

Creative Thinking for 21st Century Composing Practices: Creativity Pedagogies across Disciplines

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Abstract: In this article, the authors explore the corpus of literature on creative thinking and applied creativity in higher education to help composition teacher-scholars and writing center practitioners improve the application of creativity in written, visual, and multimodal composing practices. From studies of creative thinking investigated across disciplines, the authors draw four principles commonly articulated in creativity scholarship, present stages of creative thinking in the composition process and, finally, offer suggestions for applied creativity in composition classrooms and writing centers.

A part of creative thinking is just plain thinking.
- Flower and Hayes (1980)

I. Introduction

In the May 2015 issue of *AAC&U News*, the Association of American Colleges & Universities featured design thinking pedagogy at the Hasso Plattner Institute of Design at Stanford University. A key mission of the Hasso Plattner Institute of Design (affectionately called the "d.school" by students) is to support interdisciplinary knowledge by teaching creative thinking skills and problem solving strategies. The appeal of design thinking has already trickled to composition studies (Marback, 2009; Newcomb, 2012; Purdy, 2014), but, as indicated by *AAC&U News*, academic interest in design thinking signals a broader and renewed interest in creativity theories and pedagogies across disciplines. While design thinking may be the most well known creative thinking approach, it is just one emerging from the discipline of engineering. In other disciplines such as psychology, education, arts, and science, creativity pedagogy has long been at the center of efforts to improve student learning, problem-solving processes, and knowledge production.

Not surprisingly, early composition literature immediately recognized the importance of creativity theories in writing. Scholars borrowed creativity theories from cognitive psychology when presenting creativity as a heuristic—a technique for generating new ideas and solving significant rhetorical problems in written communication. In particular, the early research of Flower and Hayes (1977, 1980, & 1981), Peter Elbow (1983), and L. J. Carey and Flower (1989) located creativity throughout the composition process and identified creativity as an essential component in writing. In the last five years, composition scholars studying multimodal composition have renewed their investigation into the role of creativity for rhetorical problem solving, because creativity shapes the rhetorical impact on student projects ([Ridolfo & DeVoss](#), 2009; Shipka, 2011). Moreover, creativity can supply "fresh approaches" to ways students connect, communicate, and synthesize knowledge in written and multimodal channels (Livingston, 2010, p. 59). The connection between creativity and new media communication and production has also received strong

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acknowledgement outside of the academy. For instance, the [Partnership for 21st Century Skills](#), a national coalition of educators, policy makers, and business leaders, advocated an educational framework that identifies creativity as a core 21st Century skill, preparing students to effectively communicate in "a technology and technology driven environment" (Partnership). Creativity skills, particularly academic creativity skills, were viewed as essential tools for composing in multiple modes, especially the visual arts.

When investigating creativity scholarship and the connection between creative thinking and 21st Century compositional practices, we were inspired by Palmeri's (2012) inquiry into whether "there are similarities in the creative composing process of writers, visual artists, designers, and performing artists" (p. 25). Although Palmeri recognized the "limitations of generalizable theories of creativity," he suggested that it "could be useful for compositionists to conduct comparative studies of students' creativity processes when composing alphabetic and visual texts" (2012, p. 31). The assumption underlying this statement was that creativity processes for "alphabetic" text may be different from visual modes and that a comparison of creativity processes between composition and visual studies would help teachers try new approaches to multimodal composition pedagogies.

While Palmeri raised questions about modal affordances and their impact on creativity, our investigation of creativity research in composition explores the interdisciplinary developments of creative thinking. Creativity studies provide rich opportunities for writing scholars to draw new connections between creativity and writing practices. An interdisciplinary approach could be particularly important for those in writing centers who consult and provide support for writing and multimodal compositions in a variety of fields; moreover, situating creativity within disciplinary practices may enrich our ways of teaching and talking about composition. In our survey of creativity literature, we asked the following key questions:

1. How is creativity and creativity pedagogy discussed across disciplines?
2. How can creativity studies provide new ways for considering creative processes and techniques that support written and multimodal composing?

This article first summarizes our assessment of creativity theories and strategies drawn from a survey of over seventy articles and chapters in composition, engineering, sciences, social sciences, and humanities. Building on our findings from creativity research across the disciplines, we then discuss possibilities for how composition classrooms and writing centers can effectively integrate creativity. Our study results in four distilled principles of applied creativity. We also offer applications of creative thinking for written or multimodal composition, which include stages of creative thinking that could be considered alongside the composition process.

II. Creativity in Composition: Creativity as Thinking

Although creativity may be framed in a variety of ways in academic disciplines, scholars who studied applications of creativity often discussed it as a "teachable" skill (Brent & Felder, 1992) that results in generating ideas, insights, or new perspectives that are not conventional or routine. For many interested in student learning, the pedagogical outcomes of creativity were also valuable as creativity engaged students through "deeper levels of understanding" in a subject (Korgel, 2002; Sweeney, 2003). Creativity can be discussed, as Howard, Culley, and Dekoninck (2008) noted, in terms of "the creative process, the creative product (output), the creative person, and the creative environment" (p. 161). We would add to this list creative pedagogy that closely examines techniques or strategies applied to improving or achieving the creative process, product, or environment.

In this study, we focused on how creativity scholars in composition and across the disciplines frame and discuss pedagogical techniques to improve creativity in students and their academic work, whether this

work is represented as expository essays or engineering problems. We then categorized relevant articles by author and discipline, creativity trend/concepts, and purpose/definitions ([Appendix A](#)). Cataloguing the discipline allowed us to locate similar creativity strategies across fields and boundaries. The trends and concepts included ways scholars in the disciplines discussed creativity within their field. Furthermore, identifying the purpose/trend allowed us to elaborate on and contextualize the creativity concepts from the literature. The following review of creativity scholarship covers six areas: composition, visual arts, engineering, sciences, social sciences, and humanities. Additionally, we provide a separate study of creativity in the visual arts because creativity is necessary in creating art.

In composition studies, instructors may think of creativity and creative thinking as a process such as brainstorming by which students generate new ideas or topics. For composition instructors who adhere to process-writing approaches, the creative moment is often formally integrated as an early stage of the writing process. The writing process is generally understood to involve four stages (brainstorming, planning, composing, and revising) that may or may not unfold in a neat sequence; however, a range of critical thinking activities are thought to be involved during each of the four stages, according to writing process pedagogy.

Early composition scholars who supported the "process movement" in composition studies strongly emphasized creativity as a thinking act. Lauer (1970) drew from psychology when she asserted that instructors can improve how they teach the creative process in composition by reflecting on creativity as a heuristic tool, which can stimulate problem solving, questioning (rethinking), and flexibility in writing approaches. Flower and Hayes (1977) also framed writing as a "highly goal-oriented, intellectual performance" (1977, p. 449) that benefits from problem solving: "[Writing] is both a strategic action and a thinking problem" (1977, p. 449). They argued that the creative process helps students solve language or intellectual problems and increases "self awareness" of such heuristics (1977, p. 450). Elbow (1983) believed creativity was a "bona fide kind of thinking because it is a process of making sense, and putting things together" (1983, p. 38). Elbow, however, distinguished creativity as "first order thinking" (1983, p. 39), associated specifically with intuitive, free-form idea generation. This first order thinking was contrasted against "second order thinking," which he described as "directed, controlled thinking" in planning, organizing, or revising (1983, p. 38). Elbow saw creativity as distinct from directed thinking, while Flower and Hayes, especially in their later study, argued that creativity involved both kinds of free form and directed thinking in the "discovery process" of writing (1983, p. 22).

In more recent composition scholarship involving creativity, authors generally focused on creative techniques rather than the creative thinking process. Technology, media, and the visual arts have become more integrated into the composition classroom, and the affordances of composing in multiple modes were perceived to open new paths for communicating messages to audiences (Alexander, Powell, and Green, 2011-2012). However, these moves may have also complicated the ways we teach creativity in both technique and process. Recent articles explored ways in which new creative pedagogies were critical for teaching composition. Exploring academic creativity in the form of "play," Rouzie (2000) argued, "Students may need to feel some permission to experiment with the aesthetic and rhetorical possibilities of playful discourse, to experiment with a variety of roles and subject positions" (2000, p. 651). Rouzie insisted that play should be structured in the curriculum because it facilitates a critical process that invites open exploration of possible approaches, scenarios, or topics. Play allowed students to freely experiment with visual and mediated elements, to make mistakes, and to try new combinations while learning about how these decisions affect the design of a text (p. 635). Play may be particularly important as a creativity tool for learning when students are working with media and modes with which they have never composed before.

Composition scholars investigating composition and multimodality have continued to draw from theories across disciplines to inform new approaches. For example, Newcomb (2012) and Purdy (2014) identified how engineering design strategies are useful tools for improving creativity in composition studies. Evoking arguments in design studies (and echoing Flower and Hayes), Newcomb (2012) contended that design work

depends on an understanding of relationships "full of constraints" and requires students to develop and write about solutions to complex writing problems through "situational creativity" (p. 594, p. 607). Noting the emergent trend in composition, Purdy (2014) also identified the value of design thinking in "multimodal/multimedia composing tasks" (p. 614) by helping students complicate single solutions and creatively work with problems that are "ambiguous, contingent, and recursive" (p. 613). Extending the work of Newcomb and Purdy, this study gathered and processed disciplinary findings to further explore how design thinking and other creativity approaches might be applied to written and multimodal composing practices.

III. Creativity Across Disciplines

Across disciplines, creativity has been defined, studied, and explored in ways that composition instructors may quickly recognize, because, as we noted, theories and practices in composition studies have integrated cognitive psychology and engineering design theory. Furthermore, our study of creativity in visual arts, engineering, sciences, education, and humanities reinforces the Creative Thinking VALUE Rubric presented by the AAC&U in 2010. Consolidating criteria of creative thinking learning outcomes, the Creative Thinking VALUE rubric highlighted common attributes across disciplines, including innovation, divergent thinking, and risk taking. However, unlike the VALUE rubric, which was designed to help instructors across fields assess the quality of students' creative thinking, we present a detailed exploration of theories and strategies that aim to provide insights for composition pedagogy. In this section, we summarize the ways various disciplines discuss creativity and then draw observations relevant to composition studies.

A. Visual Arts: Creativity as a Skill

Creativity in the visual arts is unique because it is both a process and product of visual artists. Although often included as a discipline within the field of education, we discuss it here separately because we see the visual arts as an entry point to discussing creativity across the disciplines. Examining the production of art in our modern "information society," Drucker (2005) noted how fine artists believe that creativity innovates the arts and may "lead the way for envisioning the future in all areas of contemporary life" (p. 37).

The common aesthetic understanding of creativity—the idea of artistic originality—is one that has been applied in visual arts, where creativity may be seen by some to be at the very heart of arts education. In visual arts education, creativity is discussed as an aesthetic skill that was identified and measured to evaluate student performance. According to Eisner (1962), who outlined a typology of creativity in the visual arts, human creativity is comprised of "different kinds of creative competencies" (p. 12). Eisner identified four key behavioral characteristics of creativity that could be identified and measured by the facility of an individual to combine elements of a subject (such as genre) or forms (art material):

1. boundary pushing creativity
2. boundary breaking creativity
3. inventive creativity, and
4. aesthetic organizing creativity.

Boundary pushing creativity extended the subject or form in novel ways, while boundary breaking creativity provided an "utterly new" approach to subject or form. A third type of creativity, "inventive" creativity, was the ability to take existing forms and subjects to create something new. Finally, Eisner introduced "aesthetic organizing" creativity, which orders "specific forms so as to constitute a coherent, harmonious, and balanced whole" (1962, p. 13). More notably, aesthetic organizing creativity, which might also better understood as

the practice of design principles, represents the most flexible of creativity skills: Aesthetic organizing creativity embodied the most transferable set of skills across distinct modes of art, from haptic to visual (1962, p. 19). While Eisner described creativity as a measurable skill of creative talent, more recent arguments for creativity in visual arts education have situated artistic creativity as a transferable skill that helps students work with content (Livingston, 2010).

For composition instructors and scholars, along with writing center practitioners, two relevant observations from creativity scholarship in arts education emerged:

1. **Design principles are transferable aesthetic skills across media modes.**

Of all forms of creativity, students' skills in design principles or aesthetic organizing creativity appear to be the most transferable skills across media modes such as written, visual, aural, or haptic modes. This notion may be useful for how instructors can discuss and teach design principles beyond specific written, visual, or multimodal projects in the classroom.

2. **Aesthetic creativity is relevant for academic and non-academic work.**

In art education, artistic creativity is no longer defined within the specific realm of art; rather, it is presented as skills that are applicable more broadly to a variety of situations.

B. Engineering: Creativity as Heuristic Tool and "Event"

In fields outside of the visual arts, creativity was not usually defined by aesthetic originality but in terms of cognitive problem solving. Essential qualities of creativity were described in fields as diverse as composition, psychology, mathematics, and engineering as generating a unique combination of elements, developing novel perspectives for a performance, or solving a problem (Brent & Felder, 1992; Bump, 1985; Dorst, 2001; Elbow, 1983; Flower & Hayes, 1977; Flower & Hayes, 1980; Kokotovich, 2007; Korgel, 2002; Lauer, 1970; Lumsdaine & Lumsdaine, 1994; Mednick, 1962; Siswono, 2010). One of the earliest to propose processes for creative thinking, psychologist Mednick (1962) drew evidence from poets as well as mathematicians and scientists to theorize that creative "performances" of these artists and thinkers were due to the unique "combinations of associative elements" (p. 220) and that creative solutions of this nature were teachable through specific processes of thinking. But whereas cognitive psychology examined the creative process involving in cognitive thinking, engineering discussed creativity in terms of solving a design problem, process, and activity (Howard, Culley, & Dekoninck, 2008).

Engineering researchers interested in creativity commonly referred to creativity as a heuristic tool or heuristic process. Because engineers commonly rethink systems, procedures, and performance tasks, these creative processes necessitated the development of systematized thinking practices that encouraged engineers to break from standard approaches. In our review of engineering creativity research, we identified the following two key concepts of creativity process that may be valuable for composition studies:

1. **Creativity involves divergent thinking and convergent thinking; collaboration can help nurture creative thinking.**

While Elbow (1983) made the case for two separate types of thinking ("creative" or first order thinking and "rational" or second order thinking), engineering scholars have argued that "divergent thinking" and "convergent thinking" were essential parts of a creative thinking process. For Lumsdaine and Lumsdaine (1994) and others in engineering, divergent thinking is an ability

to think imaginatively and innovatively about the problem by seeking to understand its broader context and generate ideas without evaluation. While divergent thinking helped with generating innovative ideas that challenge conventional or status-quo thinking, engineers considered "convergent thinking" to be a complementary creative ability to logically select, evaluate, synthesize, and refine "many potential ideas into one or more workable solutions" (Sweeney, 2003, p. 139). In addition to being applied together to solve design problems, divergent thinking and convergent thinking can foster more creative results through group collaboration (Lumsdaine and Lumsdaine, 1994; Korgel 2002; Sweeney 2003). In particular, Lumsdaine & Lumsdaine (1994) argued that variable cognitive thinking styles allow for teams to draw on the strengths of team members to result in better ideas and plans.

2. **Creativity is part of a "creative event"; that is, a dynamic, exploratory process involving constant questioning and reshaping of the problem and solution.**

The hallmark of design thinking is the notion of constantly and creatively rethinking both the problem and the solution to produce results distinct from "routine product[s]" (Howard, Culley, & Dekoninck, 2008, p. 160). Design thinking, thus, involves a dynamic, creative cognitive process that never settles on an initial attempt at defining a problem or proposing a solution. Kokotovich (2007) in architectural design presented non-hierarchical visualization strategies for students to deeply rethink the problem (what he called "problem structuring") so that students may fully understand the "multiple perspectives of the problem" *before* they generated a solution response (Kokotovich, 2007, p. 50 and p. 52). Even after troubleshooting the problem, the solution response is interrogated and reconsidered. In "Creativity in the Design Process," Dorst (2001) called creativity an "event"; that is, "a period of exploration in which problem and solution spaces are evolving and are unstable until (temporarily) fixed by an emergent bridge which identifies problem-solution pairing" (p. 435). In the sciences, the practice of deriving insight through constant re-exploration of a problem or solution was described in Hadamard's "Theory of Scientific Insight" (ctd. in Langley & Jones, 1988, p. 180). Thus, in engineering (as well as in the sciences), creativity is not seen as part of an orderly, compartmentalized sequence, but a process that encourages students to toggle back and forth between problem to solution, consciously and methodically redefining and revisiting ideas numerous times. The best creative solutions emerge when the designer challenges their own interpretations of problems or solutions, and students are asked to anticipate (if not accept) the early solutions to fail.

C. Sciences: Creativity as Situated Process

"Creativity," Langley and Jones (1988) explained, "lies at the heart of the scientific process" (p. 177). As in engineering, creativity literature in the sciences generally addressed two concerns: the measuring of creative

ability and the improvement of creative ability. The literature reviewed for our study focuses primarily on discussions about how students' creativity may be improved to increase the quality of student research (Bailey, White, & Pain, 1999; DeHaan, 2009; Siswono, 2010), although some have also studied how creativity motivates students in the sciences (see Lee & Erdogan, 2007). Scholars in the sciences have made a particular case for asserting the importance of creativity in the research process and offered ways to explicitly teach creativity that take into consideration the rhetorical context or applications of creativity techniques. In the sciences, two processes emerged from the literature, which are relevant for composition studies:

1. **Scientific research processes involve creativity and rhetorical thinking that are situated in historical, cultural, and subjective contexts.**

Bailey, White, and Pain (1999) in geography and environmental management argued that science is always about interpretation of data, and that creativity comes in contextual interpretation. The authors pointed out: "This [research] process, whilst being systematic and 'scientific', nevertheless remains open to unexpected paths of questioning and discovery—to rhetorical thinking.

Creativity, intuition and, to some extent, curiosity guide the planning of the research process, which in itself leads the research critically to examine and reflect upon this research process"

(1999, p. 173). In the life sciences, DeHaan (2009) also situated creativity in scientific research as a multicomponent process occurring in particular social contexts, often involving "a remarkable degree of influence and collaboration" (p. 174). Like scholars in engineering, DeHaan asserted that creativity includes divergent thinking or what he calls "cognitive flexibility" and convergent thinking, or the ability to have analytic focus and select the best solution (2009, p. 174).

2. **Creativity is a teachable skill improved through explicit discussion and instruction.**

Creativity scholars in the sciences generally agreed that "creativity does not happen by chance" (Lee & Erdogan, 2007, p. 1317) and have argued for creative learning environments (Lee & Erdogan, 2007), discussions of creativity theory and techniques (DeHaan, 2009), and the teaching of creativity stages (Siswono, 2010). According to DeHaan (2009), students can be stimulated to be more creative if teachers actively encourage students to use creativity when solving problems and if teachers explicitly guide students in how to be creative by "inform[ing] students about the nature of creativity and offer[ing] clear strategies for creative thinking" (DeHaan, 2009, p. 176).

Other creativity scholars such as Siswono (2010) in mathematical sciences argued that the introduction of levels in creative thinking improved student understanding of the creative process.

D. Education and Social Sciences: Creativity as Constructed Environments

Creativity pedagogies in education focused on teaching creatively with an emphasis on instructing teachers to apply creative pedagogies in the classroom while constructing creative learning environments. The research in education also drew heavily from cognitive psychology and design, focusing on how to encourage students to be active creative thinkers. Areas within Education and Social Sciences often adopted

a domain general approach. According to Sawyer (2011), "[T]he implicit assumption made by arguments to justify arts education [is] that such education results in domain general creativity skills that will transfer to other subject areas" (p. 3). As Sawyer explained, teachers might look for approaches that transcend disciplines that can be adapted to fit a variety of composing contexts. Furthermore, teachers might also repurpose domain general strategies for multimodal composition instruction.

Education focused on the process of creative teaching with an emphasis on how class environment and curriculum shapes student creativity (Jeffrey & Craft, 2004; [Baker & Burns](#), 2010; Lin, 2011). In particular, Lin (2011) promoted a creativity pedagogy that embraced three features: creative teaching, teaching for creativity, and creative learning were interconnected features and interacted with one another (p. 151-152). Especially in the last decade, education scholars emphasized the crucial relationship between creativity and technology in teaching, particularly in terms of how technology in the classroom enables creativity with the digital generation (Livingston, 2010; Mishra & the Deep Play Research Group, 2012). In our review of the research on creativity in education and the social sciences, two critical concepts emerged:

1. **Creativity involves improvisation and risk-taking.**

Improvisation and risk-taking enhance creativity in education. According to Sawyer (2011), the most effective way to foster creative thinking in learners is to "guide them in a process of disciplined improvisation" (p. 14). Education creativity research suggested that risk-taking activities help students learn from making mistakes and, when reflected upon and discussed explicitly, learn to engage in deeper and more productive creative experiences (Gibson, 2010).

2. **Creativity involves problem solving and "possibility thinking."**

Like creativity scholars in engineering and the sciences, education and social science creativity scholars presented creativity as a critical tool for problem solving. Scholars in education suggested that looking at the available approaches to solving problems or even constructing problems to be solved can facilitate creative thinking in students and can help shape a creative pedagogy.

Problem solving allows students a way into a discussion, debate, or experiment. A characteristic of creativity itself, as Jeffrey & Craft (2004) explained, is "possibility thinking," which "includes problem solving as in a puzzle, finding alternative routes to a barrier, the posing of questions and the identification of problems and issues" (p. 81-82).

E. Humanities: Imaginative Thinking and Doing

The humanities presented a challenge when tracking creativity approaches because its fields recognize creativity as product and/or process. In some cases such as creative writing, creativity was the goal itself—the final result or product. As in the arts, creative writing was defined by creativity and is evaluated by its successful implementation. In literary studies, creativity was essential for investigating "literary imagination," because the choice and syntax of words become "the chief participants in imaginative sequences" (Gardner, 1982, p. 173). While academic disciplines such as English evaluated creativity in the final product and as a salient part of disciplinary work, other fields such as history viewed creativity as informing the processes of disciplinary thinking, much like the broad-based creativity strategies discussed earlier in other disciplines.

History discussed creativity in a variety of ways, including "counterfactual thinking" that parallels how engineering and sciences described creative thinking for problem solving. According to Jackson (2005), historians used creativity to imagine what cultures and belief systems were like in the past (p. 2) as well as to "engage with historical problems or the use of sources and techniques to produce new interpretations, or significantly qualify existing interpretations" (p. 2). "Counterfactual thinking" was, in fact, crucial for historians to think in alternative ways or to challenge assumptions and expand on commonly accepted views.

Finally, approaches to teaching creativity in the humanities were often derived from visual thinking. Coleman & Colbert (2001), for instance, highlighted the inherent connection between creative thinking skills and visual communication (p. 10). Similarly, Welch (2010) examined how students can improve technical writing by exploring creativity through visual design: She discussed the use of LEGO bricks to help students use their imagination and "build something of their own design" (p. 41). While the humanities encompasses many fields, we distilled two key concepts about creativity:

1. **Creativity may represent product and/or process.**

In our examination of humanities research, some academic disciplines within the humanities strongly valued creativity in the final product but also viewed creativity as a process. Creativity was seen as the thinking that takes place before, leading up to, or in preparation for the composing process.

2. **Creativity involves learning by doing, making, and visual modeling.**

Creativity in the humanities emphasized an interdisciplinary approach to design and communication, specifically in the visual, cultural, performative, and media arts. Researchers highlighted experiences that lead to creative thinking. Creative thinking was experiential in that creativity involved learning by doing or, as in the visual or performative arts, learning by making. One type of experiential learning in creativity was visual modeling, which included recreating scenes, events, or concepts or visualizing options, problems, and solutions. Through a visual modeling approach, students were asked to employ creativity to construct or reconstruct samples and consider multiple options, variations, and new interpretations.

IV. Four Principles of Applied Creativity

When reviewing creativity scholarship together, we find a great deal of consensus on the value of academic creativity and the goals of creativity as one of problem finding or problem solving. We have also discovered perspectives and concepts about creativity that may also generate productive discussions on how creativity theory and techniques can be freshly applied or even rethought for written and multimodal composition. Creativity can be a skill, a heuristic process, situated event, and a product of constructed environments. Our study has led us to identify four general principles about applied creativity across disciplines, followed by questions that might help instructors consider how written and multimodal composition might apply creative thinking:

Principle 1: Creativity is a Critical Skill

Creativity involves questioning traditional or conventional approaches and solutions to problems. Scholars argue that creativity is a skill that can be strengthened and improved through an awareness of creativity as risk taking and applying techniques that help students challenge existing approaches, thinking, or imagining. How can composition teachers design courses that reward students for developing their creativity skills and encourage risk taking? The following are two suggested applications for cultivating creativity as a skill:

- **Focus on quantity not quality through divergent thinking.**

Encourage students to resist the urge to evaluate or censor ideas too early. All too often, "convergent thinking" is emphasized over "divergent thinking" strategies, and these strategies are implemented too early in the process before considering all available options and opportunities. Instructors can help students generate ideas during the task defining and invention stages by giving them tools to generate a large quantity of ideas, topics, questions, or concepts. One tool is the "demand grid," commonly used in design studies. A sample demand grid might consist of 33 boxes and students might be asked to fill in this grid with ideas within a specified amount of time (Appendix B). In addition, students can work through multiple concepts by talking, visualizing, mapping, or sketching. Writing center workshops, for instance, might incorporate demand grids to help students generate ideas for topics.

- **Encourage multiple associations in idea generation through various modalities.**

Associative thinking is key to creativity processes. It involves helping students see relationships between and among disparate concepts, topics, items, or modalities. A creative process entails developing multiple associations—connections or threads—among topics or items. Associative thinking can be encouraged by asking students to use different modalities to explain connections between ideas and identify potential opportunities and relationships that can impact the outcome of composing process and product. Composition scholars like Patricia Dunn (2001) and Jason Palmeri (2012) have already explored how unexpected and creative connections may be generated when students challenge themselves to reimagine ideas through different modes of expression.

Principle 2: Creativity is a Heuristic Process

Previously, we mentioned that creativity is a skilled practice of questioning and re-imagining of problems and solutions. The second principle of creativity builds on this idea: Creativity is an ongoing and dynamic thinking process (divergent and convergent thinking); moreover, design thinking is an approach that systematizes this belief in order to achieve the optimal results within a given amount of time. To increase students' awareness, instructors might talk about creative thinking alongside the composition process. The most rhetorically effective, convincing, and original projects are produced when students are asked to be creative in various stages of invention and production. A discussion of the creativity process makes explicit the method and application of creativity, and allows for students to actively challenge and rethink their assumptions along the process of generating their product.

- **Apply creative thinking in composition process**

Creative thinking approaches pair well with the composition process because of their analogous stages. Creativity scholars in composition have, in fact, argued that creative thinking occurs throughout the writing process. Flower & Hayes (1980), for instance, observed that creative thinking allowed writers to constantly adjust their work as their understanding of the rhetorical situation and their own argument evolved. Consequently, creativity is seen as problem solving as well as "problem finding," and creativity is essential during revision when the writer reflects on his or her rhetorical performance and impact (Flower & Hayes, 1980, p. 23). Teachers might apply creative thinking through explicit introduction of convergent and divergent concepts from creativity research. Drawn from creativity research from Flower & Hayes as well as others, the following creativity stages provides one possible approach to integrating creative thinking techniques in the composition process (Table 1).

Table 1: Proposed Stages of Creative Thinking in the Composition Process

Stage 1	Stage 2	Stage 3	Stage 4	Stage 5	Stage 6
Task defining or problem defining	Brainstorming, or idea generation for topic, problem solving	Research context, audience, content, and design	Writing, or multimodal composing	Revising, or testing product	Revisiting stage 1 and stage 5
divergent	divergent	convergent	convergent	divergent/ convergent	divergent/ convergent

A composition process with an emphasis on creative thinking, illustrated in Table 1, presumes that creative thinking is present and taught in each stage. While creativity is not a neat process, we have identified the predominant type(s) of thinking that often occur. Stage 5 and Stage 6 include both divergent and convergent thinking. For instance, convergent thinking occurs when students strategically target specific higher or lower order concerns to revise in writing; however, an emphasis on divergent thinking (that is, the active generation of alternative possibilities) may also help students review and challenge their existing approaches to argument, organization, and style. The proposed creativity stages in Table 1 also highlight ways that creativity may frame common composition stages such as revision. Creativity scholars generally identify that projects are more creative when the solution is redefined, revisited, and questioned numerous times during the process. While a writer or designer generally revisits the problem or solution throughout the process, Stage 6 builds in an intentional reflective stage, in which a "revised" solution is actively tested (Stage 5) in terms of how it effectively and creatively addresses the original task (Stage 1).

Composition practice generally encourages an approach to writing that is recursive and strategic; but, as Purdy (2014) suggested, design thinking offers a new language to highlight the composition process through creativity. Framing creativity activities as divergent and convergent may help students become more cognizant of their creative thinking style and develop rhetorically impactful projects. More importantly, situating creative thinking in the broader composition process may help students more flexibly apply

multiple solutions and be more receptive to radical re-thinking: This approach in flexible thinking is a central part of creative thinking.

Principle 3: Creativity is a Situated Event

In addition to being a heuristic, problem-solving process, creativity is a situated event, involving historical, cultural, rhetorical, and modal contexts. Increased awareness of the situational context of creativity helps students understand how they can be original with their written or multimodal projects. While instructors of written texts have been helping students understand the historical, cultural, social or rhetorical contexts of written language, how can instructors help students become more aware of modal choices in communication? How can students become more aware of how their choices are shaped by a range of contexts? Furthermore, how can this understanding help students become more creative in playing with expectations of modal delivery, whether it is written, visual, auditory, or multimodal?

- **Encourage alternative and creative ways to "test" the rhetorical effectiveness of written and multimodal projects.**

Design thinking systematizes a creative process that can be devised to focus on the rhetorical effectiveness of a project. Students can be asked to 1) experiment with multiple and different paths to design, and 2) test the viability of their rhetorical design with audiences. In written composition, the testing typically comes in the form of instructor or peer feedback. However, if a product is meant for the public or a specific audience, students might be encouraged to quickly test the viability of their written or multimodal work in dorms, public spaces at the university, or in writing centers. For instance, writing centers might host "gallery spaces" where peers are invited to interact and give feedback to ongoing composition projects.

Principle 4: Creativity is a Product of Constructed Environments

Creativity can be learned and improved through explicit instruction and techniques. Pedagogy of creativity has been a focus in social sciences, especially education, but scholars in engineering and sciences have also examined how students' creative thinking is reinforced by curriculum that teaches creativity. How can instructors design a written or multimodal course with activities and workshops that cultivate problem solving and "possibility" thinking as the end and not just a means?

- **Encourage students to define the task/problem creatively.**

Creative processes incorporate problem solving. Problem solving makes complex and abstract topics relatable to students. Therefore, instructors might allow students to creatively address the "problem" for a multimodal project. Second, students could also be provided with specific tools and strategies for interpreting and defining the task. For instance, associative maps can help students visualize problems and needs in relation to audience, media, and mode (Kokotovich, 2007). Welch (2010) also discussed the use of creative language to increase comprehension of the task by encouraging students to "turn instructions into rap" (p. 40). By having students restate

instructions or assignments creatively, such as turning complex steps into musical lyrics, students may better define and understand the problem.

- **Define and discuss creativity explicitly.**

The process of learning to compose texts rhetorically with writing, audio, visual, and other modalities requires freedom to explore possible and effective means of expressing in these modalities (Rouzie, 2000). Articulating and providing concrete suggestions and strategies for how to "play" and to be creative with these modalities can boost student confidence with composing in multiple modes. We recommend that instructors take time in class to define and discuss the creative process within the context of the composition project, whether it is a written, visual, oral, or multimodal project. Students should be encouraged to engage with creative thinking concepts through conversations, exercises, and activities in the classroom and office hours (see Boczkowski, Randall, Render, & Sinovic, 2008).

- **Scaffold sketching and "prototyping" into assignments or activities.**

Prototyping is a term derived from engineering design and represents an important creative stage before final production. It is a quick, low-risk heuristic approach to help determine the possibility and viability of a written or multimodal project. Sketching multiple versions of a visual project, for instance, may be one of the easiest ways to prototype a design concept. For students in research writing, prototyping could be part of testing the viability of a concept or rhetorical approach through quick production and collection of data or feedback. Establishing a context for discussions of creativity and multimodal composing, Newcomb identified the creative practice of prototyping to encourage a change in "habits of mind" (2012, p. 612). "Quick prototypes," he argued, apply a design thinking process to explore new composing spaces—through blogs, for example—or expand notions of audience (Newcomb, 2012, p. 611). For multimodal projects like an animated web infographic, a student can quickly produce a prototype by applying animation on PowerPoint rather than writing code for a web page. Prototyping might also involve storyboarding for video design. By quickly producing and then sharing these versions with a wider audience (classroom or outside the classroom), the student might gain insight into which elements of a design work better or how to improve the design (Newcomb, 2012; Purdy, 2014).

Conclusion

In this article, we explored the roles of creative thinking and creativity pedagogy by investigating scholarly literature drawn from across the disciplines and by considering creativity processes and techniques for composition studies. A review of creativity theories and strategies across the disciplines led us to conclude that creative processes offered value to composition studies, especially in:

- idea generation

- quality of product
- innovative pedagogical approaches

Types of applied creative thinking practices across disciplines may depend less on modes or genre, and more on what Carter (2007) calls "metadisciplinary perspectives" (p. 407), or ways disciplines identify, evaluate, and test generalizable learning outcomes such as problem solving or empirical inquiry. However, we find that the outcome of problem solving, while not always described in this specific term, is a broadly applied creative practice: Problem solving is used to test how students understand and engage with a range of aesthetic, technical, and theoretical issues. The study resulting from the collection of creativity pedagogies across disciplines suggests the importance of problem-solving approaches not only as a visible performance of knowledge but also a means of raising the quality of the final product, whether that "product" involves scientific research, a mobile application, or a slideshow presentation. In composition studies where the product is the process, problem solving heightens students' awareness of the dynamic nature of composition. Creativity strategies reinforce the situational and iterative nature of composition, encouraging students to actively consider multiple paths toward a solution as well as question and revisit results for quality, innovation, and/or rhetorical effectiveness.

Although discussions of applied creative thinking come at a particularly important time in composition studies, creativity research in written and multimodal composition is, in some ways, just beginning. We acknowledge that our attempt to examine creativity approaches for writing studies across disciplines offers a broad perspective, but our objective was to offer a survey of interdisciplinary approaches that encourages further exploration of creative thinking skills. Future studies might follow Purdy (2014) and examine creativity approaches within a specific discipline such as engineering to tighten the connections with disciplinary approaches. Such an approach might offer an in-depth perspective of creativity in one discipline or follow the trajectory of creativity across the literature in a particular field. As composition and other university courses offer more assignments in modes different from traditional academic writing, and writing programs are asked to connect learning outcomes with other disciplinary ways of thinking and doing (Carter, 2007), composition studies may benefit from joining the extensive interdisciplinary conversations on creativity. But beyond interdisciplinary conversations, writing studies may find that it is time to revisit creativity theories. Mednick (1962) observed, innovations arise when seemingly unrelated elements are applied to create new associations. When creativity scholarship from different fields are applied to writing studies, instructors might discover not only more inventive ways to engage students in creative thinking but also more inventive ways to teach.

Appendix A: Major Creativity Scholarship and Concepts across Disciplines

Author and Discipline	Creativity Terms/Concepts	Purpose/Definition
Mednick (1962) <i>Psychology</i>	"associative" process of creativity	Creative people (regardless of discipline) form "associative elements" from apparently different elements to make novel and useful combinations. Creativity is originality plus "usefulness" (basic notion supported by other thinkers).

Lauer (1970) <i>Composition</i>	"heuristics" and invention	Creativity is involved in prewriting, generation of goals, and problem solving.
Flower & Hayes (1977); Flower & Hayes (1980) <i>Composition</i>	"problem-solving strategies" "discovery"	Creativity is involved in brainstorming; role playing; To create analogies is to see problems through a different lens.
Gardner (1982) <i>History</i>	"counterfactual thinking"	Creativity allows students to re-evaluate thinking throughout the process.
Elbow (1983) <i>Composition</i>	"first order thinking"	Intuitive, creative thinking can be obtained through brainstorming.
Bump (1985) <i>Technical Writing</i>	metaphorical thinking	Creative scientific writing uses metaphors to enable new conditions, models, and world-pictures; generate insights; clarify complex theories and objects.
Carey & Flower (1989) <i>Composition</i>	creativity is situational	Opportunities for creativity in writing occur in: <ol style="list-style-type: none"> 1. constructing and modifying task representation; 2. managing topic/content knowledge; 3. keeping track of evolving sets of goals and applying problem-solving strategies.
Brent & Felder (1992) <i>Composition</i>	"creative thinking"	Creativity is a teachable skill. Creativity requires students to move beyond the "surface approach to learning." Creativity can be scaffolded through techniques of brainstorming; Assignments should encourage problem solving.
Lumsdaine & Lumsdaine (1994) <i>Engineering</i>	visual thinking is placed with "imaginative, conceptual, and innovative thinking"	Creative thinking process involves the process of "defining problem," "idea generation," "synthesizing ideas," and "implementing ideas." There is creative value in collaborative work (especially a group consisting of different cognitive styles).

Dunn (2001) <i>Composition</i>	using visuals to promote creativity in writing	Creativity is a tool to help students retain metacognitive distance from ideas and the writing process; Creativity generates different perspectives.
Dorst (2001) <i>Design Studies</i>	"creative event"	Creativity critically defines the design problem. A creative event is the period of "exploration" in which problem and solution spaces are evolving.
Korgel (2002) <i>Engineering (Chemical Engineering)</i>	creativity and dialogue	Creativity is discussed in terms of design problem-solving; Writing is used to nurture independent thought.
Riedl & Young (2006) <i>Engineering</i>	"exploratory creativity" in storytelling versus "transformational creativity"	Creativity storytelling is an important skill that helps humans build cognitive structures for understanding the world.
Sawyer (2011) <i>Education</i>	"creative spark"	Creative thinking in groups is powerful.
Kokotovich (2007) <i>Design</i>	"creative problem solving"	Design comes out of solving design issues and creativity is important for how designers solve these problems. Cognitive maps to allow for discovery loops; Associative mind mapping is a type of cognitive map.
Boczkowski, Randall, Render, & Sinovic (2008) <i>Writing Center Studies</i>	using creativity to enhance writing center consultations	Role of play and creativity in the writing center context.
Howard, Culley, & Dekoninck (2008) <i>Engineering Design</i>	"creativity" in the design process, creative product (output), creative person, creative environment	Survey of design and creative processes from literature on creativity in psychology and engineering. The creative process has moved from one that is seen as a cognitive process to one that is more "activity-based" (what the producer/composer is doing).
DeHaan (2009) <i>Life Science</i>	creativity pedagogy: multicomponent, social, and teachable	Creativity is "multicomponent" process (divergent and convergent thinking, and analogical thinking). Creativity occurs in a social context.

Siswono (2010) <i>Mathematics</i>	creative thinking as a skill	Stages of creative thinking are: 1. awareness of creative thinking 2. observation of creative thinking 3. creative thinking strategies 4. reflection on creative thinking Divergent and convergent thinking are part of creative thinking.
Newcomb (2012) <i>Composition</i>	"situational creativity"	Creativity focuses on how students think about the problem in writing, not about how the student applies creative strategies in writing.
Alexander, Powell, & Green (2011/2012) <i>Composition</i>	creativity and multimodal composition	Creativity as an affordance of multimodal text. First year writing students respond to multimodal composition in light of their own experience in writing formal written academic genres.

Appendix B: Sample Demand Grid Exercise

Why a "Demand Grid"?

Design engineers and others in creative fields use the "demand grid" to generate a great deal of ideas. This strategy employs both divergent and convergent approaches to thinking (that is, thinking differently and generating a great deal of ideas), than thinking rationally and narrowing your selection.

Divergent and convergent thinking approaches will help you effectively produce more creative ideas that fit your interests and needs of the project. For us, creativity is defined by 1) concepts that are different from the norm and 2) concepts that are useful and applicable for the purpose of the project/product.

The demand grid will help you:

1. Increase creativity, improving quality of topic
2. Defer choice and decision until numerous ideas are formed

Directions

1. Divergent strategy:
Fill out the demand grid sheet for topics. Generate as much as you can, regardless of its relevance. Include silly, "left-field" ideas. Don't censor your thinking.

2. Convergent strategy:
 After filling out the grid, circle your top 2 or 3 ideas (based on practicality, quality, interest, and needs/requirements of project).

DEMAND GRID

Generate at least 33 free form ideas in the boxes below.

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