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Teaching Creative Process across Disciplines

ABSTRACT

While there is great interest in higher education about teaching creative process, there have been relatively few studies of how courses can facilitate the development of creative skills. The goal of this study was to document how college instructors structure courses intended to develop students' creative processes. The study data included interviews from instructors and students using a critical case sample of fifteen courses at a single U.S. University. A qualitative analysis of the transcripts yielded a set of 14 pedagogical elements appearing across courses. Common elements were open-ended projects and skill-building activities, and less frequently, risk taking experiences and self-reflection. The sample included undergraduate courses in engineering, education, the liberal arts, and the arts, and the elements observed were often shared across courses from different disciplines. These findings provide a diverse set of pedagogical approaches and opportunities for building creative process skills within undergraduate courses.

Keywords: cognition, creativity, education, research, process.

Educators and policymakers worldwide have called for more instructional opportunities to develop students' creative abilities, though U.S. leaders have been relatively slow to adopt these initiatives in schools (Beghetto, 2010). In many ways, colleges and universities are best equipped to foster creativity and innovation because they are already responsible for developing talent, conducting cutting edge research, generating new ideas, and serving as hubs connecting businesses, government agencies, entrepreneurs, and researchers (Wince-Smith, 2006). While the need for education about creative skills is clear, questions remain about how to teach students in ways that foster their learning about the creative process.

Many scholars have argued that all individuals are capable of developing their creative skills to some degree (Cropley, 2001; Runco, 2004; Sternberg & Lubart, 1995; Torrance, 1962, 1972; Torrance & Myers, 1973; Treffinger, Young, Shelby, & Shepardson, 2002). In a meta-analysis of studies on the effectiveness of instruction, Scott, Leritz, and Mumford (2004) found that creativity training helped individuals to develop their creative skills (as measured in tests of divergent thinking, problem solving, performance, attitudes, and behavior). In particular, they found instruction about cognitive strategies was most consistently effective in developing creative skills across programs. Cognitive strategies in creativity include core underlying processes such as problem construction, information encoding, combination and reorganization of best fitting categories, idea evaluation, implementation, and process monitoring (Finke, Ward, & Smith, 1992; Mumford, Mobley, Uhlman, Reiter-Palmon, & Doares, 1991).

However, college instruction on creative process may differ depending upon discipline. Kazerounian and Foley (2007) compared courses in engineering, science, and the humanities for the presence of ten principles of creativity: (1) Keep an open mind, (2) Ambiguity is good, (3) Iterative process including idea incubation, (4) Reward for creativity, (5) Lead by example, (6) Learning to fail, (7) Encouraging risk, (8) Search for multiple answers, (9) Internal motivation, and (10) Ownership of learning. From a survey of students and instructors at a university, they found that engineering students reported only one of these principles (#9, internal motivation) as present in their courses. Science students reported four of the 10 principles present (absent: #2, #4–7, #10). In contrast, students in the humanities reported 8 present (absent: #2 and #6). Daly and colleagues also found that engineering courses lacked instruction and assessment focused on divergent thinking and openness to exploration (Daly, Mosyjowski, & Seifert, 2014).

These findings suggest that explicit instruction on creative process may be most evident in the arts and humanities. Comparing creativity education goals across disciplines, Marquis and Vajoczki (2012) found that humanities instructors identified "challenging assumptions or conventions," generating "detailed, elaborated ideas or outcomes," and "expressiveness" as the most important creative factors within their fields. In contrast, health science instructors selected "innovation and flexibility" as key to creativity, and engineering instructors most commonly identified generating "multiple ideas or outcomes." However, this study also identified several factors as important *across* disciplines, including "novelty," "generation of novel or original ideas or outcomes," "problem solving," "examination of phenomena from multiple points of view," and "problem finding" (Marquis & Vajoczki, 2012). These findings suggest instructional practices from diverse domains may assist students in the development of their creative skills.

A common approach to teaching creativity is to include open-ended, exploratory assignments, with both hands-on and group-based learning strategies (Kind & Kind, 2007). An open-ended investigative or inquiry-based approach in science education was found to build higher order cognitive strategies such as mental simulation (Cloud-Hanson, Kuehner, Tong, Miller, & Handelsman, 2008; DeHaan, 2009). In engineering, open-ended assignments are used to encourage exploration of a problem (Daly et al., 2014), and often include work in teams, real-world problems, or real stakeholders (Dewulf & Baillie, 1999; Stouffer, Russel, & Oliva, 2004). Proponents of open-ended projects argue that they provide students with the opportunity to think about their own creative processes and identify ways to improve them (Baillie & Walker, 1998; Ishii, Suzuki, Fujiyoshi, Fujii, & Kozawa, 2006; Jablokow, 2001).

Additional approaches to instruction on creative process skills include exploring multiple perspectives (Cole, Sugioka, & Yamagata-Lynch, 1999), reflecting (Reynolds, Stevens, & West, 2013), and providing a safe climate to explore and take risks (Baloche, Montgomery, Bull, & Slayer, 1992). Bull, Montgomery, and Baloche (1995) asked liberal arts instructors to endorse the creative components "most important" to college instruction, and identified 20 topics including social climate, students' personality characteristics (openness to experience, enthusiasm), creative processes (brainstorming, divergent thinking), and "end results" (insight, innovation). However, it is not known if similarities and differences exist in course elements across disciplines, particularly in professional areas such as engineering, education, and the arts.

To improve our understanding of how to support students' developing creative skills, an important step is to understand current pedagogical practices across disciplines. In addition, it is important to examine course information from instructors as well as students. The study reported here documented patterns in how instructors and students perceived instruction on creative skills and examined how course emphases differ by domain. In this study, the impact or effectiveness of different approaches was not assessed; rather, we sought to identify which specific pedagogical approaches were prominent within a variety of disciplines. Our goal was to identify the learning opportunities about creative process that are provided within undergraduate courses and to determine whether these opportunities are shared across disciplinary boundaries. The research questions were:

- What general pedagogical approaches for teaching creativity are evident across a collection of courses?
- How do courses in various disciplines differ in the ways they incorporate opportunities for students to build creative skills?

METHOD

SAMPLE

We used a critical case sampling approach to identify courses (Case & Light, 2011; Creswell, 1994; Flyvbjerg, 2006, 2011) based on their emphasis on developing creative skills in consultation with teaching development staff, instructors, and deans. The fifteen college courses selected were offered at a large midwestern public university with a Carnegie Classification as a research university with very high research activity (RU/VH). Of more than 26,000 undergraduate students enrolled, slightly less than half are female. The courses represent five different undergraduate colleges, including art, music, engineering, education, and the liberal arts, and all were offered during the same academic term. The sample of courses represents a range of instruction from more traditional creativity training in the arts to the liberal arts, engineering, and education.

PROCEDURE

Our focus for this study was to identify the types of pedagogical approaches offered in courses to facilitate the development of students' creative skills. Data collection included a recorded interview with instructors (30–90 min) and students (30 min) from each course. The interviews were semi-structured, allowing focus as well as freedom to explore ideas raised by participants.

The interview questions for instructors included describing the course background, goals, pedagogy, and structure, and how they thought these related to learning about creative process. For example, instructors were asked to describe course elements they felt were "important in helping students develop their knowledge and skills around creative process," along with, "How do you set a climate in your classroom to encourage creativity," and "How do you know if students are successful in improving their creative process skills?" We also recruited up to three students per course through private email. Students were asked to describe their creative process experiences in their course, including, "Tell me about a specific experience in class where you think your creative process skills improved," and "What do you think your professor wanted you to learn about the creative process?"

DATA ANALYSIS

Data analysis was guided by a grounded theory approach, with the goal of developing themes based on emergent patterns (Glaser & Strauss, 2009; Patton, 1990). This repeated coding approach, with multiple coders and discussion to reach consensus, was implemented to enhance reliability of the findings. In the first phase of analysis, one author reviewed all of the transcribed interview materials to inductively generate an initial coding scheme with 13 codes. In a second phase of analysis, undergraduate student coders (a group of six) were trained, and for each course, two coders separately reviewed all of the data collected, and then scored it using the initial codebook. The two coders for each course then discussed differences to reach consensus.

Consensus discussions often identified instances where evidence did not include specific key words associated with the coding scheme, but represented a theme at a deep level. For example, one instructor comment included "failure" as a term ("I am a big fan of a heroic failure ... We try to tell the students on a weekly basis...") and was identified by both coders as evidence for the "risk taking" theme. Another instructor statement omitted the words "risk" or "failure" (e.g., "For a lot of them this is the first time when, when like the assignment is to make something where you're not sure it's going to work in the end."), and was coded as "risk taking" by one coder. Through discussion, the two coders agreed that this was evidence of an educational environment that promoted risk and potential failure because the instructor de-emphasized successful outcomes.

Comparing differences between the two coders also identified opportunities where codes could be clarified, condensed, or removed. For example, an original code captured "critique" as an approach, but did not identify who performed the critique. This distinction was added to the codes (one for student critiques of their peers' work, and another for instructor critiques). Another change to the coding scheme removed a theme for "contextualized experiences" because *all* of the projects described included contextual elements such as real-world stakeholders. A more important differentiator of these experiences was the duration and magnitude of the assigned project (some courses included multiple, smaller open-ended tasks rather than one major course project). Thus, major projects were differentiated from shorter open-ended assignments in the coding scheme. Finally, the distinction between explicit and implicit evidence of skill building was removed. Identifying the instructor's style of instruction (explicit or implicit) was less consistent across coders, so these subcategories were combined into a single theme for skill-building activities. The final coding scheme included 14 codes (see Table 1).

Next, two of the authors identified the prominent approaches within the evidence from each course. A theme was considered "prominent" if at least four instances were identified within the transcripts. This removed less frequently observed themes (such as a sole reference to grading scored within the "instructor feedback" theme) from the analysis. The goals of this final phase were to identify prominent pedagogical themes emphasized within each course, and allow a comparison of prominent themes across courses.

RESULTS AND DISCUSSION

First, we describe the fourteen themes evident across courses and their connections to existing scholarship. Next, we discuss similarities and differences in these approaches across disciplines, and its implications for course design.

APPROACHES TO TEACHING CREATIVE PROCESS

Skill building

Courses often included exercises or lessons meant to build skills by focusing on "how" one performs important tasks within a discipline. The skills varied by disciplinary context; for example, procedures for

TABLE 1. Summary of Emergent Pedagogical Approaches for the Development of Creative Process

Pedagogical approach	Definition
Skill Building	Learn skills that are important to successful creation within a discipline, including opportunities for practice.
Domain Knowledge	Learn technical knowledge and concepts needed within a domain of expertise.
Major Project	Undertake a large-scale (semester long) problem or task, often involving real stakeholders, constraints, and/or iteration.
Open-ended Assignments	Complete smaller assignments addressing open or ill-defined problems.
Create in Novel Contexts	Engage in the creative process in a context outside of one's own expertise or experience.
Build Repertoire	Experience and analyze existing creative work.
Student Critiques	Provide critiques of peers' work.
Instructor Feedback	Receive personal instruction through a critique of submitted work.
Cross-disciplinary Interaction	Work with others from differing disciplines, or create work crossing disciplinary boundaries.
Practitioner Models	Exposure to experienced practitioners and their approach to creative work.
Theories of Creative Process	Learn about research and theory related to creative process.
Self-Reflection	Students consider their own creative process.
Risk and Failure Experiences	Engage in activities that involve risk, failure, and recovery.
Perspective Taking	Take the role of another person to experience others' viewpoints.

using a specific type of equipment, standard practices in literary composition, and techniques for synthesizing materials. One instructor explained this as a key experience: "You have to have the skills to work with the clay and so we're trying to give them the skills and then . . . provide this playground that they can build all these different tools and play around with things." (Instructor, Course 10). Another instructor emphasized the importance of basic disciplinary skills for novices: "Obviously the freshmen at this stage are being introduced to . . . basic tools of operation so we obviously want them to learn how a specific process can be used to produce specific results" (Instructor, Course 12).

This emphasis on basic skills is consistent with the idea that one must have domain skills in order to innovate in that area (e.g., Amabile, 1983; Christiaans, 1992; Kirton, 2004). Students engaged in building these skills in both passive and active ways, by listening to lectures or following instructions for a specific skill. Other times, students were given a setting for practicing and refining the skills required to perform a procedure. Teaching students through "experiential learning," or "learning by doing" has been established as a successful way for students to learn content more deeply (Anzai & Simon, 1979; Carlson & Sullivan, 1999; Prince, 2004).

Domain knowledge

In contrast to skill building, learning domain knowledge focused on the "what," or knowledge foundational to the discipline. This foundation was described by an instructor: "Well the textbook as such is mostly um a formal introduction to literature and the exercises and the instructions that are appended to the works under scrutiny are, by in large, in the critical mode." (Instructor, Course 3). A student described this foundational knowledge as, ". . .doing research on the market and pitching the product, like advertising. Doing business analysis to see if it's profitable" (Student, Course 5).

Of course, instruction typically focuses on acquiring domain knowledge; however, the distinction evident here was the need for the domain knowledge to facilitate or enable creativity. Numerous scholars have supported the importance of content knowledge in the subject area in which one intends to be creative (e.g., Amabile, 1983; Christiaans, 1992; Csikszentmihalyi, 1990; Kirton, 2004; Simonton, 2000).

Major projects

Major projects were a frequent course element, providing large-scale tasks that students had to decompose into smaller units. These projects allowed students to make many of their own decisions about ideas to pursue. As one student noted, “The course itself allowed me for the first time to take an idea that I had and execute it into a semester-long project. I was able to set out a goal and decide from the start how I would find the solution. I could decide what aspect was most important in the project and focus more on that” (Student, Course 7). Major projects often included aspects similar to those encountered in a professional setting or a real-world context, such as stakeholders who would make use of the results or funding to support the work. One instructor described the “realness” he tried to create through the major project: “The fact that we are essentially laying two thousand dollars on the table and saying, ‘Here’s your budget, you’re responsible. This is real.’” (Instructor, Course 2).

Instructors also emphasized iteration, or revising and refining the work, as a critical part of the problem solving or design process in conducting the major project. This pedagogical approach can be characterized as problem-based or project-based learning experiences that are open-ended, and resemble challenges the students are likely to encounter as professionals (Barrows & Tamblyn, 1980; de Graaff & Kolmos, 2003; Helle, Tynjälä, & Olkinuora, 2006; Prince & Felder, 2006). Both types of learning experiences have been shown to be an effective pedagogy to support student engagement (Dochy, Segers, Van den Bossche, & Gijbels, 2003; Mills & Treagust, 2003; Prince & Felder, 2006; Vernon & Blake, 1993). In some cases, problem- or project-based learning experiences have been shown to promote metacognition and reflection (Blumenfeld et al., 1991; Chung & Chow, 2004).

Open-ended assignments

Open-ended assignments (short-term tasks) were also a common approach to teaching creativity. Across courses, open-ended projects (where the outcomes are not defined) were often evident in the pedagogy. Instructors reported that the ill-defined, independent nature of these shorter assignments provided students with the space and opportunity to be creative. Students recognized the value of open-ended tasks; for example, one student said, “I think the biggest thing is we had to come up with it on our own, it wasn’t anyone telling us ‘Ok this is how you do it.’ We had to come up with how to do it and then we had to actually do it. I think that promotes the most creativity when you have to do it on your own and you’re not given a very very strict structure” (Student, Course 14). The emphasis on open-ended projects and problems is a defining feature of creative work because the outcomes of creative processes are usually indeterminate (Hennessey & Amabile, 2010).

Open-ended assignments have been found to be an effective technique for creativity instructors (Horn, Hong, ChanLin, Chang, & Chu, 2005), and open-ended group assignments have been shown to facilitate problem solving (Hauer & Daniels, 2008). Open-ended assignments align with Kazerounian and Foley’s (2007) identification of “Ownership of learning” and “Ambiguity is good” as important themes in instruction on creativity. Without a blueprint from the instructor, students must “step up” to set their course in creating solutions.

Create in novel contexts

Some courses exposed students to creative activity in a discipline or perspective outside their past experience, forcing them to be creative in a novel context. This approach had students explore topics in unfamiliar contexts, communicate outcomes in a manner not typical of their discipline, and apply principles and ideas from one discipline to another. One instructor explicitly emphasized requiring students to create in new areas: “When people come to me already familiar with [the technologies] the mere use of them doesn’t defamiliarize anything. I want them to try the unfamiliar” (Instructor, Course 6). Working in an unfamiliar context provides students with the opportunity to break away from the typical thinking, tools, and problem solving approaches in their field, and to experiment with those in another context or discipline. One student described the benefit as, “I know so much about music, but now I had to try to do something in a completely new setting, one where I’ve never worked before. And that made me think about things very differently” (Student, Course 8).

The pedagogical approach of creating within a novel context has been identified in science education (Kind & Kind, 2007; Watts, 2001) and in education more generally (Reynolds et al., 2013). Consistent with the literature on cognitive sources of creativity (e.g., Finke et al., 1992), creating in new domains can facilitate novel combinations and connections among ideas. Working at the intersections between disparate ideas and contexts may facilitate creative modes of thinking, including association and analogy (Beaty, Silvia, Nusbaum, Jauk, & Benedek, 2014; Finke et al., 1992; Linsey, Markman, & Wood, 2012).

Build repertoire

Some instructors exposed students to existing creative artifacts to provide inspiration and demonstrate a variety of successful approaches to creative work within a field. One student described the value of seeing work done by others: "She'll show us weird examples and then that kind of gives you ideas and 'inspirations' to and about how to be creative ... once you're exposed to these kinds of things, they stick to you" (Student, Course 9). Another student talked about the value of exposure to a variety of ways problems have been approached: "Well the big part is considering what's already been done, and then trying to think of something you can do better, but then also considering why people do it the way they do already because usually they have good reason" (Student, Course 7).

In this approach, students build a repertoire of existing outcomes from which to draw inspiration and build upon in their own creative processes. Schön (1990) described "repertoire" as a store of precedents and a personal source of generative metaphors. A creator's experiences and knowledge can guide decision making about the creative process and creative outcome (Daly, Adams, & Bodner, 2012). Building and drawing upon repertoire has guided some existing educational approaches and tools (Nelson & Stolterman, 2012). For example, design-by-analogy methods leverage past cases to guide new creations (Linsey et al., 2012; Verhaegen, D'Hondt, Vandevenne, Dewulf, & Duflou, 2011).

Peer critiques

Students' critiques of peers' work was evident in courses as a strategy to develop critical skills, and to benefit from the ideas and suggestions of peers. One instructor explained, "I teach them a very practical skill, which is how to analyze each other's writing ... I put them in a group of four so they each read through other drafts, then they meet as a group and discuss each other's drafts, the strengths and weaknesses" (Instructor, Course 1). Students gained from peer critique exercises both by hearing ideas about how to improve their own work, and by developing their critical evaluation skills. One student suggested a high impact for peer critiques: "I had a workshop on Wednesday and I kind of got it bashed, which I was very surprised about. It was my first time workshopping poetry. I was told that I was too heavy in imagery and not enough on life experience, which I can kind of understand" (Student, Course 6).

Peer evaluations have been found to increase student confidence in their ability to perform, increase awareness of the quality of the student's own work, and increase reflections on their own behavior and performance (e.g., Dochy, Segers, & Sluijsmans, 1999; Topping, 1998; Van den Berg, Admiraal, & Pilot, 2006). Performing peer critique may be a more demanding cognitive task than responding to feedback (Anderson, Krathwohl, & Bloom, 2001). Somervell (1993) emphasized that peer critique is a process through which students' skills are developed, perhaps by allowing the reassessment of assumptions about successful practices (Cosh, 1999).

Instructor feedback

Some courses included feedback sessions where the instructor reviewed student work and offered comments. These feedback sessions were formal or informal, and public (including the whole class) or private for the individual student or team. One instructor stressed, "The thing that will get you in the most trouble as a writer or any artist is a defensive attitude, inability to take criticism. And, when somebody says 'this is not working,' they'll say 'well the reason I did this was' ... and so I give them very specific notes, often 5 or 6 pages of stuff of here's what you need to think about." (Instructor, Course 1). Another instructor stated, "It's more like a coach or a guide or an interrogator ... I mean, we say that we are on each and every team. We help them where we can. We help to question their assumptions. And also just to have them get finer grained with how they're looking at stuff, you know?" (Instructor, Course 2).

Instructor feedback is common in the arts, where instruction traditionally takes place through critique (Dannels & Martin, 2008), and is also common in architecture, industrial design, and engineering (Anthony, 1987; Dutson, Todd, Magleby, & Sorensen, 1997; Oh, Ishizaki, Gross, & Do, 2013; Wilkin, 2005). Prior research has pointed to the importance of receiving feedback during learning, and the role it plays in helping students develop self-generated feedback (Nicol & Macfarlane-Dick, 2006). Wilkin (2005) observed that first year students sought feedback to get instructors interested in their work, to gather more ideas, and to compare themselves with peers; by the third year of study, students primarily used feedback as a source of technical expertise, and referred to the feedback as a chance to test their own ideas. Seng (2000) also found that students given instructor feedback made higher gains on measures of creativity involving discovering relationships and flexibility of thinking.

Cross-disciplinary interaction

In some courses, instructors intentionally assigned students to cross-disciplinary teams or encouraged cross-disciplinary collaboration. This approach requires students to work with others who may approach problems or envision outcomes differently. Instructors intentionally placed students in situations where they had to explore new and unfamiliar areas, develop common ways to communicate, and synthesize their approaches and knowledge across disciplinary contexts. Some courses combined existing disciplines in new projects, such as a course on design that combined specialties within engineering (Course 7), or an applications design course combining financial, material, and artistic concerns (Course 2). Other courses combined technological advances within traditional disciplines; for example, one of the education classes (Course 11) combined politics with a computer simulation where students took on a political persona, and another added visual art to dance (Course 4).

One instructor described what he was looking for: “We also look for ... how they’re integrating things that come up that cross over between the different points of view, or when you start getting engineers posting about art projects, and you get artists posting about engineering problems. That kind of stuff where you can see a synthesis of information from multiple points of view” (Instructor, Course 2). A student pointed to this as a key element in the course: “I think the first important thing was that people of different strengths were involved ... We weren’t limited by our own experiences and background ... Even in this experience, I was inhibited in the beginning to trust their ideas. But, when we finally came up with the piece I was like, ‘Wow this is good, I mean why was I so nervous about it?’” (Student, Course 4). The existence of cross-disciplinary courses reflects this growing trend in instructor training and research (Lattuca, 2001; Lattuca, Voigt, & Fath, 2004; Spelt, Biemans, Tobi, Luning, & Mulder, 2009).

Practitioner models

In this method, instructors exposed students to accounts of experts in their discipline, and examined how these creators approached their work. In some courses, this involved a guest speaker giving a presentation on their work, or students listening or reading interviews of practitioners.

One instructor explained this pedagogical element as, “Prior to each session or section, I make them look at the video of the interview with Updike or Hirsch so that they have a sense of ... the practitioner. And all of those authors, really without exception, talk about their work, at least as far as I’m concerned, beautifully from the inside.” (Instructor, Course 3). A student described the variety of practitioners who contributed to her understanding of creative processes: “It’s been ... guest speakers coming in. [The instructor] knew the author of one of the books we have to read so he invited her to come speak about her work and what she does in print. That was really cool. And then there was another guy who does photography. It’s been artists who work in their field” (Student, Course 12). Hearing experienced creators talk about their creative process provides students with insight into how processes are used in different ways by accomplished professionals.

Career theory supports the importance of practitioners as role models to helping guide student development (Gibson, 2004; Speizer, 1981). Hearing experts discuss their approaches to creativity motivates students, highlighting practices that students can integrate into their own creative work. Kazerounian and Foley (2007) also identified “lead by example” as an important element of instruction on creativity in engineering, suggesting this element may be a valuable addition to courses aimed at developing students’ creative processes.

Theories of creative process

Instructors’ approaches included teaching students about scientific research and theory related to creativity. Instructors believed that exposing students to scholarly work on creativity would help students see the value of creative process skills, and would compel students to master them. In addition, this approach was chosen to encourage students to relate theoretical concepts of creativity to understanding their own creative processes. One student noted, “I think it’s pretty cool. I didn’t know there were so many papers out there about creativity and that people actually studied that much about creativity and these cognitive processes and thinking and theories” (Student Interview, Course 9). Another student discussed how the instructor leveraged existing research to help students understand frameworks: “I think he wanted to do more of placing guidelines. There’s a creative process, but if you don’t have somewhat of a method you want to follow, then it can be pointless; no one will be interested. So one of the things we had was a researcher who came in and talked about what goes into a good project.” (Student, Course 10).

Models of approaches to creativity built from creativity theory and research are included in many creativity books and guides (e.g., Fogler & LeBlanc, 2013; Isaksen, Dorval, & Treffinger, 2010). There is no single description of creative process based on evidence, nor is there consensus about the general theories and models to use when teaching creativity (Bull et al., 1995). However, exposure to a variety of models, as well as evidence about their efficacy, could facilitate students in applying the best available knowledge as they develop their own skills (Anderson, 2006; Elliott, 2001).

Self-reflection

Students were sometimes asked to perform reflective exercises about their own creative processes, and to analyze their individual experiences with creativity. Reflection was used in some cases as a complementary activity to open-ended projects, where the intention was for students to reflect on their own creative processes and see ways to improve their creativity. An instructor described the incorporation of self-reflection in his class as having students compare their own creative work to existing products: "I expect everyone to pick a major off-the-shelf game, play it all semester long as the foil to consider all of the things we're reading about and talking about in class. So they're supposed to reflect on those things against what they're doing" (Instructor, Course 15). A student discussed structures used to facilitate students' reflection throughout the term: "We do six journals where we work on the project for 3 weeks ... We have to go through the creative process and have to do metacognition and think about what we learned from the creative process and our insights" (Student, Course 9). By reflecting on their work, students can gain insights into their own creative processes and the elements that go into their creative process.

Having students reflect on their own thought processes, or "metacognition," is a recognized method to support deeper learning (Adams, Turns, & Atman, 2003; Bransford, Brown, & Cocking, 1999; Brown, 1987; Schön, 1993). By considering their processes and the impact of their processes on their outcomes as they engaged in creative work, students can refine their approaches. Reflection could serve as a key strategy to support better cognitive integration of implicit and experiential learning (Kolb, 1984).

Risk and failure experiences

Instructors encouraged students to engage in activities that pushed them to take risks and experience failures. These instructors helped students to feel safe in experimenting with different ideas and gaining the confidence to explore, as well as to understand that risk and failure are natural aspects of creative endeavors. For example, one instructor encouraged resilience in response to errors, saying: "I do try to make use of this concept called 'intelligent pass failure' ... which is the opportunity to ... make mistakes when it doesn't matter, such that there isn't necessarily the stigma associated with making mistakes. The point is, hey you got that wrong, okay, let's figure out why we're getting it wrong" (Instructor, Course 13). A student noted the impact of this element: "I guess the best way to learn is to fail ... if it had just been handed to us I don't think we would have gotten as much out of it" (Student, Course 8).

Studies have shown that when risk taking is supported in the classroom, students' creativity increases (Sternberg & Williams, 1996; Thousand, Villa, & Nevin, 1994; Wilde, 1993). Kazerounian and Foley (2007) identified "learning to fail," and "encouraging risk" as two of 10 maxims for instruction on creativity. To encourage risk taking, instructors can encourage dissent, de-emphasize assessment, and serve as a model for creative thinking (Cole et al., 1999).

Perspective taking

This approach asked students to consider alternative perspectives by assuming the role of another person within a task in order to develop a deeper understanding of the perspectives and goals of others, and to approach creating from a different mindset. This was a central component in a course using simulations to learn about politics: "We start at the beginning of a simulation ... saying 'Okay, now you're the Turks, how about that?' And you have to decide who your person is, who is [person], what's he all about, what does he want, what constituents does he have to be mindful of, who would he be very leery to offend?" (Instructor, Course 11). In another example from a writing course, the instructor had students create with a specific persona in mind: "I tell them to rewrite [the work] in the inflection of somebody who has gone through university and is a native American speaker or to try and write it from the vantage of someone who has just arrived from Eastern Europe or from Africa, etc. and take the same language and alter it" (Instructor, Course 3).

Perspective taking has been identified as important in fostering creativity (e.g., Cole et al., 1999; Grant & Berry, 2011; Kelley, 2007; Sessa, 1996). It can foster creativity within a team (Hoever, Van Knippenberg, van Ginkel, & Barkema, 2012) or facilitate new connections across ideas (Finke et al., 1992). Personas are a tool for taking on another perspective and driving outcomes to match to a stakeholder's perspective, and have been cited as helpful scaffolds for creativity (Sanders, 2006).

COMPARING APPROACHES ACROSS DISCIPLINES

Across these courses, instructors and students identified a variety of pedagogical approaches intended to develop students' creative skills. Within the sample of courses, multiple sources of evidence supported fourteen different pedagogical approaches. However, some approaches were evident as prominent themes more or less frequently than others. Figure 1 shows the four instructional approaches identified as most prominent in the interview transcripts for each course. Note that these results do not reflect the absence of an approach within any course; instead, the figure highlights the approaches most frequently emphasized in the interviews.

Both *open-ended assignments* and *major term projects* frequently occurred across courses, providing students with opportunities for multiple possible solutions and pathways to solutions. Less frequently, prominent approaches included *self-reflection*, *theories of creative process*, *practitioner models*, *risk taking experiences*, and *perspective taking*. While these approaches were evident in a variety of courses, they were not a main focus of instruction based on the interview data. These approaches have the potential to promote creative skills development, and may be important ways to add variety in fostering creativity in courses and curricula.

Grouping the courses by discipline highlights some differences in emphasis. First, courses on writing, visual arts, and performing arts included a large variety of approaches across courses. This may be partially due to the fact that the course offerings were more diverse. Engineering courses were more similar to each other in the pedagogical approaches evident, with all featuring *skill building*, and most including *acquiring domain knowledge* and *major term projects*. In the liberal arts and education courses, *self-reflection* and *perspective taking* were central to some, perhaps reflecting sensitivity to self-monitoring derived from psychological and educational theories. *Building a repertoire* was evident in the liberal arts and in the visual and performing arts. Across disciplines, *open-ended assignments* and *acquiring domain knowledge* were prominent.

Furthermore, no single approach was present as a predominant element in all of the courses. Even a frequently observed approach, such as "Open ended Assignments," was not prominent in 6 of the 15 courses. The variation in themes within each course suggests the importance of multiple pedagogical approaches.

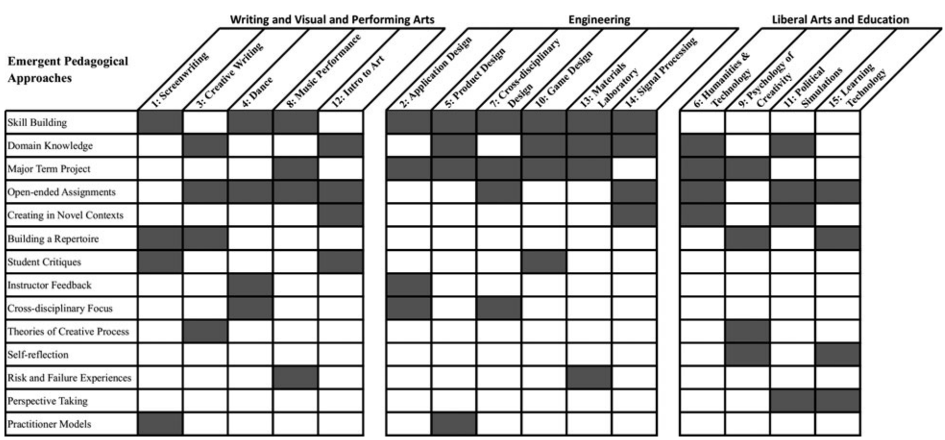

FIGURE 1. The four most prominent pedagogical approaches identified within each of the 15 courses.
Note. Other approaches may also have been present within a given course. The courses are grouped into writing and arts courses, engineering courses, and liberal arts and education courses.

The collection of elements identified in this study provides a repertoire of approaches to consider in teaching creative skills, and suggests that it is helpful to include multiple approaches within a curriculum when teaching about creative process.

The commonalities across disciplines in these findings speak to the potential for their applicability for the development of creative skills across disciplines and domains. The collection of approaches observed can serve as a starting point for instructors to better direct their pedagogy toward building creative skills. By reviewing the list of approaches, an instructor may identify alternative approaches for creative skill development, and create more diversity of elements within their pedagogy. The pedagogical elements observed can help instructors think about different ways to support the creative development of their students, and help universities think about how to provide opportunities to develop creative skills across programs.

The findings also provide suggestions for what discipline-specific practices can contribute in teaching creative skills in a different domain. For example, *building a repertoire* was an approach not predominant in any engineering courses in the sample. While preserving a collection of learning objects is typical in some disciplines (Nelson & Stolterman, 2012), engineering, the sciences, and other disciplines may also benefit from the *building a repertoire* approach. Another approach, *perspective taking,* was evident in both education courses, but appeared less often in other disciplines. The ability to take on another viewpoint—purchaser, audience, teammate, technician, or other stakeholder—is central to successful creative activities; consequently, intentional instruction on how to take alternative perspectives would likely benefit students across disciplines.

This study provides new information about the pedagogical approaches evident in creative skills instruction across disciplines in college courses. The study included a sample of 15 courses from a single U.S. university, restricting the ability to generalize the findings; however, the critical case method allows other researchers to apply and translate the findings into their own contexts (Case & Light, 2011; Malterud, 2001). Evidence in our study was collected from instructor and student interviews, and thus may not capture all teaching practices in the courses; in particular, these data collection procedures do not allow inferences from the absence of observations. This study also offers no evidence of the effectiveness of the identified approaches in the development of students' creative skills. Future studies are needed to tie student learning outcomes to the use of specific pedagogical elements in courses aimed at developing creative process skills.

CONCLUSION

Creative skills are required by many disciplines today, but there is a lack of knowledge about how to assist students in their development, limiting both instructional methods and students' deep learning about creative processes. The diverse collection of courses included in this research provided evidence for a variety of pedagogical strategies in teaching about the creative process within college courses. The observed pedagogical approaches suggest ways for instructors to provide students with multiple forms of support in their creative skill development across disciplines.

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