinking and Problem Solving.** Problem solving is defined as the analysis and solution of new and complex problems (Mayer & Wittrock, 2006). Creative thinking and problem solving often are intertwined, particularly when problem-solving focuses on solving complex non-routine, or ill-defined, problems. Non-routine problems may require creative thinking to consider alternative hypotheses and generate innovative solutions. Additionally, like critical thinking, non-routine problem solving incorporates elements of convergent thinking, such as interrogating assumptions, evaluating claims, and critiquing solutions (NRC, 2012; Treffinger et al., 2002).

Unlike critical thinking, however, problem solving is not always triggered during the creative thinking process. One can engage in creative thinking without having to solve a specific problem. Moreover, problems that are less complex may not trigger the creative thinking process or require creativity.

**Creative Thinking and Metacognition.** Metacognition refers to thinking about one's thinking; it occurs when someone is aware of their own thinking and learning process. Examples of

Creative thinking and problem solving often are intertwined, particularly when problem-solving focuses on solving complex non-routine, or ill-defined, problems.



metacognition include thinking aloud, self-monitoring progress, pausing to reflect on one's own actions during a task, or self-assessing one's strengths and weaknesses. Metacognitive knowledge guides the selection, evaluation, and correction of cognitive strategies during the creative thinking process.

Metacognitive knowledge guides the selection, evaluation, and correction of cognitive strategies during the creative thinking process.

The better one can apply metacognition to self-regulate thinking and behavior, the better one can support the creative thinking process (Jai et al., 2019). Creative thinking is optimized when prior knowledge is consciously selected, a work plan is implemented, strategies are implemented and flexibly adjusted, and the originality and utility of products or ideas generated are competently evaluated—all metacognitive processes. Importantly, research has shown that metacognitive knowledge and processes can be taught, and that their effective application will, in turn, support creative thinking and problem solving (Jai et al., 2019).

### **Creative Thinking and Social-Emotional Learning Skills.**

The research literature acknowledges the role of social-emotional skills as essential for promoting creative thinking and creative output (NRC, 2012). As mentioned above, several creative thinking frameworks identify specific social and emotional dispositions that influence creative thinking. Additionally, the OECD's seminal project, "Fostering and Assessing Creativity and Critical Thinking in Education," includes skills such as self-efficacy, persistence, curiosity, conscientiousness, collaboration, and communication as overlapping skills that develop in parallel with creativity and critical thinking. The National Research Council (2012) also acknowledged the overlapping nature of creative thinking with non-cognitive inter- and intrapersonal skills. Although it remains unclear whether creative thinking influences social and emotional skills or vice versa, decades of research has established strong links between social-emotional learning skills, habits of mind, and creative thinking (Khalil et al., 2019).

The research literature acknowledges the role of social-emotional skills as essential for promoting creative thinking and creative output (NRC, 2012).

## **DEVELOPMENT**

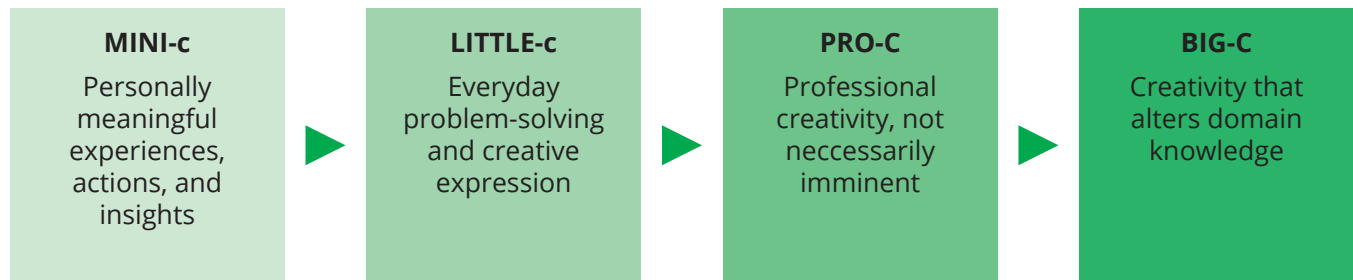
### **How Does Creative Thinking Develop?**

The ability to think creatively emerges at about 12-18 months of age when a child develops symbolic thought as well as the cognitive ability to think in images and symbols (Nicolopoulou, 1993). With the development of symbolic thought, children engage in imaginative play when they are a toddler (18 months-3 years) and demonstrate creative thinking through activities such as pretending, role-playing, and creating make-believe scenarios (Illinois Early Learning Project, 2023). By ages 4-5, children begin to exhibit more advanced creative thinking: they can generate unique ideas, engage in storytelling, and create simple drawings to illustrate imaginative ideas. They even begin to solve problems in unconventional ways (Resnick, n.d.). By ages 6-12, children begin to generate original ideas, ask thought-provoking questions, and explore multiple solutions to problems.

Although most theories of child development view young children as highly creative, creativity as measured by divergent thinking tests declines at ages 5-6, when most children enter kindergarten (Sharp, 2004). Moreover, creative thinking skills often develop unevenly from early childhood through adulthood, presumably because children develop dispositions and talents at different rates, they are exposed to domain-specific content at different rates and time periods, and they are differentially influenced by a myriad of other environmental factors that influence creative thought (Runco, 1996).

Kaufman and Beghetto (2009) presented a lifespan developmental progression of creativity. Their 4C Model conceptualizes creativity across four broad stages: mini-c, little c, pro-c, and Big-C creativity. Mini-c and little-c creativity focus on everyday creative activities in which people engage. Pro-c creativity emphasizes how experts engage in the creative process, and Big-C creativity focuses on the few creative geniuses who impact domain knowledge in life-altering ways. Assessment and instruction regarding creative thinking in school settings typically concern little-c creativity. Because students engage in the creative thinking process as novices, standards of creative thinking and creative output are different: Students may generate ideas and problem-solutions that are novel to them but well-known to domain experts.

**Figure 3.**  
**Four C Creative Model (Kaufman and Beghetto, 2009)**



The field of education lacks a common understanding of creative thinking, its defining features, and how it develops (Mullet et al., 2016). Moreover, developmental frameworks and learning trajectories for creative thinking are coarse and theoretical. Creative thinking frameworks such as ACER, Centre for Real World Learning (CRL), Critical Thinking and Innovation (CTI), PISA, and the Torrance Test of Creative Thinking (TTCT) (Appendix B) describe creative thinking development in qualitatively different ways and have contrasting instructional implications for K-12 teachers. For example, ACER's framework focuses on activities that promote the cognitive aspects of creative thinking, such as divergent thinking, experimentation, and elaboration. ACER posits that explicit instruction on these cognitive processes will improve creative thinking (see Figure 1). Alternatively, CRL focuses less on cognitive skills and more on creative dispositions that are positively associated with creative output (Lucas et al., 2021, [Vincent-Lacrin, 2013](#)). Unlike ACER, the CRL framework emphasizes formative instructional activities that elicit evidence of behavioral dispositions (e.g., curiosity, collaboration, discipline) as students engage in the creative process. Educators worldwide increasingly value creative thinking as an important construct. Several countries have adopted grade-level standards, learning continua and profiles, and rubrics (e.g., ACARA, 2018; British Columbia Ministry of Education, 2023). Although these instructional supports are based on well-developed theories, they lack robust empirical evidence. Further, vagueness regarding the nature of creative thinking and its expected outcomes unfortunately translates into unclear priorities for educators.

The field of education lacks a common understanding of creative thinking, its defining features, and how it develops.

Empirically informed developmental progressions and age-appropriate learning outcomes is necessary for teaching complex skills such as creative thinking (Foster & Piacentini, 2023). Learning progressions can be used as a basis for establishing the validity of creative thought processes and behaviors developmentally. With evidence of valid learning progressions, high-quality standards and curriculum can be developed, refined, and used to cultivate creative thinking skills in K-12 schools. Fortunately, much of the research currently underway is designed to address gaps in what is known about the development of creative thinking skills.

## What is Malleable with Respect to Creative Thinking as a Result of Instruction?

Frameworks for the creative thinking process generally identify four instructionally malleable components of the creative thinking process:

- **Divergent Thinking:** Students can be taught to generating a wide range of ideas or solutions.
- **Experimenting:** Students can be taught to combine and manipulate ideas and idea components; redefining the context through which ideas are developed to generate additional possibilities and solutions.
- **Reflecting and Evaluating:** Students can be taught to consider the merit of each idea and its contribution to addressing the problem or intended outcome.
- **Elaborating:** Students can be taught to clearly communicate an idea's potential for meeting a given purpose.

Additionally, frameworks recognize—either explicitly or implicitly—the role of creative dispositions in cultivating creative thinking skills. Behaviors such as collaboration, discipline, persistence, risk-taking, and openness to new experiences are thought to mediate creative thinking skills and creative output.

The instructional pathway begins with the development of a wide range of ideas. Next, those ideas are combined and synthesized to develop new ideas. These ideas are then operationalized, pressure tested, analyzed, and evaluated. Finally, the best ideas are communicated to achieve a desired result or solve a problem. This cycle often continues as inventions, ideas, and new discoveries are formally tested and more is learned. Later, in the section on instruction, specific instructional strategies are considered that have been found to influence the development of these creative thinking components.

## What Might Be Distinct about Creative Thinking Across Contexts and Cultures?

Models of creative thinking are developed through different cultural lenses: Definitions and attributes of creative thinking vary across cultures and contexts. Creativity literature often characterizes cultural differences using the “East vs. West” dichotomy (Shao et al., 2019). Eastern countries (e.g., China, Japan, Korea) emphasize collective interests over individualism and share similar philosophical and thought traditions (e.g., Taoism, Confucianism). Western countries (e.g., United States, Western Europe, Australia) reflect more individualist cultures and follow ideas linked to ancient Greece, Christianity, Judaism, and rationality (Dubina & Ramos, 2016; Xie & Paik, 2019).

Models of creative thinking are developed through different cultural lenses: Definitions and attributes of creative thinking vary across cultures and contexts.

Shao et al. (2019) reviewed the creativity research to examine how culture shapes creativity and creative thinking. Three key findings emerged:

- People from different cultures have distinct conceptions of creativity.
- Individuals from different cultures (particularly Eastern vs. Western cultures) show different preferences in terms of valuing specific components of the creative process and output. For example, when evaluating creative output, *usefulness* is perceived as more important than *novelty* in Eastern cultures.
- Assessments of creativity tend to incorporate content that is culturally bound. As a result, cross-cultural differences may be attributed to cultural biases inherent in the assessment.

With regard to creative thinking, Shao et al.'s review found that foundational research-based frameworks used in the East and West generally highlight similar processes; however, key variations exist. Western-based research tends to highlight cognitive aspects of the creative process, whereas Eastern-based research highlights emotional and intrapersonal aspects that influence creative thought. Moreover, Western vs. Eastern conceptions of the creative process tend to emphasize different purposes. The West prioritizes creative thinking for problem solving; the East prioritizes creative thinking for rediscovery, revelation, and spiritual enlightenment. For example, Maduro (1976) described a community in India that considered the creative process a sacred mystery. Creative evolution in this community is inextricably connected to the four stages of the Yoga Sutras: student, householder, forest walker, and renunciate. The creative process develops through dispositions emphasized in the Yoga Sutras, such as self-will, persistence, internal identification, personal insights, and social communication of personal realizations. Contrast this with Wallas' (1926) foundational four-stages of the creative process—preparation, incubation, illumination, and verification—a model reflecting many Western conceptualizations of creative thinking (e.g., ACARA, 2018, OECD, 2019; Ramalingham et al., 2020; Durham Commission, 2019) (Shao et al., 2019, pp. 4-5).

Culture also influences the assessment of creative thinking and the validity of results. Items developed and used to assess creative thinking often incorporate images and objects that are culturally bound and may introduce bias. For example, a study of children's creativity in Hong Kong, which used the Chinese version of the Torrance Test of Creative Thinking (TTCT), found that TTCT images and stories were much more familiar to American and European children than to Asian children (Lubart, 1999). Additionally, the Shao et al. (2019) review found that culture influences the ratings of creative products. Specifically, variability in scores of creative output is related to the cultural characteristics of raters (also see Yarbrough, 2016).

Culture also influences the assessment of creative thinking and the validity of results. Items developed and used to assess creative thinking often incorporate images and objects that are culturally bound and may introduce bias.

Recent findings from these cross-cultural studies have important implications for those who teach and assess creative thinking. First, a student's cultural background may influence how they approach a creative task. For example, a student focused on the collective interests of the group may be less inclined to offer alternative ideas or provide critical feedback. Second, what is creative to one student may not be creative to another. Because of this, classroom teachers should provide clear guidelines and expectations for a creative task. Additionally, regular communication and feedback with students can ensure that students share a common understanding of the creative process, the creative task, and evaluative expectations. Third, educators and experts should remain aware of cultural biases that may influence their ratings of students' creative thinking performance or creative work products. Moreover, they should be sensitive to the subjectivities that they bring to the creative process and how that might affect students' task engagement and performance.

## INSTRUCTION

### What Are Some Instructional Approaches to Teaching Creative Thinking?

Problem- and project-based learning, design-based learning, Montessori, and dialogic learning (e.g., the Socratic Method) are frequently cited approaches for promoting higher-order thinking skills, including creative thinking (Beghetto & Kaufman, 2010; Darling-Hammond et al., 2019; Davies et al., 2013; Lacrin et al., 2019). These approaches share many instructional design criteria and strategies, such as open-ended tasks



and activities, that require students to apply their knowledge and skills to novel situations. When used effectively, the combination of these design criteria and strategies is presumed to cultivate essential prerequisite skills and dispositions that, in turn, influence creative thinking.

The strategies described below are commonly held as good teaching practice and, further, correlate with many higher-order thinking skills beyond creative thinking. Although research has yet to firmly establish causal links across select strategies and approaches, mediating dispositions, and creative thinking outcomes, this correlational evidence is based on robust theoretical frameworks and a growing empirical knowledge base (Lucas, 2023). Appendix C includes additional information regarding promising instructional practices for supporting the development of students' creative thinking.

**Integrate Creative Thinking Into Content-Specific Instruction.** Creative thinking can be fostered in all school subjects (Kampylis & Berki, 2014) using the types of instructional approaches described above. The OECD report, *Fostering Students' Creativity and Critical Thinking* (Vincent-Lacrin et al., 2019), presents a framework for designing classroom activities to teach creative thinking skills as part of the curriculum. Additionally, the report describes 11 "signature pedagogies," such as problem- and project-based learning, which are ideal for developing creative and critical thinking skills.

#### **Incorporate Authentic Questions and Open-Ended**

**Problems.** For example, project-based learning is designed to engage students in activities that promote divergent and critical thinking, analysis, and other skills associated with creative thinking because of its focus on incorporating authentic questions and open-ended problems.

**Make Room for Student Voice and Choice.** Allow students to choose problems that are personally meaningful and give students choice around how they demonstrate what they learn. These allowances provide students with the freedom and flexibility to pursue problems that are personally meaningful, which, in turn, increases student engagement and makes learning more fun.

**Create Activities that Result in Visible, Tangible Products or Artifacts.** Research in the learning sciences indicates that students learn better when they develop external representations of their constructed knowledge (Scardamalia & Bereiter, 2006). These external representations can be represented as abstract ideas or solutions (e.g., via a written essay, presentation, model, drawing) or tangible products. Making the creative thinking process visible is also important in the assessment of creative thinking skills.

**Provide Time for Deliberate Practice of Content-Based Skills.** This is particularly important for students who have not yet mastered skills that may be foundational to understanding content, such as fluency and comprehension in reading, or times tables and estimation in mathematics. When foundational skills are automatized, working memory has more capacity to develop and experiment with new ideas. Additionally, deliberative practice happens through self-, peer-, and expert feedback, iteration (e.g., drafting and re-drafting ideas), and demonstrating or presenting work to multiple audiences.

Problem- and project-based learning, design-based learning, Montessori, and dialogic learning (e.g., the Socratic Method) are frequently cited approaches for promoting higher-order thinking skills, including creative thinking (Beghetto & Kaufman, 2010; Darling-Hammond et al., 2019; Davies et al., 2013; Lacrin et al., 2019).

Creative thinking can be fostered in all school subjects.

**Prioritize Creative Pursuits.** Teachers can prioritize creative thinking by listening to students' interests, affirming their strengths and talents, incorporating students' unique interests in performance tasks and classroom activities, and modeling intrinsic enjoyment of creative pursuits. Teachers can reinforce intrinsic motivation by actively developing creative thinking processes in their classroom and modeling their own enjoyment of creative pursuits (Hennessey & Amabile, 1987).

**Use Strategies That Challenge Students and Push Them To Create New Ideas.** Strategies such as scaffolding, providing formative feedback, thinking aloud, and modeling the creative thinking process are especially effective when they target a student's zone of proximal development.

**Balance Time for Independent Work, Dialogue With Teachers, and Collaboration With Peers.** Students need time to struggle with questions, brainstorm ideas, and attempt to understand difficult concepts on their own. However, research also suggests that creative thinking is optimized when students are exposed to multiple perspectives. Independent work (e.g., brainstorming, deliberative practice, problem solving, experimentation, reflection) allows students time to develop and clarify their own thinking. Collaboration with the teacher and one's peers can then be used to introduce new ideas and offer different perspectives. As students listen to others, they are prompted to connect, combine, manipulate, and expand their thinking to produce new ideas and solutions.

**Assess and Reward Creativity In Appropriate Ways.** Using external rewards and competition to externally motivate student performance can stifle creative thinking (Amabile, 2020). Teachers should minimize summative evaluation of students' creative thinking skills and, instead, use narrative feedback and other types of formative assessment. Formative assessments, which provide students with detailed feedback on how they are progressing, are better than summative assessments for fostering creative thinking (Kampylis & Berki, 2014). Moreover, narrative feedback is most useful when it considers students' prior achievements and supports their own learning goals.

**Be Flexible With the Use of Space and Time.** Provide time for students to reflect and experiment with new ideas. Leave time for the unexpected and accept non-conformity. For example, common misconceptions are most effectively addressed when they initially occur and create a "wait, that can't be right" moment, which places students in a state of cognitive dissonance. Teachers can take advantage of these opportunities when they are willing to shift plans to address the problem at hand. They can also use the time to explore, examine, and elaborate on novel ideas.

**Allow for Mistakes and Sensible Risk-Taking.** The creative thinking process is inherently risky. Teachers promote creative thinking when they allow students to take risks by exploring and experimenting with novel ideas and solutions. Teachers

Teachers can prioritize creative thinking by listening to students' interests, affirming their strengths and talents, incorporating students' unique interests in performance tasks and classroom activities, and modeling intrinsic enjoyment of creative pursuits.

Creative thinking is optimized when students are exposed to multiple perspectives.

Using external rewards and competition to externally motivate student performance can stifle creative thinking (Amabile, 2020).

Teachers promote creative thinking when they allow students to take risks by exploring and experimenting with novel ideas and solutions.

promote risk-taking by modeling the creative thinking process, illustrating how historically consistent failure has often preceded the most creative solutions, and cultivating a classroom environment in which failure is acceptable in working toward success.

**Encourage Student Use of Educational Technologies.** New communication technologies (e.g., Google communication tools, i-phone, internet) and artificial intelligence (AI) assistants (e.g., Chat GPT) are revolutionizing how instruction is delivered and students learn. These technologies encourage creative thinking by retrieving, synthesizing, and evaluating loads of information and representing information in a variety of modes. These technologies support a diversity of learning strategies. They also dissolve the boundaries between learning in and outside of school. There is a consensus among research- and practitioner-experts that these technologies, when integrated with student-centered pedagogies, can become powerful tools for self- and peer-assessment, problem-solving, inquiry, communication, and collaboration—all skills that are foundational to the creative thinking process (Kampylis & Berki, 2014).

Table 3 presents a high-level theory of change for using instruction to promote creative thinking. The first column is a list of promising instructional strategies, the second provides key dispositions that emerge through the use of such strategies, and the third shows the resulting improvements in creative thinking domains. The bi-directional arrow between dispositions and creative thinking outcomes recognizes their reciprocal nature. For example, a growth mindset influences creative thinking outcomes. When a student obtains feedback revealing this connection, they are more likely to apply those same growth mindset behaviors to future creative thinking tasks (Guskey, 2021).

**Table 3.**  
***Theory of Change for Designing Instruction to Develop Creative Thinking***

PROMISING INSTRUCTIONAL DESIGN CRITERIA	DISPOSITIONS THAT MEDIATE CREATIVE THINKING	CREATIVE THINKING OUTCOMES
<ul style="list-style-type: none"> <li>• Integrate creative thinking into content</li> <li>• Use authentic and open-ended questioning</li> <li>• Promote student voice and choice</li> <li>• Balance independent work and collaboration</li> <li>• Create visible products and artifacts</li> <li>• Appropriately assess creative thinking</li> <li>• Provide opportunities for deliberate practice</li> <li>• Prioritize creative pursuits</li> <li>• Challenge students</li> <li>• Flexibly use space and time</li> <li>• Allow for mistakes and risk-taking</li> <li>• Encourage technology use in creative pursuits</li> </ul>	<ul style="list-style-type: none"> <li>• Ability to work through ambiguity</li> <li>• Collaboration</li> <li>• Comfort with risk-taking and failure</li> <li>• Discipline</li> <li>• Growth mindset</li> <li>• Imagination</li> <li>• Inquisitiveness</li> <li>• Intrinsic motivation</li> <li>• Openness to ideas</li> <li>• Persistence</li> <li>• Playfulness</li> <li>• Self-direction</li> <li>• Self-regulation</li> </ul>	<ul style="list-style-type: none"> <li>• Divergent thinking (number, range, originality of ideas)</li> <li>• Experimenting and manipulating ideas</li> <li>• Convergent thinking (thinking critically, analyzing, and selecting the best ideas)</li> <li>• Reflecting and evaluating (assessing feedback on ideas)</li> <li>• Elaborating (extending and communicating ideas)</li> </ul>

## What Do We Know About the Effects of Instruction on the Development of Creative Thinking Skills?

There is limited empirical evidence supporting the effectiveness of the instructional design criteria in Table 3 for improving creative thinking skills. This is because much of the related research has been qualitative and descriptive; little has employed correlational or experimental designs. These latter studies have investigated programs that are based on different creative-thinking definitions and frameworks, implement different instructional design criteria, focus on different student populations, and perhaps unsurprisingly, produce mixed results. Consequently, it remains unclear which types of interventions work, for whom they work, and under what conditions they work. The paragraphs below summarize what we presently know about the effects of instruction on the development of creative thinking skills.

**Impacts of Instructional Approaches Presumed to Improve Creative Thinking Outcomes.** The Condliffe et al. (2017) literature review regarding project-based learning approaches (PBL) found that PBL showed limited effects in math and literacy and stronger effects in science and social studies. This is important because PBL is designed to develop creative thinking skills and related skills such as critical thinking, collaboration, and communication. Condliffe et al. (p. iii) concluded that evidence for PBL's effectiveness is "promising but not proven" for improving these higher-order academic skills and workforce outcomes. Studies of PBL's effects on higher-order thinking skills, such as creative thinking, are limited by the paucity of valid and reliable measures of these skills. Additionally, most of the evaluations conducted on PBL were not designed to address causal claims about the effects of PBL.

Evaluations of its effectiveness have been hampered by the paucity of valid, reliable, and readily usable measures of the kinds of deeper learning and interpersonal and intrapersonal competencies that PBL aims to promote. Many studies, too, have used evaluation designs that leave open the possibility that factors other than PBL were responsible for the outcomes that were found (Condliffe et al., 2017, p. iii).

The Hewlett Foundation funded a series of studies that examined whether students who attended high schools with at least moderately well-implemented approaches to promote "deeper learning" had greater deeper-learning opportunities and achieved better short- and long-term outcomes compared with other schools.<sup>3</sup> The concept of deeper learning incorporates higher-order thinking skills and entails (a) deeper understanding of core academic content; (b) the ability to apply that understanding to novel problems and situations; and (c) the development of a range of competencies such as mastery of core academic content, collaboration, growth mindset, critical thinking and problem solving, effective communication, and learning how to learn. Early studies conducted by the American Institutes for Research (2022) found positive impacts on opportunities for deeper learning, deeper learning competencies (e.g., collaboration, self-efficacy), high school graduation and college enrollment. However, a follow-up study conducted five-years later found mixed and largely inconclusive effects on college and workforce outcomes (American Institutes for Research, 2022).

<sup>3</sup> More information about studies of deeper learning can be found here: <https://www.air.org/project/study-deeper-learning-opportunities-and-outcomes>



**Impacts of Creative Instructional Strategies and Interventions in K-12 School Settings.** This section summarizes the research literature on instructional strategies specifically designed to improve creative thinking outcomes. Cremin and Chappell (2021) recently reviewed the research literature concerning the impacts of “creative pedagogies” on students’ creativity outcomes. They identified seven interrelated strategies characterizing such pedagogies:

- generating and exploring ideas
- encouraging autonomy and agency
- playfulness
- problem-solving
- risk-taking
- co-constructing and collaborating
- teacher creativity

Most studies in this literature were qualitative and not designed to generalize across schools or student populations; only 6 of the 35 studies meeting review criteria sought to examine the influence of creative pedagogies on creative outcomes. Of these six studies, samples varied widely regarding grade level, setting, student demographics, measured outcomes, and reported findings. From these few studies, Cremin and Chappell concluded that “there is little empirical evidence of the impact of creative pedagogies on students’ creativity” (p. 320). Additionally, they recommended that more research-practitioner partnerships be established to examine the effects of specific pedagogical practices on creative outcomes.

Lai et al. (2018) reviewed research on specific programs designed to improve targeted components of creative thinking, such as divergent and convergent thinking, and elaborating on a solution (also see Appendix C). They summarized three meta-analyses, finding average effect sizes (*ES*) on creative thinking components between .24 and .84 standard deviations. The largest effect sizes were associated with problem solving (*ES* = .84) and divergent thinking (*ES* = .75), while smaller effect sizes were reported for performance tasks (*ES* = .35) and attitudes and behavior such as reacting to creative ideas and initiating creative efforts (*ES* = .24). The most effective interventions emphasized the use of cognitive processes for idea generation, problem-finding strategies, and conceptual combination (synthesizing two or more basic concepts into a higher-order concept). Effective interventions also tended to involve social modeling, cooperative learning, and application of creative strategies (e.g., divergent/convergent thinking) to solve real-world problems. Interventions having smaller effects stressed “imagery, expressive activities, and imaginative exercises” and used “feedback, instructor encouragement, and unstructured exercises as a basis for training” (pp 15; also see Scott et al., 2004b, p. 164).

**Impacts of Creative Strategies Among Adults.** Haase et al. (2023) conducted a meta-analysis synthesizing 332 effect sizes across 84 studies of various instructional methods on creativity and the creative thinking process in adults.<sup>4</sup> Structured training and other “creative enhancement methods” had moderate effects on creativity outcomes, with *ES* = .53. Promising strategies for improving creative performance included meditation, exposure to unfamiliar cultures or situations, and short divergent-thinking tasks. Because this review focused on adults, it is unclear whether these effects generalize to K-12 students. Haase et al. also examined impacts on the more general construct of creativity: Outcome measures included both creative thinking *processes* (e.g., measures of divergent thinking) and creativity *outcomes* (e.g., performance tasks).

<sup>4</sup> For a study to be included in this meta-analysis, the mean age of the sample had to be above 18.0 years.

Further examination of the effect of various instructional methods on specific aspects of the creative thinking process, which remains uncertain, are warranted.

**Summary.** Instructional approaches and strategies designed to enhance creative thinking processes are far from proven, to say the least. Our understanding of approaches, strategies, and interventions that impact creative thinking processes is still in its infancy. More experimental and quasi-experimental investigations are needed so that causal claims can be confidently made about the effects of instructional approaches and strategies on creative thinking processes. Additionally, more effort should be directed at improving the reliability and validity of assessments purporting to measure creative thinking holistically as well as creative thinking components.

Instructional approaches and strategies designed to enhance creative thinking processes are far from proven.

More experimental and quasi-experimental investigations are needed so that causal claims can be confidently made about the effects of instructional approaches and strategies on creative thinking processes.

## MEASUREMENT/ASSESSMENT

### How is Creative Thinking Typically Measured or Assessed?

Measurement and assessment are two distinct concepts. Treffinger et al. (2002) distinguished between measurement and assessment in their guide for assessing student creativity. Measurement, they said, refers to the use of instruments or testing procedures to obtain quantitative data related to student achievement. In contrast, assessment is a process of gathering and reasoning from evidence to understand students' strengths and weaknesses and, in turn, the corresponding implications for instruction. Treffinger et al. identified several sources for gathering information about creative abilities:

- performance data, such as creative products, recitals, and accomplishments
- self-reported data, such as personal checklists and attitude inventories
- rating scales, such as ratings from teachers, peers and parents
- tests, such as standardized performance-based items

Reliability and validity are important issues to consider, of course, when making judgments about students' creative thinking skills. Score reliability is improved by standardizing the test design, administration, and scoring conditions. Score reliability also is improved by increasing the number of items or tasks a student responds to. However, assessments tend to define creativity narrowly (e.g., divergent thinking), comprise mainly selected-response items, and offer limited representations of the construct. This is called construct underrepresentation and, compared with a more complete representation of the creative thinking construct, can adversely affect the validity of score interpretations. For example, someone who scores high on a measure of divergent thinking might nonetheless struggle to converge ideas and produce something novel and useful (Bolden et al., 2020). Thus, a more holistic understanding of students' creative thinking skills requires assessment via multiple sources of evidence, including performance-based tasks where application of the creative thinking process can be made visible.

Reliability and validity are important issues to consider, of course, when making judgments about students' creative thinking skills.

Attempts to assess creative thinking and creativity have occurred for over a century. Consequently, standardized measures of creative thinking exist that are reasonably stable—if students took the same measure again, they would get similar results—and moderately predictive of later performance in this domain (Lai et al., 2018). Additionally, classroom-based assessments can elicit evidence of creative thinking processes. Table 4 presents common standardized measures (first column) and types of classroom-based assessments (second column) of creative thinking. Different types of assessments can provide a unique window into a student’s creative thinking skills and, in turn, support their creative potential. A detailed discussion of these examples follows the table.

**Table 4.**  
**Examples of Creative Thinking Assessments**

CREATIVE THINKING STANDARDIZED MEASURES	TYPES OF CLASSROOM-BASED ASSESSMENT <i>(could be used to gather evidence about a student's creative thinking)</i>
<ul style="list-style-type: none"> <li>• Alternative Uses Test (Guilford, 1967)</li> <li>• Guilford’s Tests of Creativity (Berger &amp; Guilford, 1965)</li> <li>• Creativity Assessment Packet (Williams, 1993)</li> <li>• PISA Creative Thinking Assessment (OECD, 2019)</li> <li>• Remote Associates Test (Mednick, 1962; Wu et al., 2020)</li> <li>• Runco’s Ideational Behavior Scale (Runco et al., 2001)</li> <li>• Torrance Tests of Creative Thinking (Goff &amp; Torrance, 2000; Khatena &amp; Torrance, 1988; Torrance, 1981)</li> </ul>	<ul style="list-style-type: none"> <li>• Anecdotal records</li> <li>• Behavioral checklists</li> <li>• Peer feedback</li> <li>• Performance-based tasks</li> <li>• Portfolios</li> <li>• Questionnaires and surveys</li> <li>• Self-assessment</li> <li>• Teacher feedback</li> </ul>

**Measures of Creative Thinking**

Standardized creative thinking measures tend to focus on divergent thinking. For example, the Torrance Tests of Creative Thinking (TTCT; Torrance et al., 2003), which targets the domain of divergent thinking, is one of the most widely used measures of the creative process. The TTCT has two versions: figural and verbal. The figural measure uses three picture-based exercises, and the verbal measure comprises six word-based ones. Figural tasks are scored for fluency, originality, and elaboration,<sup>5</sup> while verbal tasks are scored for fluency, originality, and flexibility. There are other well-established divergent thinking tests, such as the Alternative Uses test (Guilford, 1967).<sup>6</sup> Divergent thinking is only one dimension of creative thinking, and this dimension therefore should not be considered in isolation to measure creative ability.

Standardized creative thinking measures tend to focus on divergent thinking.

That said, standardized measures of creativity may be useful for evaluating how well school- or classroom-based practices affect students’ creative thinking processes based on some intervention. For example:

- A school administers the TTCT at the beginning and end of the school year to examine the effectiveness of a creative thinking intervention on students’ divergent thinking skills.

<sup>5</sup> Authors stopped scoring the fluency tasks for flexibility because the scores could not be differentiated from fluency scores (Kim, 2006).

<sup>6</sup> See Treffinger et al. (2002, Table 2, p. 14) for a more complete list of indicators of creativity focused on idea generation and divergent thinking.

- A team of teachers administer the PISA Creative Thinking Assessment to grade 10 students to evaluate the effectiveness of a local curriculum designed to improve creative thinking skills.
- A mathematics teacher uses one of these standardized measures in an action research project, in which they ask, “Did changes in how I delivered feedback on complex real-world problems influence students’ openness to new ideas and experimentation with mathematical concepts?”

In all three examples, the creative thinking assessment is treated as an outcome; it measures how changes in practice (e.g., a new curriculum or instructional strategy) may influence dimensions of creativity (e.g., divergent thinking, convergent thinking, elaboration). By using more formal measures in these ways, educators may contribute to their own understanding about how creativity develops across the K-12 grade span.

### ***Classroom-Based Assessment of Creative Thinking***

Assessment of creative thinking should rely on multiple information sources to holistically understand an individual’s or group’s creative potential, including both strengths and areas for improvement. Teachers collect and use assessment information, gathered through formal measures (e.g., end-of-unit tests, other curriculum-based assessments) and informal sources (e.g., teacher-student interactions, observations), to understand and support students’ creative thinking. Many classroom-based assessment methods can enhance the creative thinking process (Treffinger et al., 2002). Below are examples of classroom-based assessment methods and how they can support the development of creative thinking processes.

Assessment of creative thinking should rely on multiple information sources to holistically understand an individual’s or group’s creative potential, including both strengths and areas for improvement.

**Anecdotal Records.** Anecdotal records are brief, qualitative descriptions of student behaviors, where the teacher systematically records evidence of skills and dispositions associated with creative thinking. For example, some teachers will tab sections of a notebook with students’ names and then document when a student demonstrates particular skills. By doing so, teachers have a richer pool of data for documenting when, and how, students’ demonstrate creative thinking.

**Behavioral Checklists.** Behavioral checklists enable the teacher to convey to students hard-to-observe creative thinking dispositions, such as taking risks, being open to new ideas, embracing ambiguity, practicing resilience, and being curious. Checklists most often are used during, or immediately after, instruction to monitor progress and make instructional or behavioral adjustments. For example, teachers may develop—or ask students to develop—a list of behaviors that arguably are evidence of creative thinking. Teachers could ask students to set a learning goal related to one of these creative thinking dispositions at the beginning of a lesson, and then reflect on their success towards the end of the lesson.

**Performance Tasks and Portfolios of Students’ Work.** Performance tasks and portfolios of students’ work are useful for assessing students’ application of knowledge and skills to complex, novel problems. This requires the use of creative thinking processes. Additionally, students can often choose how they will demonstrate proficiency with these assessments, which promotes meaningful and authentic engagement and further enhances creative thinking. These assessments could also allow the teacher and peers to provide formative feedback regarding skills associated with creative thinking, such as critical thinking, collaboration, and problem-solving.

**Questionnaires and Surveys.** Questionnaires and surveys can be used to quantify the extent to which environmental conditions support students' creative thinking. Although surveys typically are used for evaluative purposes at the school or classroom level, they also can serve to prompt student self-reflection about how to improve creative thinking skills and dispositions. These measures also can be used by teachers to inform instructional next steps for improving students' creative thinking skills. For example, surveys can prompt teachers to reflect on questions such "How do my students think creatively," and "What skills and dispositions should they rely on when they engage in the creative process?"

**Self-Assessment and Peer Feedback.** Self-assessment and peer-feedback can support student reflection and goal setting. Through collaborative discussions or structured questioning, peers can help the students other students reflect on key creative thinking processes and dispositions. Peers also can recommend strategies that students can try for improving creative thinking skills, such as thinking divergently and convergently, experimenting with ideas, and elaborating on details about how something works. With respect to self-reflection and self-assessment, journals and learning logs are useful tools for documenting behaviors when students are engaged in specific activities or content. Students can review logs to revisit and reflect on prior ideas, brainstorm new ideas, or verbally walk through "what-if" scenarios. They also can evaluate their success in using creative thinking strategies. For example, a teacher could ask students to reflect on the question, "how did you nurture your creative potential this week?" Further, teachers can provide support through daily or weekly student prompts to promote divergent and convergent thinking (e.g., "list as many uses for water as you can think of").

**Teacher Feedback.** Students benefit from regular and timely feedback on their creative thinking processes and dispositions. Teacher feedback is an essential element in the formative assessment process and, when delivered effectively, produces greater learning (Black & Wiliam, 1998; Hattie, 2008; Marzano et al., 2001). Effective feedback should be goal-referenced, concrete, actionable, specific and personalized, timely, ongoing, and consistent (Wiggins, 2012). Moreover, because feedback is most effective when it references a well-defined, long-term goal (e.g., developing a novel and useful solution to a specific problem), providing frequent feedback against the goal is essential for improvement.

Students benefit from regular and timely feedback on their creative thinking processes and dispositions.

Teachers can provide effective feedback to students as they engage in the creative thinking process. When a teacher routinely points out creative behaviors and thoughts as they occur, students are more likely to both recognize and internalize those thought processes. Following these observations with specific and timely suggestions can enhance the creative thinking process. Additionally, when teachers show students how to deliver effective feedback, students can, in turn, provide more effective feedback to their peers.

### What are the Measurement and Assessment Issues Related to Creative Thinking?

One issue that affects creative thinking measurement and assessment is the interpretation of assessment results, which often are based on disparate definitions of creative thinking. More specifically, creative thinking, as assessed, often reflects an unclear definition or one that underrepresents the creative thinking process. A clear definition is the foundation of sound measurement and assessment. Unfortunately, research literature often conflates the concepts of creativity, creative thinking, and specific components of creative thinking. This compromises validity for the announced use.

Research literature often conflates the concepts of creativity, creative thinking, and specific components of creative thinking. This compromises validity for the announced use.



For example, an assessment that purports to measure creative thinking may actually be measuring creative performance. Or a measure of divergent or critical thinking may be used to assess creative thinking. The propensity to conflate terms is quite common and has been called the jingle-jangle problem. The jingle problem is when the same term is defined differently across research traditions (Duckworth et al., 2019), whereas the jangle problem is when different terms are used to refer to the same construct. The jingle-jangle problem makes it difficult to tease apart the differences between creativity and creative thinking. However, doing so is important. This is because valid, reliable, and fair assessment relies on a clear understanding of the skills and abilities to be measured. One objective of this paper is to clearly delineate the constructs of creativity and creative thinking. A clear definition makes it easier to (a) clarify the desired inferences that educators expect to make from assessment results, (b) determine what evidence will be collected, and (c) design or select assessment approaches and tools that provide information to elicit the appropriate evidence and support valid inferences (Mislevy & Haertel, 2006).

Another issue affecting creative thinking measurement and assessment is that mediating factors often are difficult to control, or isolate, when designing assessments and measures of creative thinking. A preponderance of evidence supports a confluence approach to theorizing about creative thinking. As described above, confluence approaches outline four necessary components for any individual to produce creative work: (a) domain-specific knowledge and skills, (b) creative thinking skills (e.g., divergent and convergent thinking), (c) task motivation, and (d) a conducive environment. If a confluence-approach theory of creative thinking holds true, then it suggests the assessment of creative thinking skills are mediated by a range of skills and dispositions. For example, when a student cannot transfer skills from one domain to another, it might be because they need

- more domain-specific instruction;
- more instruction on creative thinking skills (e.g., divergent/convergent thinking);
- more instruction to improve attention, persistence or motivation; or
- an environment or task that addresses unique language or cultural issues that may have affected the student's performance.

Content knowledge and dispositional skills, as well as environmental and cultural considerations, are all potential confounds of creative thinking outcomes. Therefore, the design of creative thinking measures—and especially standardized measures—must account for the potential role of these factors in an individual student's creative thinking development and performance.

A third issue involves the intended purpose and use of creative thinking assessments. For example, assessment can suppress creativity when it is used—or perceived to be used—to

- influence competition and comparisons among students,
- motivate performance (i.e., using grades to reward or punish), or
- evaluate summatively a student's creative thinking performance, particularly for high-stakes purposes.

Using assessments can cause anxiety, undermine students' motivation, and stifle their capacity to think creatively (Bolden et al., 2020; Hennessey & Amabile, 1987). Moreover, high-stakes testing can discourage creative thinking, especially in low-performing schools (Olivant, 2015). And the pressure to raise scores on such tests can intensify a focus on drill-and-kill skills,

Using creative thinking assessments for formative purposes can improve students creative thinking skills (Bolden et al., 2020).

influence more traditional and rigid instruction, detract from activities that encourage exploration and discovery, and discourage teachers and students from focusing on related higher-order skills like critical thinking and problem-solving (Guthrie, 2002; Jones et al., 2003). In contrast, using creative thinking assessments for formative purposes can improve students creative thinking skills (Bolden et al., 2020).

## What are the Implications of Previous Research for Assessment Design and Use?

The findings described above have several implications for assessment design and use. The section below provides general principles for both large-scale and classroom-based use.

### Assessment Design

**Evaluate the Defining Characteristics.** Not all creative thinking assessments reflect comprehensive or research-based definitions of the creative thinking process. Educators should consider the assessment's announced definition and then ask, What creative skills and abilities does this assessment *really* assess? For example:

- Do the underlying dimensions of creative thinking, as described in the assessment's definition of creative thinking, accurately reflect the predominant research-based frameworks?
- Does the assessment evaluate a product's novelty and usefulness and, therefore, assess creativity more generally?
- Does the assessment's definition reflect all aspects of the creative thinking process, or is it designed to assess only a few (e.g., divergent thinking or analytic thinking)?

With regard to the last question, robust measures of specific aspects of creative thinking may be useful for improving particular dimensions of creative thinking, provided they are not mistaken for the comprehensive process of creative thinking itself.

**Utilize Principles of Evidence-Centered Design.** Assessments can be designed to measure targeted dimensions of creative thinking. The most useful assessments elicit observable evidence and allow students to demonstrate the highest forms of creative thinking, whether it be within a content area or via general learning contexts. Evidence centered design (ECD) is a process for developing assessments of hard-to-observe constructs like creative thinking. ECD incorporates validity arguments into the design process, rather than seek validity evidence after administration. ECD views an assessment as an evidence-based argument, using things that students say, do, or create to make inferences about the extent of their knowledge, skills, and abilities (Mislevy & Haertel, 2006). In this way, ECD is especially relevant when designing performance tasks that include creative thinking, or its targeted dimensions, as an outcome. Through the ECD process, assessment developers delineate types of evidence—an interrelated set of knowledge, skills, and abilities—known to reflect a construct or competency. This collection of evidence is then structured to reflect the relative importance in demonstrating each competency. Rubrics can be designed to capture the intended evidence (e.g., divergent thinking, experimentation, elaboration), and the weight of that evidence, toward measuring the overall competency. Finally, cycles of iteration typically are needed to refine the rubric.

Educators should consider the assessment's announced definition and then ask, What creative skills and abilities does this assessment really assess?

Evidence centered design (ECD) is a process for developing assessments of hard-to-observe constructs like creative thinking.

**Consider the Role of Context and Culture.** Many experts question whether, and how well, creative thinking can be measured. They generally agree that creative thinking is malleable; it can be cultivated and improved through good instruction and mentoring. However, attempts to isolate creative thinking skills from contextual and culturally relevant influences is difficult if not impossible (e.g., domain-specific content, aspects of self-regulation, relevant social/emotional skills). Therefore, assessment tasks should reflect how context and culture matter.

Learning and assessment tasks that work well for fostering and assessing student creativity in one context may not work equally well in another.

The nature of creative thinking is bound within a particular social and cultural context. Learning and assessment tasks that work well for fostering and assessing student creativity in one context may not work equally well in another (Soland et al., 2013). Attending to cross-cultural validity is critical, although sparse in the literature (Ericikan & Oliveri, 2016). As Soland et al. argue,

extra caution is warranted when considering measures of 21st century competencies, particularly interpersonal and intrapersonal competencies, because these may be more culturally and contextually dependent than traditional academic skills. To the extent possible, the validity of scores on a given measure should always be confirmed locally (p. 41).

Given the inter-relationship between context and creativity within and across domains, these cautions hold true for assessing the dispositions, processes, and products associated with creative thinking. The following procedures should be used to examine the cross-cultural comparability of assessments, especially when they are administered to students in group settings (OECD, 2019):

**Review the Test Materials for Face Validity.** In this context, face validity is the extent to which what is measured by a test, task, or item is understood similarly by students who speak different languages or represent different cultural groups. Ideally, the assessment should be reviewed by experts in the measurement of creative thinking and who are familiar with the cultural groups being tested. This often happens through committee, in which groups of experts independently evaluate the assessment and then convene to compare judgments. This results in a set of recommendations for improving the assessment's quality. The review should focus on evaluating the assessment to ensure that

- the assessment's language is understood similarly across groups;
- the assessment is unlikely to produce construct-irrelevant variance—score variance that is unrelated to creative ability—by virtue of its language or other design features; and
- the assessment is free of cultural bias.

**Conduct Cognitive Labs.** Here, a draft assessment is given to a student who then engages with the test materials out loud. For example, a teacher might ask the student to “read the directions aloud and then talk through what you are thinking as you engage with the task.” Cognitive labs are helpful for identifying confusing language, possible bias, and other problems before the assessment is officially administered to others.

**Conduct Small-Scale Pilot Studies.** In such a study, the assessment is given in at least one classroom for validation purposes. An analysis of the results can reveal whether the assessment's items are performing as intended, both in general and for targeted groups of students. Any problematic items are then revised.

**Conduct a Field Trial.** A field trial serves to confirm that any problems identified in the pilot study were successfully addressed by giving the assessment to a larger, representative sample of the target population.

This process provides the opportunity to conduct a comprehensive review of the assessment prior to administering it to the whole target population. Analysis of student data or annotations of student work can be conducted to ensure that the assessment is measuring what it is designed to measure and, further, that the results support valid interpretations across racial, ethnic, and other cultural groups.

Applying these procedures is important for ensuring valid interpretations of test results in any case, but particularly where students have different socio-cultural backgrounds.

### **Assessment Use**

#### **Use a Range of Assessment Information to Support Creative Thinking.**

Many of the well-established creative thinking assessments measure individual dimensions of creative thinking. Additionally, many are based on self-perceptions. Educators who want to assess creative thinking comprehensively should incorporate a variety of summative tools and formative strategies in their practice. They should consider gathering evidence from numerous sources that include self and peer assessment, as well as teacher and expert feedback on student work products. Additionally, collecting school-level information on social and emotional mediators and climate-based information can be used to address the environmental conditions that promote creative thinking. Assessment maps can be a helpful tool for ensuring that a range of information is being collected and used throughout the year to inform creative thinking skills.

Educators who want to assess creative thinking comprehensively should incorporate a variety of summative tools and formative strategies in their practice.

**Prioritize Assessment Practices that Complement Promising Instruction.** The research base linking instructional strategies to specific creative thinking skills is relatively sparse. Additionally, research on instructional practices to promote higher-order thinking is promising but far from well-established. Although the field is not definitive about which instructional strategies are most effective for promoting specific higher-order skills, there are some well-established and reliable instructional principles of good instruction. Approaches such as project- and problem-based learning are two examples. More specific examples are to

- facilitate the use of open-ended questions;
- allow for student voice and choice;
- enable opportunities for collaboration and idea-sharing;
- provide opportunities for teachers to work with students individually and in small groups;
- enable teachers to connect with students on a personal level, providing opportunities for encouragement and regular feedback on skills that mediate the creative process; and
- promote the use of portfolios and performance tasks through which students can both cultivate and demonstrate creative thinking skills.

#### **Use Assessment to Improve Environmental Conditions for Creative Thinking.**

The creative press—the environment in which one learns to be creative—is a critically important lever for integrating creative thinking into students' and teachers' everyday behaviors. Schools that attend to the conditions supporting creative thinking and associated skills tend to also promote creative thinking and performance. Additionally, students learn through interactions with their environment. Parents, adults, and community members who strive to be creative thinkers will raise children to become creative thinkers. Adults who prioritize the

Schools that attend to the conditions supporting creative thinking and associated skills tend to also promote creative thinking and performance.

creative process likely will incorporate creative practices into their day-to-day conversations, model behaviors that cultivate creativity, and raise children who practice creative thinking and value creative behaviors. Collectively, by practicing their own creative thinking, adults create an environment for students that is conducive to thinking creatively.

**Avoid the Use of Creative Thinking Assessments for High-Stakes Purposes.** There is considerable debate about whether a person’s creative thinking ability can, and should, be evaluated through large-scale assessment. And perhaps more importantly, there also is debate around whether, and under what circumstances, large-scale assessments of creative thinking could ever be a useful method for improving creative thinking abilities. Ultimately, an assessment’s effectiveness depends on its purpose and use. For example, a summative assessment can be productive when one’s purpose is to monitor the development of creative thinking over time. However, an assessment that reduces creative thinking to a single score to rank and sort students arguably harms the creative process. Additionally, formal evaluation of students’ creative pursuits similarly can have negative effects. Wherever possible, teachers should minimize summative evaluation of students’ creative thinking and, instead, use narrative feedback and other types of formative assessment.

Teachers should minimize summative evaluation of students’ creative thinking and, instead, use narrative feedback and other types of formative assessment.

## CONCLUSION

This report synthesized research in education-related disciplines to conceptualize creative thinking, report research findings, and discuss the corresponding implications for assessment design and use. Overall, this literature shows creative thinking to be a multi-dimensional construct that reflects a range of cognitive, interpersonal, and intrapersonal skills. Creative thinking comprises a malleable set of skills that are contextually and culturally bound; they are cultivated through formal instruction and regular exposure to environmental conditions that value the creative process. Research on programs, approaches, and instructional strategies designed to promote creative thinking is still relatively sparse. However, general principles and practices associated with project- and problem-based learning have shown promising results. Additionally, research suggests that measuring creativity is not only possible; it can be used in powerful ways to develop and optimize the creative potential of students. Doing so requires gathering data from multiple sources to understand the richness and breadth of creativity, in an appropriate context, and for appropriate purposes. Creative thinking is perhaps best developed through everyday formative instructional strategies that emphasize the development of skills and behaviors associated with the creative process, and in school communities where adults are devoted to developing their own creative potential.



## REFERENCES

- Amabile, T. M. (1983). *The social psychology of creativity*. New York, NY: Springer-Verlag.
- Amabile, T.M., (1998). How to kill creativity. *Harvard Business Review*, 76(5), 76-87.
- Amabile, T.M. (2020). How your work environment influences your creativity. Berkeley, CA: Greater Good Magazine. Retrieved from [https://greatergood.berkeley.edu/article/item/how\\_your\\_work\\_environment\\_influences\\_yourcreativity](https://greatergood.berkeley.edu/article/item/how_your_work_environment_influences_yourcreativity)
- American Institutes for Research. (2022). Does Deeper Learning Improve Longer Term Outcomes for Students? Washington DC: American Institutes for Research.
- Australian Curriculum, Assessment, and Reporting Authority (ACARA). (2018). Critical and Creative Thinking General Capabilities and Learning Continuum. Retrieved from <https://www.australiancurriculum.edu.au/f-10-curriculum/general-capabilities/critical-and-creative-thinking/>
- Baer, J. (1998) Gender differences in the effects of extrinsic motivation on creativity. *The Journal of Creative Behavior*, 32(1), 18-37.
- Berger, R. M., and Guilford, J. P. (1965). *Match problems*. Lincoln: University of Nebraska Press.
- Binkley, M., Erstad, O., Herman, J., Raizen, S., Ripley, M., Miller-Ricci, M., & Rumble, M. (2012). Defining twenty-first century skills. In P. Griffin, B. McGaw & E. Care. *Assessment and teaching of 21st century skills* (pp. 17-66). Springer.
- Black, P., & Wiliam, D. (1998). *Assessment and classroom learning*. *Assessment in Education: Principles, Policy & Practice*, 5(1), 7-73.
- Bolden, B., DeLuca, C., Kukkonen, T., Roy, S., & Wearing, J. (2020). Assessment of creativity in K-12 education: A scoping review. *Review of Education*, 8(2), 343-376.
- British Columbia Ministry of Education. (2023). Creative Thinking Core Competencies. <https://curriculum.gov.bc.ca/competencies/thinking/creative-thinking>
- Condliffe, B., Quint, J., Visher, M.G., Bangser, M. R., Drohojowska, S. Saco, L., and Nelson, E. (2017). Project Based Learning: A Literature Review, 1-78. New York, NY: MDRC.
- Craft, A., Cremin, T., & Burnard, P. (Eds.). (2008). *Creative learning 3-11 and how we document it*. Stokeon Trent: Trentham Books.
- Cramond, B. (1994). The Torrance Tests of Creative Thinking: From design through establishment of predictive validity. In R. F. Subotnik & K. D. Arnold (Eds.), *Beyond Terman: Contemporary longitudinal studies of giftedness and talent*. New York, NY: Ablex Publishing.
- Cremin, T., and Chappell, K. (2021). Creative pedagogies: a systemic review. *Research Papers in Education*, 36(3), 299-331. doi: 10.1080/02671522.2019.1677757
- Csikszentmihalyi, Mihaly. (2006). A systems perspective on creativity. In Henry, J. (Ed.), *Creative Management and Development*, p. 3-17. Thousand Oaks, CA: Sage Publications Ltd. doi: 10.4135/9781446213704.n1
- Darling-Hammond, L., Flook, L., Cook-Harvey, C. Barron, B., & Osher, D. (2019). Implications for educational practice of the science of learning and development. *Applied Developmental Science*, 24(2), 1-44. doi: 10.1080/ 10888691.2018.1537791

- Davies, D., Jindal-Snape, D., Collier, C., Digby, R., Hay, P., & Howe, A. (2013). Creative learning environments in education: A systematic literature review. *Thinking Skills and Creativity*, 8, 80–91.
- Dubina, I. N., and Ramos, S. J. (2016). "Creativity through a cultural lens: the dichotomy of "the west" and "the east"" in *Creativity, innovation, and entrepreneurship across cultures, innovation, technology, and knowledge management*. eds. I. N. Dubina, and E. G. Carayannis (New York: Springer), 29–34.
- Duckworth, A., Taxer, J.L., Eskreis-Winkler, L., Galla, B.M., and Gross, J.J. (2019). Self-control and academic achievement. *Annual Review of Psychology*, 70, 373-399. doi: 10.1146/annurev-psych-010418-103230
- Durham Commission (2019). *Durham Commission on Creativity and Education*. London: Arts Council England.
- James, S., Houston, A., Newton, L., Daniels, S., Morgan, N., Coho, W., Ruck, A., and Lucas, B. (2019). Durham Commission on Creativity and Education. Arts Council UK and Durham University
- Ercikan, K., & Oliveri, M. E. (2016). In search of validity evidence in support of the interpretation and use of assessments of complex constructs: Discussion of research on assessing 21st century skills. *Applied Measurement in Education*, 29(4), 310–318.
- Foster, N. and M. Piacentini (Eds.) (2023), *Innovating assessments to measure and support complex skills*. Paris, France: OECD Publishing. doi: 10.1787/e5f3e341-en.
- Goff, K., & Torrance, E. P. (2000). *Abbreviated Torrance Test for adults*. Bensenville, IL: Scholastic Testing Service.
- Guilford, J.P. (1967). *The nature of human intelligence*. New York, NY: McGraw-Hill.
- Guskey, T. (2021). The past and future of teacher efficacy. *Educational Leadership*, 79(3), p. 20-25.
- Guthrie, J. (2002). Preparing students for high-stakes test taking in reading. In A. E. Farstrup & S. J. Samuels (Eds.), *What research has to say about reading instruction* (3rd ed., pp. 370–391). Newark, DE: International Reading Association.
- Haase, J., Hanel, P. H. P., & Gronau, N. (2023). Creativity enhancement methods for adults: A meta-analysis. *Psychology of Aesthetics, Creativity, and the Arts*. Advance online publication. doi: 10.1037/aca0000557
- Hattie, J. (2008). *Visible learning: A synthesis of over 800 meta-analyses relating to achievement*. New York: Routledge.
- Hatzius, J., Briggs, J., Kodnani, D, and Pierdomenico, G. (2023, March). The potentially large effects of artificial intelligence on economic growth. Goldman Sachs Global Investment Research. Retrieved from [https://www.ansa.it/documents/1680080409454\\_ert.pdf](https://www.ansa.it/documents/1680080409454_ert.pdf)
- Henessey, B.A., and Amabile, T.M. (1987). *Creativity and Learning: What Research Says to the Teacher*. Washington, D.C.: National Education Association.
- Hong, E., & Milgram, R. M. (2010). Creative thinking ability: Domain generality and specificity. *Creativity Research Journal*, 22(3), 272–287. doi: 10.1080/10400419.2010.503535
- Illinois Early Learning Project. (2023). *Approaches to learning: Creativity, inventiveness, and Imagination*. Urbana-Champaign: University of Illinois College of Education Early Childhood Collective. Retrieved from <https://illinoisearlylearning.org/ielg/creativity/>
- Jia X., Li W., Cao L. (2019). The role of metacognitive components in creative thinking. *Frontiers in Psychology*, 10 (2404). doi: 10.3389/fpsyg.2019.02404.

- Jones, M. G., Jones, B. D., & Hargrove, T. Y. (2003). *The unintended consequences of high-stakes testing*. Lanham, MD: Rowan & Littlefield.
- Julmi, C., & Scherm, E. (2015). The domain-specificity of creativity: Insights from new phenomenology. *Creativity Research Journal*, 27(2), 151-159. doi: 10.1080/10400419.2015.1030310
- Kampylis, P. & Berki, E. (2014). Nurturing creative thinking. *Educational Practices Series - 25*. Retrieved from the UNESCO International Bureau of Education Digital Library, <https://unesdoc.unesco.org/ark:/48223/pf0000227680>
- Kaufman, J. C., & Beghetto, R. A. (2009). Beyond big and little: The four c model of creativity. *Review of General Psychology*, 13(1), 1–12. doi: 10.1037/a0013688
- Khatena, J. J., & Torrance, E. P. (1988). *Thinking creatively with sounds and words*. Bensenville, IL: Scholastic Testing Service.
- Kaufman, J. C., & Beghetto, R. A. (2009). Beyond big and little: The four C model of creativity. *Review of General Psychology*, 13(1), 1–12.
- Kim, K.H. (2006). Can we trust creativity tests? A review of the Torrance Tests of Creative Thinking (TTCT). *Creativity Research Journal*, 18(1), 3-14.
- Kim, K.H. (2011). The APA 2009 Division 10 debate: Are the Torrance Tests of Creative Thinking still relevant in the 21st century? *Psychology of Aesthetics, Creativity, and the Arts*, 5 (4), p. 302-308.
- Kozbelt, A., Beghetto, R. A., & Runco, M. A. (2010). Theories of creativity. In J. C. Kaufman & R. J. Sternberg (Eds.), *The Cambridge handbook of creativity* (pp. 20–47). New York, NY: Cambridge University Press. doi: 10.1017/CBO9780511763205.004
- Lai, E.R., Yarbrow, J., DiCerbo, K., and de Geest, E. (2018). *Skills for Today: What We Know about Teaching and Assessing Creativity*. London: Pearson.
- Lansing-Stoeffler, K., and Daley, N. (2023). Navigating the spectrum of conventionality: Toward a model of creative thinking. *Journal of Intelligence*, 11(2), 21. doi: 10.3390/jintelligence11020021
- Lubart, T. I. (1999). Creativity across cultures. In R. J. Sternberg (Ed.), *Handbook of creativity* (pp. 339–350). Cambridge University Press.
- Lucas, B. (2016). A five-dimensional model of creativity and its assessment in schools. *Applied Measurement in Education*, 29(4), 278–290.
- Lucas, B. (2023). *Leadership for creativity and creative thinking in schools*. University of Winchester: Centre for Real World Learning.
- Lucas, B., Spencer, E. and Stoll, L. (2021) *Creative leadership to develop creativity and creative thinking in English schools: A review of the evidence*. London: Mercers' Company.
- Ma, H. (2006). A synthetic analysis of the effectiveness of single components and packages in creativity training programs. *Creativity Research Journal*, 18(4), 435–446.
- Markle, R., Brenneman, M., Jackson, T., Burrus, J., & Robbins, S. (2013). Synthesizing frameworks of higher education student learning outcomes (Research Report No. RR-13-22). Princeton, NJ: Educational Testing Service. doi: 10.1002/j.2333-8504.2013.tb02329.x

- Marzano, R., Pickering, D., & Pollock, J. (2001). *Classroom instruction that works: Research-based strategies for increasing student achievement*. Alexandria, VA: ASCD.
- Mayer, R. and Wittrock, M. (2006). Problem-solving transfer. In D. Berliner & R. Calfee (Eds.), *Handbook of Educational Psychology*, pp. 47–62. Mahwah, NJ: Erlbaum
- Mednick SA. (1962). The associative basis of the creative process. *Psychological Review*, 69: 220–232.
- Mislevy, R. J., & Haertel, G. D. (2006). Implications of Evidence-Centered Design for Educational Testing. *Educational Measurement Issues and Practice*, 25(4), 6–20.
- Mullet, D.R., Willerson, A., Lamb, K.N., and Kettler, T. Examining teacher perceptions of creativity: A systematic review of the literature. *Thinking Skills, and Creativity*, 21, p. 9-30. doi.org/10.1016/j.tsc.2016.05.001.
- NACCCE (1999). All our futures: Creativity, culture and education, national advisory committee on creative and cultural education. London: DFEE. <http://www.cypni.org.uk/downloads/alloutfutures.pdf>
- National Research Council 2012. *Education for Life and Work: Developing Transferable Knowledge and Skills in the 21st century*. Washington, DC: The National Academies Press. <https://doi.org/10.17226/13398>
- Nicolopoulou, A. (1993). Play, cognitive development, and the social world: Piaget, Vygotsky, and beyond. *Human Development*, 36(1), p. 1-23.
- Organization for Economic Co-operation and Development. (2019). PISA 2021 Creative thinking framework: Third draft. OECD.
- Olivant, K.F. (2015). “I am not a format”: Teachers’ experiences with fostering creativity in the era of accountability. *Journal of Research in Childhood Education*, 29(1), p. 115-129. DOI: [10.1080/02568543.2014.978920](https://doi.org/10.1080/02568543.2014.978920)
- Patston, T. J., Kaufman, J. C., Cropley, A. J., & Marrone, R. (2021). What is creativity in education? A qualitative study of international curricula. *Journal of Advanced Academics*, 32(2), 207–230. DOI: [10.1177/1932202X20978356](https://doi.org/10.1177/1932202X20978356)
- Plucker, J. A. (1999). Reanalysis of student responses to creativity checklists: Evidence of content generality. *Journal of Creative Behavior*, 33, 136–137.
- Plucker, J. A., Beghetto, R. A., & Dow, G. T. (2004). Why isn't creativity more important to educational psychologists? Potentials, pitfalls, and future directions in creativity research. *Educational Psychologist*, 39(2), 83–96.
- Ramalingham, D., Anderson, P., Duckworth, D., Scoular, C, and Heard, J. (2020). Creative thinking: Skill development framework. Camberwell, VIC: The Australian Council for Educational Research Ltd.
- Resnick, M. (n.d.). All I really need to know (about creative thinking) I learned (by studying how children learn) in kindergarten. Cambridge: MIT. Retrieved from <https://web.media.mit.edu/~mres/papers/kindergarten-learning-approach.pdf>
- Rhodes, M. (1961). An analysis of creativity. *Phi Delta Kappan*, 42, 305–311.
- Runco, M.A. (1996). Personal creativity: Definition and developmental issues. *New Directions for Child and Adolescent Development*, 1996 (72), p. 3-30.

- Runco, M.A., Millar, G., Acar, S., & Cramond, B. (2010). Torrance Tests of Creative Thinking as predictors of personal and public achievement: A fifty-year follow-up. *Creativity Research Journal*, 22 (4), p. 361-368. DOI: 10.1080/10400419.2010.523393
- Runco, M.A., & Jaeger, G.J. (2012). The standard definition of creativity. *Creativity Research Journal*, 24 (1), p. 92-96.
- Runco, M.A., Plucker, J.A., and Lim, W. (2001). Development and psychometric integrity of a measure of ideational behavior. *Creativity Research Journal*, 13, 393-400.
- Scardamalia, M. and C. Bereiter (2006), *"Knowledge Building: Theory, Pedagogy, and Technology"*, in Sawyer, K. (ed.), *The Cambridge Handbook of the Learning Sciences*, Cambridge University Press, Cambridge.
- Shao, Y., Ahang, C., Zhou, J., Gu, T., and Yuan, Y. (2019). How does culture shape creativity? A mini-review. *Frontiers in Psychology*, 10 (1219), p. 1-8. DOI: 10.3389/fpsyg.2019.01219/full
- Sharp, C. (2004). Developing young children's creativity: What can we learn from research. *Topic*, 32, p. 5-12.
- Soland, J., Hamilton, L. S., and Stecher, B. M. (2013). *Measuring 21st century competencies: Guidance for educators*. Santa Monica, CA: RAND Corporation.
- Torrance, E. P. (1981). *Thinking creatively in action and movement*. Bensenville, IL: Scholastic Testing Service.
- Torrance, E. P., Ball, O. E., and Safter, H. T. (2003). *Torrance tests of creative thinking*. Bensenville, IL: Scholastic Testing Service.
- Treffinger, D. J., Young, G. C., Selby, E. C. & Shepardson, C. (2002). *Assessing creativity: A guide for educators*. Guide prepared for the National Research Center on the Gifted and Talented. Retrieved from <https://files.eric.ed.gov/fulltext/ED505548.pdf>
- Vincent-Lacrin, S. (2013, April 11). Creativity in schools: What countries do (or could do). *Education Week*. Retrieved from <https://www.edweek.org/teaching-learning/opinion-creativity-in-schools-what-countries-do-or-could-do/2013/04>
- Vincent-Lancrin, S., Gonzalez-Sancho, C., Bouckaert, M., de Luca, F., Fernandez-Barrerra, M., Jacotin, G., Urgel, J., and Vidal, Q. (2019). *Fostering students' creativity and critical thinking: What it means in school*. Paris, France: Educational Research and Innovation, OECD. doi: 10.1787/62212c37-en.
- Vincent-Lancrin, S., Urgel, J., Kar, S., and Jacotin, G. (2019), *Measuring innovation in education: What has changed in the classroom?* Paris, France: Educational Research and Innovation, OECD. doi:10.1787/9789264311671-en
- Wallas, G. (1926). *The art of thought*. London: Watts.
- Wiggins, G. (2012). Seven Keys to Effective Feedback. *Educational Leadership*, 70(1), p.10-16.
- Williams, F. E. (1993). *Creativity assessment packet examiner's manual*. Austin, TX: PRO-ED.
- World Economic Forum. (2023). *The future of job report, 2023*. World Economic Forum. Retrieved from <https://www.weforum.org/publications/the-future-of-jobs-report-2023/>
- Wu C-L, Huang S-Y, Chen P-Z and Chen H-C. (2020). A Systematic Review of Creativity-Related Studies Applying the Remote Associates Test From 2000 to 2019. *Frontiers in Psychology*, 11:573432. doi: 10.3389/fpsyg.2020.573432



Xie, G., and Paik, Y. (2019). Cultural differences in creativity and innovation: are Asian employees truly less creative than western employees? *Asia Pacific Business Review* 25, p. 123–147. doi: 10.1080/13602381.2018.1535380

Yarbrough, N. D. (2016). Assessment of creative thinking across cultures using the Torrance Tests of Creative Thinking (TTCT): Translation and validity issues. *Creativity Research Journal*, 28(2), 154–164.

## APPENDIX A

### Definitions of Creativity, Creative Thinking, and Associated Constructs<sup>1</sup>

DOMAIN	ORGANIZATION	DEFINITION	PERSON	PROCESS	PRODUCT	PRESS
Creativity	<a href="#">Durham Commission on Creativity and Education</a> , (2019)	The capacity to imagine, conceive, express, or make something that was not there before.	X	X	X	
Creativity	<a href="#">National Advisory Committee on Creative and Cultural Education</a> (NACCCE), 1999, p. 29	Imaginative activity fashioned so as to produce outcomes that are both original and of value.	X <sup>2</sup>	X	X	
Creativity	Plucker, Beghetto, and Dow, 2004	Creativity is the interaction among aptitude, process, and environment by which an individual or group produces a perceptible product that is both <b>novel and useful</b> as defined within a social context (p. 90).	X	X	X	X
Creative Thinking	<a href="#">Durham Commission on Creativity and Education</a> , 2019	A process through which knowledge, intuition and skills are applied to imagine, express or make something novel or individual in its contexts. Creative thinking is present in all areas of life. It may appear spontaneous, but it can be underpinned by perseverance, experimentation, critical thinking and collaboration.	X	X	X	X
Creative Thinking	Markle et al., 2013	Creative thinking can be defined as: (1) generation of new ideas, (2) novel integration of existing ideas, and (3) application of new ideas in a real-world setting.		X	X	X <sup>3</sup>
Creative Thinking	Organization for Economic and Co-operative Development (OECD, 2019)	Creative thinking is the competence to engage productively in the generation, evaluation and improvement of ideas, that can result in original and effective solutions, advances in knowledge and impactful expressions of imagination. (p. 7)	X	X	X	

<sup>1</sup> This table includes prominent definitions of creativity from 2000 to 2023. Coding definitions for person, process, product, and press are adapted from Rhodes (1961). **Person** is checked when the definition addresses aspects of an individual's creative ability such as intelligence, temperament, personality, attitudes, self-concept, value systems, defense mechanisms, and behavior (p. 307). **Process** is checked when the definition addresses aspects of learning, thinking, and communicating. **Product** is defined as "artifacts of thought" (p. 309), which is interpreted in this analysis as representing a variety of outcomes (e.g., ideas, possibilities, products). **Press** is checked when the definition acknowledges the interaction of contextual forces in shaping the creative process (p. 308).

<sup>2</sup> Imagination is a habit of mind widely referenced in creativity frameworks (Lucas, Claxton, and Spencer, 2012).

<sup>3</sup> Definition references a "real-world setting."

## APPENDIX A (CONTINUED)

Think Creatively	Partnership for 21st Century Learning (P21) <sup>4</sup>	Thinking creatively involves: (1) using a wide range of idea-creation techniques (such as brainstorming), (2) creating new and worthwhile ideas (both incremental and radical concepts), and (3) elaborating, refining, analyzing, and evaluating their own ideas in order to improve and maximize creative efforts.		X	X	
Creative Thinking	<a href="#">Australian Council for Educational Research (ACER) Skill Development Framework</a> (Ramalingham et al., 2020)	Creative thinking is the capacity to generate many different kinds of ideas, manipulate ideas in unusual ways and make unconventional connections in order to outline novel possibilities that have the potential to elegantly meet a given purpose.		X	X	
Creative Thinking	Torrance, 1966	A process of becoming sensitive to problems, deficiencies, gaps in knowledge, missing elements, disharmonies, and so on; identifying the difficulty; searching for solutions, making guesses, or formulating hypotheses about the deficiencies; testing and retesting these hypotheses and possibly modifying and retesting them; and finally communicating the results.		X	X	
Creative Thinking	<a href="#">Australian Curriculum, Assessment, and Reporting Authority</a> (ACARA, 2018)	Creative thinking involves students learning to generate and apply new ideas in specific contexts, seeing existing situations in a new way, identifying alternative explanations, and seeing or making new links that generate a positive outcome. This includes combining parts to form something original, sifting and refining ideas to discover possibilities, constructing theories and objects, and acting on intuition. The products of creative endeavor can involve complex representations and images, investigations and performances, digital and computer-generated output, or occur as virtual reality.	X <sup>5</sup>	X	X	X
Creative Thinking	Sternberg (2003), p. 325-326	Thinking that is novel and that produces ideas that are of value.		X	X	
Creative Learning	Craft et al. (2008, p. xxi)	Significant imaginative achievement as evidenced in the creation of new knowledge.		X	X	

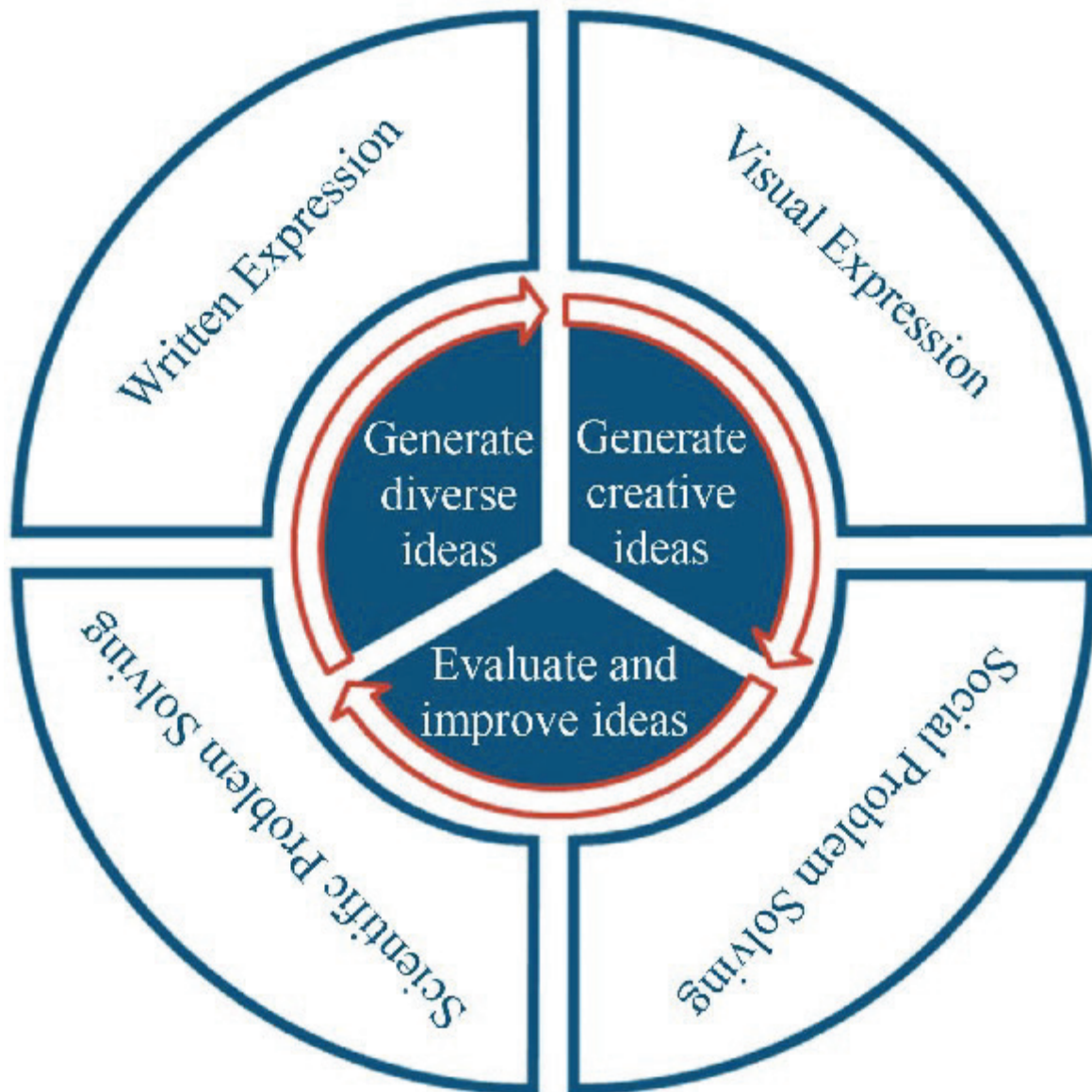
<sup>4</sup> “Think creatively” represents one of three sub-domains in P21’s broader domain of “creativity and innovation.” The three sub-domains are (1) think creatively, (2) work creatively with others, and (3) implement innovations.

<sup>5</sup> ACARA’s definition incorporates the use of intuition, which I coded as a disposition. Additionally, ACARA’s statement of general capabilities for critical and creative thinking indicates that “dispositions such as inquisitiveness, reasonableness, intellectual flexibility, open- and fair-mindedness, a readiness to try new ways of doing things and consider alternatives, and persistence promote and are enhanced by critical and creative thinking” (ACARA, 2018. <https://www.australiancurriculum.edu.au/f-10-curriculum/general-capabilities/critical-and-creative-thinking/>)

## APPENDIX B

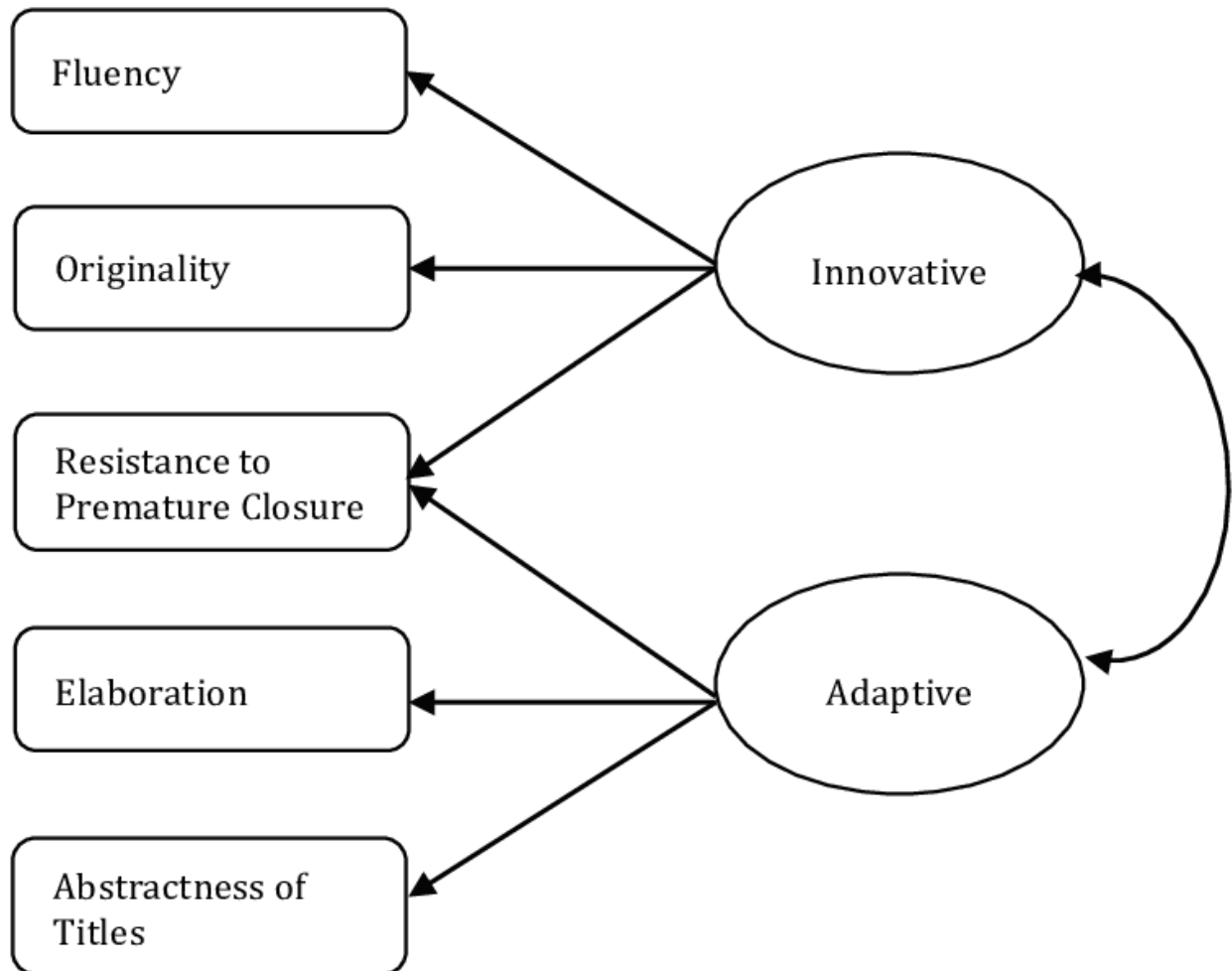
### Prominent Creative Thinking Models and Frameworks

Competency Model for the PISA Test of Creative Thinking (OECD, 2021)



## APPENDIX B (CONTINUED)

### Two-Factor Model for the Latent Structure of the Torrance Test of Creative Thinking (Kim, 2006)





## APPENDIX B (CONTINUED)

### Creative Thinking and Innovation Framework (Lansing-Stoeffler and Daley, 2023)



SKILL	DEFINITION
Conventional Thinking	The identification and generation of conventional ideas in compliance with given criteria.
Diverse Thinking	The identification and generation of diverse ideas in compliance with given criteria.
Unconventional Thinking	The identification and generation of unconventional or unique ideas in compliance with given criteria.
Evaluate and Improve Ideas	The identification and generation of ideas that iterate and improve on given ideas to improve creativity.

## APPENDIX B (CONTINUED)

Critical and Creative Thinking Framework, Australian Curriculum, Assessment, and Reporting Authority (ACARA, 2018)



## APPENDIX B (CONTINUED)

### Creative Thinking Core Competencies, British Columbia Ministry of Education and Child Care (British Columbia Ministry of Education, 2023)

#### Creating and Innovating

Students get creative ideas that are novel and have value. An idea may be new to the student or their peers, and it may be novel for their age group or the larger community. It may be new to a particular context or absolutely new. The idea or product may have value in a variety of ways and contexts – it may be fun, provide a sense of accomplishment, solve a problem, be a form of self-expression, provoke reflection, or provide a new perspective that influences the way people think or act. It can have a positive impact on the individual, classmates, the community, or the world.

#### Generating and Incubating

Students may generate creative ideas through free play, engagement with other's ideas, or consideration of a problem or constraint, and/or because of their interests and passions. New ideas and inspirations can spontaneously arise from the unconscious mind, but students can also develop strategies to facilitate the generation of ideas – learning a lot about something, engaging in a period of reflection, providing time for incubation, and doing relaxing or automatic activities to quiet their conscious mind. The capacity for creative thinking expands as individuals increase their range of ideas and concepts to recombine them into new ideas. The ideas available as raw material for creative thinking depend on previous experiences and learning, as well as students' cultural legacies.

#### Evaluating and developing

Students reflect on their creative ideas in order to decide which ones to develop. They consider whether their idea would ultimately support the well-being of self, community, and the land. They do this with a sense of place and taking into consideration unintended consequences for other living things and our planet. If they decide to develop an idea, they work individually and/or collaboratively to refine it and work to realize it. This may require accessing the knowledge of those who have gone before, building the necessary skills, sustaining perseverance, using failure productively over time, and reflecting on process and results. It may also require the generation of additional creative ideas to come up with solutions to problems along the way.

## APPENDIX C

The OECD identified 11 “signature pedagogies” that cultivate creative and critical thinking dispositions across content domains (Lacrin et al., 2019, p. 76). Most signature pedagogies such as creative partnerships are designed for use across all subject areas. Table C1 below includes a description of each of OECD’s 11 signature pedagogies and their targeted subject areas.

**Table C1.**

***OECD’s 11 Signature Pedagogies to Promote Creative and Critical Thinking***

SIGNATURE PEDAGOGY	SUBJECTS	DESCRIPTION
Creative Partnerships	All	Promotes partnerships between creative practitioners and schools. The program promotes changes in teaching methods by engaging creative practitioners, typically artists or people working in the creative industries, as actors and advisers in the teaching process. Creative practitioners intervene in schools around a pre-identified problem and work with teachers to develop projects or new teaching techniques that would address the problem (p. 77)
Design Thinking	All	Method adopted from business aimed at engineering new or improved products and processes. Students develop an innovative solution to a complex real-world problem by going through certain design processes. Design Thinking instruction is comprised of three core features: 1) a flexible learning space; 2) teamwork; and 3) a systemic approach on problem solving. This pedagogy emphasizes students’ exploration, openness to new ideas and sharing of knowledge (p. 79).
Dialogic Teaching	All	Teaching method that ‘fosters continuous and controlled dialogue between students and teachers, as opposed to traditional teacher-centered methods. Five core principles describe dialogic pedagogies: 1. Collectivity: Students address learning tasks together. 2. Reciprocity: Students listen to each other, share ideas and consider alternative perspectives. 3. Support: Students express their ideas freely, without fear of being wrong and they support one another to reach mutual understandings. 4. Cumulation: Students build ideas from others’ oral contributions, which adds to a coherent line of thinking. 5. Purposefulness: Classroom talk is open and encouraged, but it is also planned and framed to achieve specific learning objectives (p. 81)
Metacognitive Pedagogy	Mathematics; All	An approach that makes teachers and students reflect on their teaching and learning, and ensure that they have explicit steps and questions to regulate their learning. Teachers and students Scaffolding questions are aligned to the OECD rubric on creativity and critical thinking so that students become aware of the learning process when developing their own creativity. The acronym CREATE is used to organize questions that address five steps corresponding to the OECD rubrics: • Core problem and sub-problems • Reconstruct connections to generate new ideas • Explore, explain, and experiment • Additional strategies, methods, and technologies • True-but (reservations related to the idea/solution) • Evaluation
Modern Band Movement	Music	A music program that applies a teaching method called Music as a Second Language.” Modern Band organizes music instruction around a student-centered repertoire (pop music), nurtures a comfortable learning environment, enhances intrinsic motivation, utilizes comprehensible resources, and introduces students to improvisation and composition in the early stages of their musical development. The learning experience occurs through learning by doing, with music knowledge and skills being acquired with little consciousness of the process (p. 85).

## APPENDIX C (CONTINUED)

Montessori	All	A comprehensive model of schooling that posits successive stages or “planes” of development: birth to 6, 6-12, 12-18 and 18-24. These correspond to periods of schooling with learning environments and curricula designed to respond to the needs and characteristics of each stage. Classrooms are designed to encourage movement, choice, exploration, self-correction, and multiple strategies for problem solving. Other features include open seating plans, mixed-age student groupings, large class sized (25-35), intense teacher training on the model, and large periods of interrupted work (2-3 hours; p. 86).
Orff Schulwerk	Music	An active, learner-centered approach to music education. Children are led through a discovery learning process of exploring, experimenting, selecting and creating. It is a student -centered and process-oriented form of instruction: the focus is entirely put on the process of music making, notably singing in group, improvising and composing (p. 88)
Project-Based Learning	All	A model built around three principles: 1) learning is context-specific; 2) learners are actively involved in the learning process; 3) learners achieve a common goal through social interactions and the sharing of knowledge and understandings. Projects focus on meaningful real-world questions or problems that drive students to acquire course-specific concepts. Other core features include collaboration, use of technology tools to support learning, and the creation of an artifact or performance to demonstrate knowledge and understanding (p. 90).
Research-Based Learning	Science	An approach in which students learn about methods and procedures associated with the research process. Teachers plan, deliver, and assess students’ work as they engage in the scientific process to address a specific problem or question. Steps include: (1) scientific inquiry around a specific question; (2) literature review, (3) design of an experimental protocol; (4) implementation of the research protocol; (5) organization and data analysis; (6) validation of results and conclusions; and (7) communication of results.
Studio Thinking	Visual Arts	An instructional framework that outlines four studio structures and eight studio habits of mind that are used in high-quality, thinking-centered visual arts classrooms. Teachers use four studio structures to design classroom space and time, and interactions with students. Studio structures include (1) demonstration-lecture, (2) students-at-work, (3) critique and (4) exhibition. Eight habits of mind are taught during thinking-centered visual arts classroom lessons. Habits of mind include: 1) developing craft (technique and studio practice); 2) engaging and persisting; 3) envisioning; 4) expressing (finding and showing meaning); 5) observing; 6) reflecting; 7) stretching and exploring; and 8) understanding art worlds (domain and communities; p. 93).
Teaching for Artistic Behavior (TAB)	Visual Arts	A pedagogical approach based on student agency and choice structured around three fundamental pillars: (1) children are the artists; (2) the classroom is their studio; and (3) what do artists do? , Students develop their own projects: they struggle to find inspiration, envision an idea, design a plan of action, reflect on their progress, persist through difficulties, evaluate the work as it proceeds and see the project through to completion. They do the research, the exploration, create the artwork, then reflect on and revise it, before deciding when it is finished and, to some extent, whether it is successful. Teachers may choose to adapt students’ level of choice to support the creative process. (p. 94).



The OECD report also lays out a framework to support teachers in designing classroom activities to teach creative thinking skills as part of the curriculum. Design criteria and domain-general and domain-specific rubrics are provided (p. 129). Design criteria include<sup>6</sup>:

1. Create students' interest to learn.
2. Be challenging.
3. Develop clear technical knowledge in one or more curriculum domains.
4. Include the development of a visible product or artifact.
5. Have students co-design part of the product or solution.
6. Deal with problems that can be looked at from different perspectives.
7. Leave room for the unexpected.
8. Include time and space for students to reflect and to give and receive feedback.

Other literature reviews and meta-analyses have identified instructional principles and methods that influence the development of creative thinking processes. Hennessey and Amabile (1987; also see Amabile, 2020) reviewed interventions designed to enhance creativity and offered three implications for classroom settings:

1. Make learning fun. Children are most creative when they are having fun. Toward this end, students should be given choice about how to accomplish learning objectives. Additionally, students should have ample time to reflect and experiment with new ideas
2. Prioritize creative pursuits. Teachers can prioritize creativity by listening to students' interests, affirming their strengths and talents, incorporating students' unique interests in performance tasks, and modeling intrinsic enjoyment of creative pursuits. Teachers can reinforce intrinsic motivation by actively pursuing creativity in their classroom and modeling their own enjoyment of creative pursuits.
3. Avoid external rewards and competition. Using external rewards and competition to externally motivate student performance stifles creativity (Amabile, 2020). Additionally, formal evaluation of students' creative pursuits can have similar negative effects. To the extent possible, teachers should minimize summative evaluation of students' creativity and, instead, use narrative feedback and other types of formative assessment.

Additionally, Kampylis and Berki (2014) identified eight research-based principles that undergird and inform teachers' practices to cultivate creative thinking. Notably, these principles are embedded in many of the OECD's signature pedagogies described above.

1. Creativity can be promoted through all school subjects.
2. Influence creative thinking through well-designed learning spaces.
3. Increase the use of open-ended questions.
4. Engage learners in meaningful and authentic activities.
5. Collaboration enhances creativity.
6. Make efficient use of educational technologies.

<sup>6</sup> Descriptions were pulled from Lucas, B., Spencer, E., and Stoll, L. (2021). *Creative leadership to develop creativity and creative thinking in English Schools: A review of the evidence*. London: Mercers' Company.

7. Allow for mistakes and sensible risk-taking.
8. Learn how to assess and reward creativity.

Gregory et al.'s (2013) review of creative thinking research identified three factors that can be manipulated in a classroom setting and have shown to influence creative thinking ability: (1) collaboration, (2) exposure to ideas of others, and (3) evaluation of ideas.

- Collaboration: Group work is especially effective in developing solutions for complex tasks. Additionally, the use of external representations such as directed questions, lecture notes, and graphic organizers tend to stimulate creative problem solving when used in a group context.
- Exposure to ideas of others: Groups that are exposed to a range of ideas and information on a topic tend to generate more ideas and/or problem-solutions.
- Evaluation of ideas: Prompting students to evaluate ideas produces more original ideas and improves problem-solving performance. Notably, this finding seems to hold only when ideas are evaluated with a specific context in mind.

Lucas and Spencer (2017) synthesized decades of research on the teaching of creative thinking, which resulted in their identification of five “signature pedagogies”:

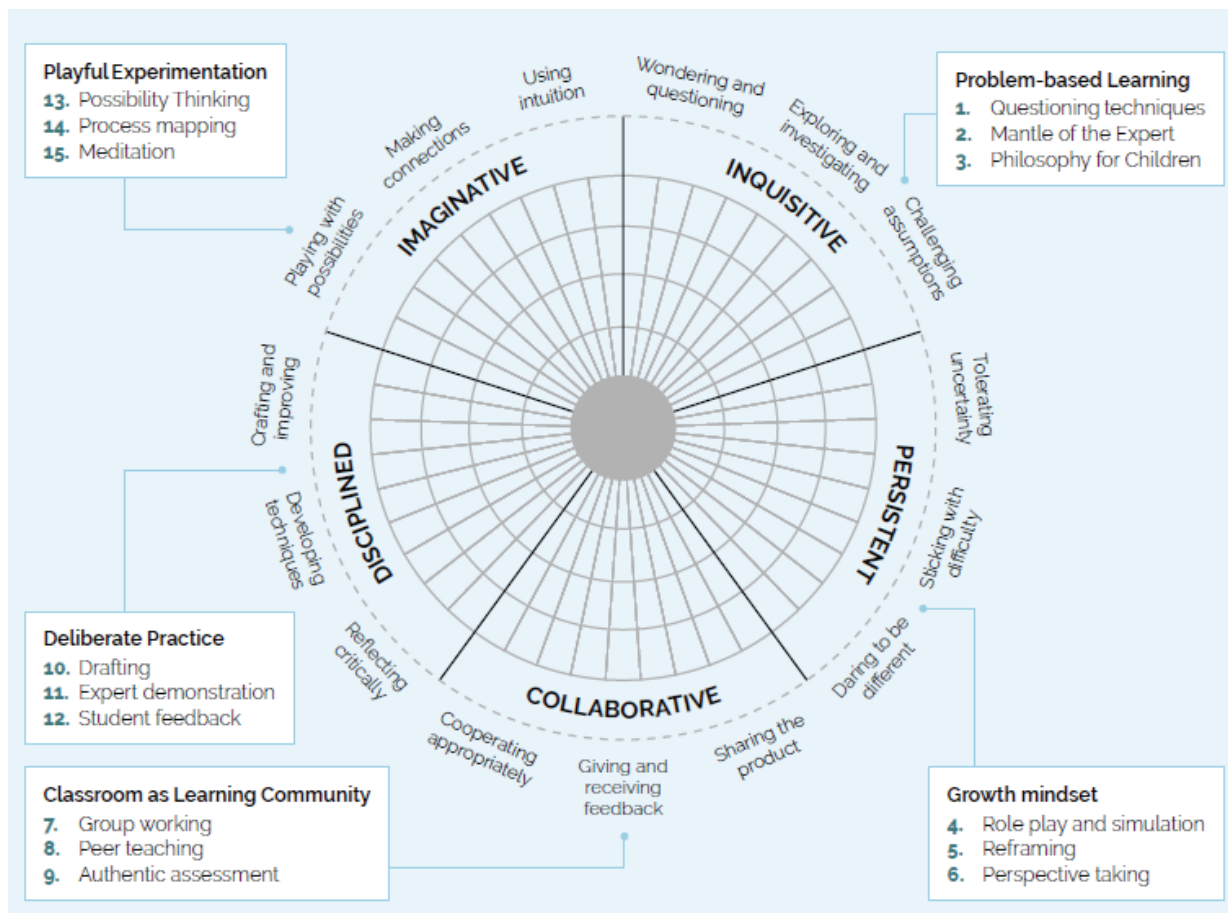
1. Problem-based learning
2. Growth mindset
3. Classroom as learning community
4. Deliberate practice
5. Playful experimentation

Each signature pedagogy promotes a unique creative habit of mind in the Center for Real World Learning's (CRWL) five-dimensional model. Further, each pedagogy is associated with three associated teaching methods that cultivate creative thinking skills (see Lucas, Spencer, and Stoll, 2021, p. 14).<sup>7</sup> Figure C1 maps the signature pedagogies and associate teaching methods to CRWL's model.

<sup>7</sup> Both Lucas and Spencer's research and OECD's research use the term “signature pedagogies” to illustrate instructional programs and approaches that promote creative thinking. It seems somewhat coincidental that both use the same term to refer to overlapping, yet distinct, programs and approaches.

## APPENDIX C (CONTINUED)

**Figure C1.**  
*Signature Pedagogies for Teaching Creative Thinking*<sup>8</sup>



Cremin and Cheppell (2021) conducted an extensive literature review on creative pedagogies enacted in formal educational settings across the K-12 age span. These researchers ultimately focused on 35 empirical, peer-reviewed studies, most of which were qualitative. Findings described seven interrelated features that characterized creative pedagogical practice:

1. Generating and exploring ideas
2. Encouraging autonomy and agency
3. Playfulness
4. Problem-solving
5. Risk-taking
6. Co-constructing and collaborating
7. Teacher creativity

Authors noted that results, though preliminary, provide helpful guidance for educators interested in nurturing creativity in the classroom.

<sup>8</sup> Image copied from Lucas, Spencer, and Stoll (2021), p. 15.

## APPENDIX C (CONTINUED)

Lai (2018) summarized research on specific programs designed to improve targeted components of creative thinking. Table C2 summarizes these programs and their effect sizes below.

**Table C2.**  
***Effect Sizes of Select Creativity Training Packages***

TRAINING PACKAGE	DESCRIPTION	EFFECT SIZE	
		M	SD
<b>The New Directions in Creativity Program (Renzulli, 1973)</b>	Based on Guilford's (1967) Structure-of-Intellect Model; contrasts divergent (identifying as many answers or solutions as possible) and convergent (trying to find the best or right answer) thinking	1.41	0.21
<b>Osborn-Parnes Creative Problem-Solving Program (Osborn, 1963; Parnes, 1967)</b>	Provides instruction in four stages of creative problem-solving: (1) identifying and finding problems; (2) generating solutions; (3) evaluating solutions; (4) elaborating on a solution	0.82	0.58
<b>Khatena's Training Program</b>	Involves instruction and practice in five creative thinking strategies: (1) breaking away from the obvious and commonplace, (2) transposition, (3) analogy, (4) restructuring, and (5) synthesis	0.82	0.61
<b>Purdue Creative Thinking Program (Feldhusen, Speedie, &amp; Treffinger, 1971)</b>	Uses twenty-eight audiotaped lessons to support divergent thinking (fluency, flexibility, originality, and elaboration) through instruction, illustrations, and practice	0.63	0.65
<b>Computer-aided creativity training</b>	Includes a combination of computer graphic technology (manipulating text and graphics) as well as Logo computer programming (identifying problems and choosing or combining information, knowledge, and solutions)	0.61	0.23

In summary, a growing research base describes several promising instructional approaches for promoting creative thinking. Make time for students to engage in playful experimentation. Promote a strong community in which students are encouraged to take intellectual risks. Provide structured opportunities for groups to share and evaluate one another's ideas, particularly when they involve complex tasks. Use project- and problem-based approaches to learning that focus on complex problems and ideas, are grounded in authentic and real-world tasks, encourage student choice, and provide a balance of autonomy and interaction with others. And finally, prioritize students' mastery of content-specific knowledge and skills, as creative thinking skills improve through content-specific expertise.



# MEASURING STUDENT SUCCESS SKILLS: A REVIEW OF THE LITERATURE ON CREATIVE THINKING



National Center for the Improvement  
of Educational Assessment  
Dover, New Hampshire



[www.nciea.org](http://www.nciea.org)