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Creative Learning: A Fresh Look

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That creativity can play a role in learning seems clear. Indeed, creativity researchers and educational scholars have long asserted that theories of learning need to be broadened to include creative cognition. What is less clear, however, is the specific nature of that role. The purpose of this article is to introduce a new model of creative learning. The article opens with a brief discussion of previous work on learning and creativity. Next, a model of creative learning is introduced, specific assertions based on the model are discussed, and an example of how the model might be applied to classroom learning is presented. The article closes with a discussion of implications for future research on creative learning.

Keywords: creativity; learning; creative learning; creative theory

"Thank goodness I was never sent to school; it would have rubbed off some of the originality."

—Helen Beatrix Potter

How might we think about the relationship between creativity and academic learning? One way is to view creativity and learning as independent or even incompatible. Although few creativity scholars hold this view, it is sometimes held by educators and may be one reason why creativity enhancement efforts are impeded in educational settings (Beghetto, 2010). Another way to view this relationship is to recognize that there is a link between creativity and learning. A long line of scholars has held such a view (Barron, 1969; Guilford, 1950; Kagan, 1967; Sawyer, 2010; Vygotsky, 1967/2004). The ways in which scholars have conceptualized and empirically examined this relationship, however, are quite varied. What insights can be gleaned from revisiting previous work on this relationship, what remains to be known, and how might a fresh look at creativity and learning point to new and more viable directions for research?

The purpose of this article is to address these questions. First, I highlight previous research on the relationship between learning and creativity. Next, I introduce a new model of creative learning, discuss nine assertions based on the model, and then apply the model to an example of classroom learning. I close with a brief discussion of the implications for future research on creative learning.

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REVISITING THE LINK BETWEEN CREATIVITY AND LEARNING

Creativity Influencing Academic Achievement

One way creativity researchers have conceptualized the link between creativity and learning is to posit creativity as a factor influencing academic achievement (creativity → learning). Along these lines, researchers have examined whether creativity scores influence academic learning outcomes, such as grades and grade point averages (GPAs). The findings from these studies, spanning more than 50 years of active research, have yielded mixed and inconclusive results. Some researchers have reported moderate to strong links between creativity scores and academic performance, whereas others found positive, yet weaker links (e.g., Cicirelli, 1965; Cline, Richards, & Needham, 1963; Getzels & Jackson, 1962; Niaz, de Nunez, & de Pineda, 2000). Still, others have found even more variable patterns in this relationship. Gralewski and Karwowski (2012), for example, explored this link in a study of 34 schools. In some schools, they found a positive, strong, and statistically significant link between creativity scores and GPA, whereas in others, they found nonexistent or even negative relationships. Freund and Holling (2008) have reported similar findings. In their study, they found that the relationship between creativity scores and GPA varied across classrooms and, in a few cases, creativity scores were associated with lower grades.

What might account for these mixed and variable patterns? There likely are several factors that account for this variation. Subject area seems to be one of those factors. Indeed, several researchers have found that the link between creativity scores and academic performance varies by subject area (Freund, Holling, & Preckel, 2007; Niaz et al., 2000). Beghetto and Baxter (2012), for example, found that whereas students' creative self-efficacy beliefs in science were indirectly related to teachers' ratings of students' science understanding, creative self-efficacy beliefs in math were directly related to students' math understanding.

In addition to subject area, researchers have described a combination of factors that might result in mixed and variable findings. Several of these factors include the use of different measures of creativity and achievement, different types of analyses employed, and whether contextual and other moderating and mediating variables were accounted for in the models (Freund & Holling, 2008; Gralewski & Karwowski, 2012).

In summary, researchers who have examined the relationship between creativity and academic performance (creativity → learning) have yielded variable results. Perhaps, the best that can be said as to whether creativity influences academic achievement is "It depends." Consequently, this line of research does little to clarify the role that creativity plays in classroom learning or the role that academic learning plays in students' creative expression in the everyday classroom.

Academic Learning Influencing Creative Accomplishment

Another way scholars have conceptualized the relationship between creativity and academic learning is to posit academic learning (or domain knowledge) as a factor influencing creative performance (learning → creativity). The assertion that domain knowledge is necessary for creativity is one of the most broadly endorsed views in the field of creativity studies (see Ericsson, 1996; Gardner, 1993; Sawyer, 2012). Guilford (1950), for example, provided a succinct summary of this assertion, "no creative person can get along without previous experience or facts" (p. 448). Indeed, high levels of creative accomplishment tend to require deep knowledge of a domain (Sawyer, 2012). Creativity scholars, however, acknowledge that *more* is not necessarily *better*. There is, in fact, evidence that too much formal schooling can result in diminishing returns when it comes to creativity (Simonton, 1994).

If deep domain knowledge is necessary for creativity, how might formal education undermine creative accomplishments? One reason is that people can become too fixed or dogmatic in their thinking (Ambrose & Sternberg, 2011; Plucker & Beghetto, 2004). When trying to solve a novel problem, for instance, a person deeply immersed in a field of study may rely too much on what is readily known. This tendency can undermine a person's ability to generate original ideas or solutions (Ward, Patterson, Sifonis, Dodds, & Saunders, 2002). At the same time, generating wildly original ideas can undermine feasibility or task appropriateness of those ideas (Ward, 2008). Creativity therefore requires a balance between originality and feasibility and domain knowledge plays a key role in striking this balance.

When it comes to influencing creative outcomes, how people have structured and use their domain knowledge seems to be as important as having a lot of domain knowledge. Indeed, prior research has demonstrated that producing creative outcomes depends greatly on how one's domain knowledge is encoded (Mumford, Baughman, Supinski, & Maher, 1996), how accessible that knowledge is for the person trying to use it (Rietzschel, Nijstad, & Stroebe, 2006), and how a person attempts to put that domain knowledge to use when solving novel problems (Hao, 2010). Put simply, accomplished creators know how and when to use their knowledge to generate creative outcomes (Kaufman & Beghetto, 2013).

In summary, researchers who have conceptualized academic learning (or domain knowledge) as influencing creative accomplishments (learning → creativity) have provided consistent, albeit somewhat nuanced, insights into this relationship. Specifically, accomplished creators not only have deeper domain knowledge but they also know how to make strategic and flexible use of that knowledge to produce creative outcomes (Mumford, Medeiros, & Partlow, 2012; Plucker & Beghetto, 2004). Although previous work on the link between prior knowledge and creativity provides important insights regarding the role that domain knowledge plays in creative outcomes, these findings pertain more to accomplished creators than to K12[1] students.

Interdependence of Creaçtivity and Learning

Yet another way to view the relationship between creativity and academic learning is to conceptualize them as interdependent (creativity ← → learning). Several creativity scholars and learning theorists have held this view. Jean Piaget, the eminent learning theorist, titled one of his books, *To Understand Is to Invent*. Scholars in the learning sciences also share this view and recognize that "learning is always a creative process" (Sawyer, 2012, p. 395). Guilford (1967) went as far as to claim that "creativity and learning are much the same phenomenon" (p. 307).

Some scholars use the compound term *creative learning* to signify the overlap between creativity and learning. Wyse and Spendlove (2007), for instance, derived a definition of creative learning by drawing on previous definitions and descriptions of creativity and learning. They defined creative learning as "learning which leads to new or original thinking which is accepted by appropriate observers as being of value" (p. 190). Their definition puts a spin on Guilford's (1950) assertion that "a creative act is an instance of learning" (p. 446) and suggests that an instance of creative learning is a creative act.

Other scholars use the term *creative learning* to refer to a much broader range of pedagogical practices, curricula, and educational reform initiatives. *The Routledge International Handbook* *of Creative Learning* (Sefton-Green, Thomson, Jones, & Bresler, 2011), for example, provides a collection of essays that reflects this broader conceptualization of creative learning. Although such broad views of creative learning acknowledge the microlevel relationship between creativity and academic learning (i.e., students' subjective and interpersonal creative learning experiences), the focus tends to be placed on mesolevel activities (i.e., creative curricula and pedagogy) and macrolevel policy and reform (i.e., creative school change and system change).

Still, other scholars have viewed creativity and learning as being linked by a third concept, such as problem solving. Guilford (1967) was one of the earliest scholars to note this link. Following Guilford, several scholars have used problem solving as the basis for their models of creative learning. Treffinger's model for creative learning (MCL), for example, represents a three-step developmental framework for helping people learn how to become more proficient at creative problem solving (Treffinger, 1980; Treffinger, Isaksen, & Firestien, 1983).

Truman (2011) also developed a model of creative learning inspired by creative problem solving. Truman's model represents a three-phase process (preparation, generation, and evaluation), which combines social factors (task negotiation, collaborative design, social evaluation) and personal factors (personal preparation, individual design, personal evaluation) to guide the production of creative outcomes. Truman's model is noteworthy in that it specifically attempts to incorporate facets of learning theory with creativity and can be used to guide curriculum design. Her model, however, still leans more toward explaining the process that leads to creative outcomes (rather than how creativity can also support learning).

At this point, a fresh perspective on creative learning is needed—one that can clarify both sides of the interdependent relationship of creative learning and also clarify students' subjective and interpersonal experiences with creative learning. The remainder of this article is directed at introducing a new model of creative learning for K12 classrooms.

CREATIVE LEARNING: A FRESH LOOK

Previous conceptions of creative learning tend to fall short of representing the full, interdependent relationship between creativity and learning. Moreover, the role that subjective and interpersonal experiences play in the process is often obscured. As such, the concept of creative learning might benefit from being split into two subconcepts: *creativity-in-learning* and *learning-in-creativity*. The first, creativity-in-learning, refers to the role that creativity plays in the development of personal understanding. The second, learning-in-creativity, refers to the role that sharing one's understanding plays in making creative contributions to others. The model, depicted in Figure 1, endeavors to highlight this relationship.

As illustrated in Figure 1, creative learning involves two spheres of influence. The first is the intrapsychological sphere, where the emphasis is on the role that creativity plays in changing personal understanding (or *creativity-in-learning*). The second is the interpsychological sphere, where the focus is on the role that sharing personal learning plays in making a creative contribution to others (or *learning-in-creativity*).

Taken together, creative learning can be defined as a combination of intrapsychological and interpsychological processes that result in new and personally meaningful understandings for oneself and others. The creative learning model depicted in Figure 1 is a schematic of these processes and provides a new way to represent the interdependent relationship between creativity and learning. Moreover, similar to previous conceptions of creativity and learning (e.g., Beghetto, 2013b, in press; Littleton & Mercer, 2013; Vygotsky, 1967/2004), it

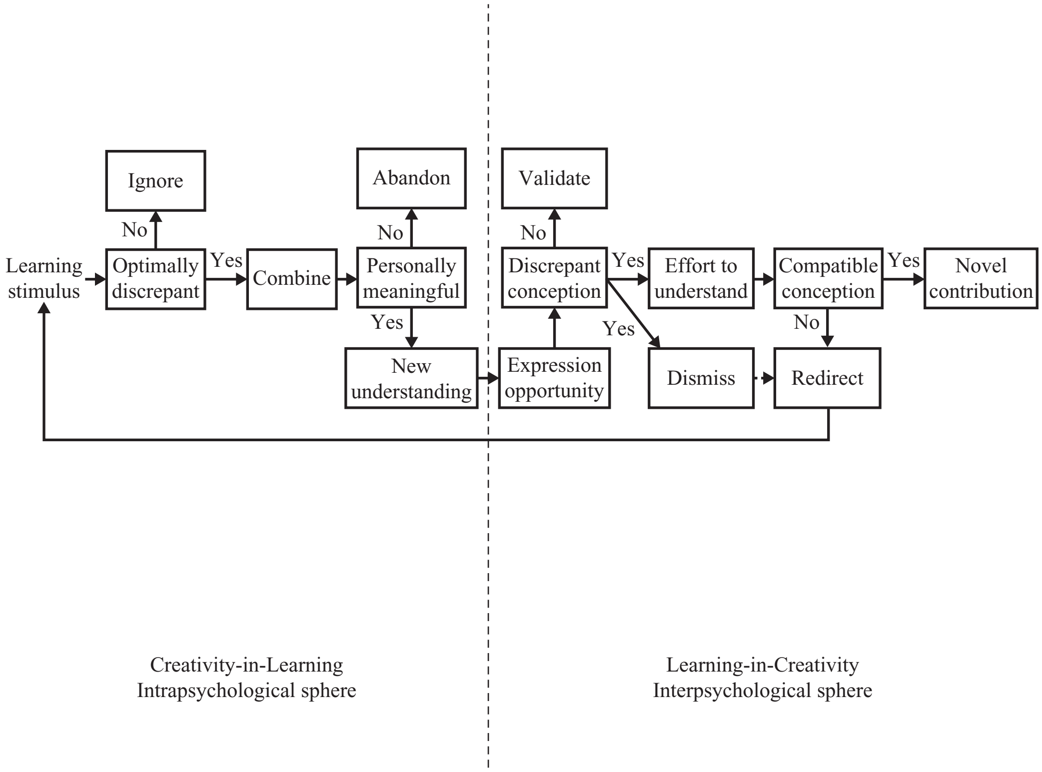

FIGURE 1. Creative Learning Process Model.

also recognizes a relationship between the individual and sociocultural factors at play in creative learning.

In the following sections, I discuss the key assertions of the model. Prior to doing so, I want to briefly clarify the context. Although the assertions derived from this model may generalize to various types of learning experiences and events, the model has been designed to describe creative learning that might occur within the context of formal instructional activities found in K12 classrooms. More specifically, the model focuses on the creative learning opportunities presented by instructional activities, such as classroom discussions, wherein students can develop and share their new and personally meaningful understanding of academic subject matter.

Attending to Optimally Discrepant Stimuli

Assertion 1: Learners Attend to Optimally Discrepant Learning Stimuli. As illustrated in Figure 1, the first step of the process involves attending to learning stimuli. Learning stimuli refer to a wide array of learning-related information that may engage the learner's attention. In the context of a classroom discussion, for instance, this could be academic content that a teacher has presented to students, a teacher's question, a peer's response or question, or a teacher's response to students.

It almost goes without saying that unless a learner attends to a learning stimulus, the information presented will not be learned or meaningfully understood by that learner. Contemporary learning theorists take it as a given that learning results from a process of attending to and interpreting new experiences in light of one's prior learning and experiences (Donovan & Bransford, 2005). Just because a teacher presents a learning stimulus, however, does not mean a student will attend to it. Why might this be the case?

There are at least two reasons. One reason is the stimulus is not discrepant enough to be noticed. In short, the stimulus lacks sufficient novelty to catch the learner's interest and attention. Indeed, humans seem to be hardwired to notice novel and unexpected events (National Research Council, 2000). Alertness to novel events not only provides opportunities to learn, it may also be a survival instinct. This alertness to novelty can be seen in the behavior of infants. Renee Baillargeon and her colleagues have, for instance, demonstrated this tendency in a series of experiments (e.g., Baillargeon, Needham, & DeVos, 1992; Needham & Baillargeon, 1993). They devised scenes and situations to test infants' reactions to expected and unexpected events. The researchers found that unexpected events (e.g., a box seemingly floating in the air) held infants' attention reliably longer than did expected events.

Another reason why students may not attend to learning stimuli—even highly novel stimuli—has to do with a phenomenon that Mack and Rock (1998) have called *inattentional blindness*. Inattentional blindness tends to occur when people are focused on some other aspect of their environment. This phenomenon has been demonstrated in several studies. Researchers have, for instance, directed participants to focus on a video clip of a small group of people passing basketballs. A few moments into the clip, a woman with an open umbrella (Neisser, 1979) or a person in a gorilla suit (Simons & Chabris, 1999) walk in a direct path through the center of the scene. Invariably, some portion of the participants will fail to notice these surprising stimuli.

In the context of creative learning, learning stimuli must fall in the zone of optimal difference in order for students to attend to it. Stimuli not only need to cross a threshold of novelty (be different enough to be noticed) but students also need to be undistracted by other features of the environment to attend to the target learning stimuli. If a stimulus does not fall into this zone of optimal difference, the learner will simply recognize it as an example of what is already known and ignore it.

Combining New Stimuli With Existing Knowledge

Assertion 2: Learners Engage With Learning Stimuli by Combining Those Stimuli With Their Existing Understanding. Students interpret new experiences through the lens of their existing knowledge (Donovan & Bransford, 2005). This sense-making process is a combinatorial and creative process. Creativity researchers have long recognized that combining discrepant stimuli is at the heart of the creative process and can result in new ideas, concepts, and products (e.g., Finke, Ward, & Smith, 1992; Mumford et al., 2012). A combinatorial process is also central to the concept of mini-c creativity (Beghetto & Kaufman, 2007). Specifically, mini-c creativity refers to a "process of constructing personal knowledge and understanding" as the result of developing new and personally meaningful interpretations of one's experiences, actions, and events (Kaufman & Beghetto, 2009, p. 3).

This combinatorial process is also consistent with how scholars in the learning sciences have conceptualized the development of student learning and understanding. Donovan and Bransford (2005), for example, have asserted, "new understandings are constructed on a foundation of existing understanding and experiences" (p. 4). This constructive process is referred to as *cognitive constructivism*. As Cazden (2001) has explained, *constructivism* refers to the “significant mental work” necessary for a learner to develop a new understanding. This mental work involves combining what a student already knows with new information and experiences found in the student’s learning environment.

In the context of the present model, once students have attended to new learning stimuli, they will attempt to make sense of it by combining it with what they already know. This combinatorial process drives creative learning that, in turn, can result in a change in students’ personal understanding.

Personally Meaningful Interpretation

Assertion 3: Learners Attempt to Make Sense of the Combination. When combining new learning stimuli with existing understanding, the learner is actively engaged in trying to make sense of the result of that combination. In the context of creative learning, a sensible combination would be one that the learner considers new and meaningful. As Guilford (1967) has explained, an act can be said to be creative “when there is something novel about it; novel, that is, for the person performing the act. The act must also be relevant . . . ” (p. 307). The same can be said of creative learning.

If learners are unsuccessful at making sense of the combination, then they will abandon the effort. Some learners will immediately abandon the sense-making effort when unsuccessful, whereas others will persist. Persisting can include seeking help from others or suspending the effort and returning to it at some later time. If eventually successful, then the sense-making effort will result in new understanding. If not, learners will eventually abandon the effort. Abandoning the sense-making effort can happen when students do not have sufficient background knowledge to meaningfully interpret the discrepant learning stimulus (Donovan & Bransford, 2005), do not believe they are capable of success (Bandura, 1997), or simply fail to see the personal relevance in the combination. In such cases, it can be said that the learning stimulus was discrepant enough to be noticed but too discrepant for the learner to makes sense of it. Regardless of the reason, the end result is essentially the same: The learner is unable to meaningfully interpret the combination, and the effort is abandoned.

In some cases, such as cramming for an exam, a student may memorize new information for later recall. Memorization can result in developing a personal understanding but would require the additional cognitive effort of combining the memorized stimulus with one’s existing understanding. Otherwise, memorized information might serve as (inert) stored stimuli, which has the potential to be transformed into personally meaningful information. Being able to store and accurately recall information does not, in itself, suggest that one has developed a meaningful understanding of that information (Beghetto & Plucker, 2006). Rather, the development of new understanding requires doing the cognitive, combinatorial work necessary to transform a discrepant learning stimulus into something that the learner interprets as personally meaningful.

In summary, if a student is able to make sense out of the combination, then the result will be a change in that student’s understanding. Otherwise, the learner may continue to try to make sense out of the combination or abandon the effort.

New Understanding

Assertion 4: A Change in a Student’s Personal Understanding Results From the Subjective, Combinatorial Process of Creativity-in-Learning. The outcome of creativity-in-learning is a change in a student’s understanding. The magnitude of that change depends on several factors. One key factor is how discrepant the learning stimulus was from the learner's prior understanding. The more discrepant the learning stimulus is from the student's prior understanding, the greater the change that can be expected in the student's personal understanding. Creativity researchers have argued that diverse conceptual combinations are the driving force of creative outcomes (Mumford et al., 2012). This ability to successfully combine remote stimuli into new and meaningful outcomes is a hallmark of accomplished creators. Rothenberg (1996), for instance, explained that the most accomplished creators, such as Nobel Prize winners, tended to use what he called *Janusian thinking* (i.e., successfully combining directly opposite ideas). In the context of creative learning, as long as the stimulus falls in the optimal range of difference (i.e., different enough to be noticed), then we can expect the magnitude of change in a student's personal understanding to correspond with the initial amount of discrepancy between the learning stimulus and the learner's prior understanding.

In summary, new understanding is the outcome of the process of creativity-in-learning. At this point in the process, the creative learning that has occurred is a change in the intrapsychological sphere of the learner. Others have not yet vetted the learner's new understanding. Consequently, the student's resulting understanding may or may not be compatible with his or her teacher's or peer's understanding (von Glasersfeld, 1995). The student, however, has still engaged in a creative act of learning. The next phase of the creative learning process involves the student having the opportunity to share and receive feedback on his or her ideas.

Expression Opportunity

Assertion 5: Learners Can Socially Validate Their Understanding and Make Creative Contributions if They Are Given Opportunities to Share Their Understanding. In order for students' personal understanding to rise to a socially compatible understanding, they need an opportunity to share and receive feedback on their new ideas and insights. Doing so helps students test out their ideas, identify their strengths and limitations, develop confidence in their ideas, and become aware of how they might further strengthen their understanding (Bandura, 1997; Cianci, Klein, & Seijts, 2010). Feedback can also help students develop their personal understanding into classroom contributions that support the learning of others (Beghetto, 2007). Indeed, feedback from others helps students develop their creative potential into creative contributions (Beghetto & Kaufman, 2007).

Simply asking students to share their ideas may not be enough, however. Prior research has demonstrated that perceived teacher support is a key factor in predicting whether students will have confidence in their ideas (Beghetto, 2006) and be willing to take the risks necessary to share those ideas (Beghetto, 2009). As such, students need to feel that it is safe (or at least worth the risk) to share their ideas. When teachers have created a supportive classroom environment they have established a bridge between the intrapsychological and interpsychological spheres of creative learning.

The invitation to share one's ideas moves personal learning and potentially creative ideation out of the mind of the learner and situates it in the sociocultural context of the classroom. This is not to say that the mind of the learner is somehow sealed off from sociocultural influences but rather that the opportunity to share one's developing ideas allows learners to expand and contribute their personal understanding in dialogue with others (Littleton & Mercer, 2014). In this way, the intrapsychological process of creativity-in-learning starts to become externalized in the context of the classroom. Unless teachers provide opportunities for students to share their unique and personally meaningful understanding, the creative potential and social viability of their understanding remains latent.

Discrepant Conception

Assertion 6: Others Evaluate How Discrepant a Learner's Understanding Is in Light of Their Own Conceptions. Much like the process the individual learner goes through in the intrapsychological sphere of creative learning, teachers and peers will evaluate how discrepant the students' shared ideas are in relation to their own personal understanding. If others view the learner's ideas as fitting with their existing understanding (i.e., not discrepant), then they will socially validate those ideas. Social validation at this stage in the process signifies that the student's ideas are viewed as viable but not creative. This is because the student's ideas correspond with what is already known or expected. When this happens, it serves as an example of how a student's understanding can be creative at the subjective (or mini-c) level but not at the more objective, classroom (or little-c) level (Beghetto & Kaufman, 2007). Although validation of the student's ideas would end the creative learning process (i.e., not result in a creative contribution to others), the social vetting of the student's ideas still represents an important aspect of creative learning. Providing students with an opportunity to validate their new and personally meaningful understanding helps ensure that the subjective creativity-in-learning process is not simply an exercise in solipsism.

If, on the other hand, a student's ideas are viewed as discrepant, at least two outcomes are possible. One is the student's unexpected ideas may be dismissed; the other is that the teacher will make an effort to understand the discrepant ideas. This is a pivotal moment in the interpsychological sphere of creative learning. If the ideas are simply dismissed because they are not easily understandable, then the potential of these ideas is lost. This can have a negative impact on the learning of the student sharing ideas as well as the potential learning of peers and teachers (see Beghetto, 2013b; Black & William, 1998, for a review).

Not all dismissals will end the creative learning process, however. It is possible that a dismissal can serve as a learning stimulus and, in turn, result in the revision of students' understanding. In order for students to revise their understanding, they need feedback on how and why their understanding might be revised. Unfortunately, dismissals often fail to provide the level of feedback necessary to support the further development of students' personal understanding (Black & Wiliam, 1998; Kennedy, 2005).

In addition to dismissing student's unexpected ideas, teachers and peers have another option: attempt to understand the student's discrepant idea. When teachers put forth the effort to understand students' unexpected ideas, the potential for their ideas to be viewed as compatible and to make a contribution to the learning of others remains active and the creative learning process moves forward.

Effort to Understand

Assertion 7: Supportive Others Attempt to Understand Seemingly Incompatible Conceptions of Learners. In order for the potential of a student's discrepant ideas to be vetted and make a contribution to the learning of others, teachers and peers need to make an effort to understand those ideas. Making the effort to understand unconventional ideas is easier said than done. Teachers must manage multiple instructional demands, which can easily tax their cognitive load. Indeed, as Ball (1993) has explained, "the unusual and novel may consequently be out of earshot . . . [and] even when the teacher hears the child, what is [the teacher] supposed to do?" (p. 385). Knowing what to do when confronted with discrepant ideas comes with experience and deep pedagogical knowledge.

Prior research, for instance, has demonstrated that more experienced teachers tend to be better at eliciting and working more flexibly with unconventional student ideas as compared to novice teachers who tend to respond to students in ways that discourage students from sharing their ideas and unique understanding (Akerson, Flick, & Lederman, 2000; Borko & Livingston, 1989; Housner & Griffey, 1985). Consequently, if teachers want to understand students' unconventional ideas, they need to strike a balance between structured disciplinary knowledge and in-the-moment flexibility (Beghetto & Kaufman, 2011).

This process of attempting to understand students' ideas also requires a different kind of evaluative judgment than what typically occurs in classrooms. Evaluation or assessment in support of creative learning is, as Sefton-Green (2011) has argued, "situated in a different set of power relations than those that traditionally pertain in relation to the curriculum" (p. 317). In the context of creative learning, teachers need to be willing and able to move beyond simply assessing whether students can accurately reproduce previously transmitted information. Unless teachers make a good faith effort to work with students to develop a compatible understanding of emerging and often idiosyncratic ideas, the opportunity for students to make creative contributions will be lost.

Compatible Conception

Assertion 8: Others Determine Whether a Discrepant Conception Can Be Made Compatible With Their Understanding. Constructivists, such as von Glasersfeld (1995), have argued that we can never really know what is beyond our own subjective interpretations but that we can strive for compatible conceptions with others. In the context of the classroom, striving for a compatible conception between a student's discrepant ideas and the conceptions of that student's teachers and peers requires the kind of classroom dialogue the allows students and the teacher to continually clarify and work with each other's ideas (Littleton & Mercer, 2013). This goal differs from the kind of classroom that focuses on matching teacher's preconceived expectations (Beghetto, 2010; Cazden, 2001) and, instead, aims to arrive at a compatible understanding. When successful, students and teachers establish what Edwards and Mercer (1987/2012) call "common knowledge." Common knowledge represents a dynamically evolving, shared framework of understanding among teachers and students.

The effort to establish a compatible understanding between a student's discrepant ideas and the conceptions of that student's teacher and peers parallels the intrapsychological process of creativity-in-learning. One way of thinking about this effort is to recognize that when a student shares a discrepant idea, it serves as a learning stimulus for the student's teacher and peers. In this way, the process of attempting to understand the seemingly unconventional understanding of a student can also be a creative act.

More important, striving for compatibility is not a one-way process. As I have discussed elsewhere (Beghetto, in press), sometimes, it will require students to modify their personal understanding. Other times teachers will need to adjust their expectations. Still other times, teachers and students will need to modify what they expect and understand from each other. This can be something as simple as a teacher taking a moment to ask a student to repeat an idea and then working with the student so the idea is more clearly articulated and understood.

Other times, it may take several iterations over a much longer time span. It can also require students and teachers to abandon their prior conceptions in light of more viable conceptions. In some cases, compatibility may not be achieved. Even in such cases, the process can be reinitiated at some later time.

In summary, striving for a socially compatible understanding requires that teachers facilitate the kind of conversation that engages multiple voices in the classroom and allows students to share and receive feedback on their personal understanding.

Novel Contribution

Assertion 9: Others Who Come to Recognize the Compatibility of a Discrepant Idea Will Also Recognize It as a Creative Contribution to Their Own Understanding. Students develop their competence when they have an opportunity to apply, test, and refine their understanding in subject matter rich contexts (Donovan & Bransford, 2005). This allows students to simultaneously develop their subject matter and creative competence (Beghetto, in press). Moreover, when students have opportunities to "show us their thinking" they will, as Carolyn Maher has argued, "surprise us . . . [because] they represent their ideas in very interesting ways, in ways that would not even have occurred to us" (Maher in Harvard-Smithsonian Center for Astrophysics [HSCA], 2000). Students can, of course, show their thinking and make novel contributions in multiple modalities (i.e., the written word, a performance, nonverbal gestures, material artifacts, and speech acts). In the context of classroom discussions, however, verbal expression is the most frequent mode used by students to reveal their thinking and potentially make contributions to others.

When students' discrepant ideas are given voice and teachers skillfully work with those ideas, it not only provides an opportunity for students to socially validate their personal understanding, but it can also result in them making a contribution to the learning and understanding of their peers and teachers. When this happens, the expression of individual student learning serves as an interpersonal creative act and represents *learning-in-creativity*.

Classrooms that support the full expression of creative learning provide ongoing opportunities for students and teachers to learn with and from each other. This is similar to what Littleton and Mercer (2013) have described as establishing an intermental creativity zone (ICZ). They explain that the ICZ results from an ongoing exchange and development of common knowledge between and among participants. The creative learning process described herein seems to represent one way that an ICZ may be cultivated and sustained in K12 classrooms.

In summary, the full expression of creative learning involves the ongoing development, refinement, and contribution of students' personal understanding in collaboration with their teachers and peers.

APPLYING THE MODEL

Background

In what follows, I attempt to illustrate the full process of the creative learning model by way of example[2] (adapted from Ball, 1993; Bass, 2005). In this example, a third-grade teacher and her students have been working on odd and even numbers. The children had some prior conceptions about even and odd numbers. The teacher used story problems (e.g., Gum is 2 cents. A pretzel is 7 cents. What options does Mick have if he wants to spend 30 cents on these items?)

to help students explore various combinations of even and odd numbers (e.g., even + odd = odd, odd + odd = even). The teacher established a classroom environment in which students were invited to share their ideas and thinking.

Creative Learning: The Intrapsychological Sphere

One day, when the students were preparing to work through the even and odd combinations to determine whether they were true for all numbers, a student (Sean) raised his hand and shared the following unexpected idea:

> I was just thinking about six . . . I'm just thinking it can be an odd number, too, 'cause there could be two, four, six, and two, three twos, that'd make six . . . And two threes, that it could be an odd and an even number. Both! Three things to make it, and there could be two things to make it. (Bass, 2005, p. 424)

Working backward from this surprising utterance, we can speculate that the teacher's invitation to her students to "consider whether all numbers fit into the combination rules" (i.e., even + odd = odd; odd + odd = even) served as a learning stimulus for Sean. The stimulus seemed to be optimally discrepant for Sean as he clearly engaged with it and combined it with his understanding of the number six. This combination resulted in Sean developing a new and personally meaningful understanding that the number six "could be an odd and an even number."

As we move from the intrapsychological sphere to the interpsychological sphere, we can draw on a rather detailed empirical record of the classroom discussion and the retrospective thinking of Sean's teacher (described in Ball, 1993; Bass, 2005). These data, when viewed through the lens of the creative learning model, provide a practical example of how teachers and peers can support the development of a student's subjective experience of creative learning (i.e., creativity-in-learning) into a creative contribution that impacts the learning and understanding of others (i.e., learning-in-creativity). This process is discussed in the section that follows.

Creative Learning: The Interpsychological Sphere

Returning to the example, it seems clear that the classroom environment created by the teacher provided Sean with an opportunity to share his personal understanding. Indeed, Sean was willing to share his unconventional idea that the number six is both an odd and an even number. Once he shared his idea, his teacher viewed it as discrepant and struggled with how to handle it. She had to "grapple with whether or not to validate nonstandard ideas" (Ball, 1993, p. 387)—worrying that by choosing to accept such ideas she might cause confusion in his peers. When Sean shared his idea, she was confronted with a key decision. Given that the idea was discrepant with her own conception, she couldn't immediately validate it. But how should she respond? Should she devote class time exploring such an unconventional idea and risk confusing all the other students?

A seemingly justified response in such a case might be to gently dismiss (e.g., "Think about this some more, Sean") or attempt to correct and redirect Sean (e.g., "Six is an even number, it can't be both). As discussed earlier, such dismissals are quite common (Beghetto, 2013b; Black & Wiliam, 1998; Kennedy, 2005). Teachers, however, have another option in a situation like this: Attempt to understand the student's reasoning. In this particular case, Sean's teacher decided not to correct or redirect him but rather take time to explore his idea by restating it and inviting his classmates into the discussion.

Once Sean's teacher invited his peers into the discussion, it became evident that his peers also viewed his idea as discrepant. Indeed, according to Bass (2005), Sean's peers already knew from second grade that six is an even number. Not surprisingly, they immediately disagreed with Sean. More important, however, their disagreement was not a dismissal of Sean's idea, but under the skillful guidance of their teacher, served as an opportunity to actively engage with this idea.

Bass (2005, p. 425) recounts a portion of the dialogue between Sean and his peers. Cassandra is the first student to challenge Sean and uses the number line in front of the classroom to try to convince him that six is an even number. Starting with zero, she counts up to six (even, odd, even, odd, even . . .). Sean, however, is persistent and explains that six can also be odd because "three of something can make six." Another student (Kevin) interjects, "just because two odd numbers add up to an even number doesn't mean it has to be odd." The teacher then asks Sean and the other students to share their working definition of an even number, which another student (Jillian) explains as "a number that you can split evenly without having to . . . split one in half." Sean agrees that six would be even using this definition but continues to assert that it could also be odd, " . . . Three twos could make it."

At this point, Sean's peers and teachers still have not arrived at a compatible understanding. Again, it might seem reasonable for a teacher to abandon this discussion and redirect Sean. Sean's teacher, however, continued to facilitate the conversation. After some more discussion, Sean's peers challenged him to "prove it to us . . . " and Sean drew the following example on the board (adapted from Ball, 1993, p. 385):

oo| oo| oo|

Sean used his drawing to explain that six is an odd number because it can be made up of three groups of two. Sean then explained that six could also be an even number based on his understanding of odd–even combinations and because even numbers can split into two even groups (two groups of three). He made the following drawing to demonstrate (adapted from Ball, 1993, p. 385):

ooo| ooo

Sean's claim that six could be both even and odd was based on his new, personally meaningful understanding. Sean's teacher and peers put forth great effort to understand Sean's discrepant conception, but it did not come easily. Sean's classmates and his teacher struggled with how Sean's idea might actually fit with their own way of thinking about numbers. One of Sean's classmates, Mei, shared her interpretation of what Sean was saying, "I think what he's saying is that you have three groups of two. And three is an odd number so six can be an odd number and an even number" (Bass, 2005, p. 426).

Mei engaged Sean in this discussion, letting him know that she had difficulty accepting his idea because other numbers, such as 10, share the same properties. The result of doing so helped Sean clarify and expand his understanding, "I didn't think of it that way . . . thank you for bringing it up" (Bass, 2005, p. 427). This, at first, exasperated Mei because she thought it would eventually lead to all numbers being classified as odd and even, " . . . if all numbers were odd and even, we wouldn't even be having this discussion!" (Bass, p. 427).

By working through several more examples, Sean, his teacher, and peers were able to recognize that not all numbers share the unique properties that he was describing. Eventually, Sean's teacher and peers were able to recognize the unique contribution of his new category of numbers what they came to call "Sean's numbers." This was made possible by the teacher's skillful facilitation of the class discussion. Sean's teacher asked him to develop a definition, which he did: "Sean's numbers have an odd number of groups of two" (Ball, 1993, p. 387).

This example illustrates how, in the context of this third-grade classroom, the full expression of creative learning occurred. Specifically, moving through creativity-in-learning (i.e., the intrapsychological process of Sean's developing understanding) to learning-in-creativity (i.e., the interpsychological process of socially vetting Sean's ideas and the contribution of his ideas to his teacher's and peer's conceptions). The outcome was that Sean, his teacher, and his peers had expanded their understanding of odd and even numbers to include the new category: *Sean's numbers*. When teachers establish a learning environment supportive of students' developing and sharing their personally meaningful understanding of academic subject matter, they support both creativity-in-learning and learning-in-creativity. Such learning environments, of course, do not guarantee that students will develop a meaningful understanding of everything that is taught or that students who share their understanding will always make a creative contribution to the understanding of others. That said, the kind of learning environment illustrated in this example highlights how the full expression of creative learning can occur in the context of a K12 classroom.

Implications for Theory and Research on Creative Learning

The creative learning model introduced herein provides a new way for creativity scholars to conceptualize and empirically examine the interdependent relationship between creativity and learning. This model contributes to existing theory and research by providing a comprehensive model of creative learning in K12 classroom settings. Although previous efforts have shed some light on how people learn creative problem solving strategies and the relationships between creative performance and academic outcomes, they tend to fall short when it comes to representing the interdependent relationship between the subjective and interpersonal aspects of creative learning. The model introduced in this article can address this shortcoming by providing a theoretical bridge between the intrapsychological (creativity-in-learning) and interpsychological (learning-in-creativity) spheres of creative learning in academic settings.

Perhaps the greatest potential of the model, however, is that it offers testable assertions. In order for researchers to realize this potential, they will need to draw on existing (or perhaps develop new) methodologies that allow them to simultaneously examine the tacit (intrapsychological) and more explicit (interpsychological) features of creative learning. The kinds of methods this type of exploration requires are techniques that have not frequently been used in creativity research.

Working backward from a student's surprising utterance is one, albeit speculative, way to gain insight into the intrapsychological space of creative learning. Another way would be to prompt students to share their thinking while working on a problem (i.e., think-aloud protocols) or videotape students and have them retrospectively explain their thinking (i.e., stimulated recall). Researchers have successfully used such techniques to uncover the more tacit and microgenetic processes (intrapsychological) along with the more explicit and observable (interpsychological) features of teaching and learning (see Beghetto, 2013a; Siegler, 2002, 2006).

In the case of creative learning, researchers can use a combination of methods to zero in on preexisting conceptions of some topic (e.g., asking third graders how they would explain the difference between positive and negative numbers), document specific observable behaviors and events during a lesson (e.g., videotape a teacher's presentation of a learning stimulus, a student sharing his or her ideas, a teacher or peer's response to those ideas), and then use stimulated recall to have students and teachers explain their reasoning or understanding during those key events (e.g., What were you thinking when that student shared her idea?).

Researchers will also need to examine whether and how the assertions of this model vary across contexts. They likely will find that various individual and sociocultural factors mediate and moderate the process of creative learning. Moreover, aspects of creative learning likely vary by grade level and subject area. Researchers may also find that various combinations of students' beliefs (e.g., creative self-efficacy, intellectual risk taking, perceptions of teacher support) influence whether they have the confidence to take the risks necessary to share their tentative ideas. Relatedly, the way teachers design their classroom learning environment likely will influence whether the full expression of creative learning is supported. Indeed, context matters when it comes to creative expression (Amabile & Pillemer, 2012; Beghetto & Kaufman, 2014; Yi, Hu, Plucker, & McWilliams, 2013). Although researchers (e.g., Davies et al., 2013) have identified features of the classroom environment that tend to support creative expression, additional research is needed to continue to understand how teachers can design the kinds of creativity-supportive learning environments that will support the full expression of creative learning described herein.

In conclusion, there are many potential directions that researchers can take to test and refine the assertions of the model introduced in this article. Such work is ambitious, will require the development (or adaption of) novel methodologies, collaboration among researchers and educators, and could easily become the focus of one's entire program of research. Researchers working in cross-disciplinary and international teams may be able to make the most progress in this somewhat uncharted terrain. The insights gleaned from such efforts could help move the field into important and much needed directions—shoring-up long-standing assertions about the relationship between creativity and learning.

NOTES

1. The abbreviation K12 refers to school-age students in kindergarten to Grade 12 classrooms.
2. The example blends hypothetical and actual aspects of the published account (from Ball, 1993; Bass, 2005) and draws on a prior description of this account (adapted from Beghetto, 2013b). The hypothetical aspects pertain to the creativity-in-learning portion of the model. This is because the published accounts do not include data on the intrapsychological sphere of the process (Ball, 1993; Bass, 2005). Although hypothetical, it still illustrates how this process might be accounted for in an actual study. Moreover, in the conclusion, I briefly discuss how existing analytic methods might be adapted to elicit this otherwise hidden intrapsychological sphere of creative learning. With respect to the interpsychological sphere, I draw on the qualitative data presented by Ball and Bass and interpret those data in light of the creative learning model. Again, the aim in providing this example is to illustrate how the creative learning model might be applied and to highlight areas in need of further development by researchers. This is just but one of many possible examples of how a student's personal understanding might be developed (creativity-in-learning) and, in turn, contribute to the learning of others (learning-in-creativity).

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