On creative thinking in education:

Eight questions, eight answers

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Creative thinking in education has often been described as a critically important 21st century skill. A skill necessary for young people to successfully navigate an increasingly uncertain future. If we pause to think about such a claim, we likely will realise that it is a bit problematic to describe creative thinking as a 21st century skill. Such claims overlook the fact that the ability to think in creative ways is something people have always done throughout the course of humanity.

It is also problematic to describe our experience of the 21st century as involving more change than what people experienced during other historical periods. That said, it is understandable why people are placing emphasis on creative thinking, given the amount of uncertainty we face with rapid global and technological changes.

Indeed, machines are now capable of (and in some cases surpassing) some of the high water marks of human intelligence and creativity, such as: producing original music compositions, writing original news stories, generating creative recipes, and outperforming humans in strategic and, in some cases, creative thinking (for example Jeopardy, Chess, and Go).

Not surprisingly, the rise of machine learning and advances in artificial intelligence has resulted in a range of concerns, including everything from rethinking what it means to be human (are we turning into cyborgs?), reconsidering what should be taught in schools (if machines are better at storing and retrieving information than humans, how should subject matter be taught?), and even worrying

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about potential existential threats to humanity (will we survive a world run by smart machines?).

In order to understand the educational implications of such concerns and the role that creative thinking can play in addressing them, it is important to first clarify several core questions, including what exactly creative thinking is. Do students always need to be thinking creatively? Is creative thinking yet another curricular add-on that needs to be taught and tested? Should schools bring in creativity specialists to work with teachers and students? How can educators support creative thinking in young people?

The purpose of this paper is to explore these and related issues by addressing the following commonly asked questions:

1. What is creative thinking?
2. How does creative thinking relate to other forms of thinking?
3. How do we determine whether an idea is creative?
4. When do we need to think creatively?
5. How are creative possibilities generated?
6. How do we select from possibilities we generate?
7. Is creative thinking domain-specific?
8. Is creative thinking teachable?

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1 What is creative thinking?

Creative thinking is defined here as: a process of generating thoughts (ideas, interpretations or insights) that are evaluated by oneself or others to be original and meaningful in the context of a particular task, situation or domain.

Prior to unpacking the various elements of creative thinking, it is important to briefly discuss a few key operating assumptions about the definition, including how it connects to the way researchers have conceptualised the creative process and how there are no guarantees when it comes to creative outcomes.

Creative thinking is a process

Creative thinking is defined here as a process. A process implies a series of phases, steps or procedures that people go through to produce creative thoughts. Creativity researchers and creators themselves have described various components and process models of creative thinking (Runco, 2018; Sawyer, 2012; Wallas, 1926). Some of the models focus on a sequence of steps, while others highlight components of the process.

Generally speaking, most descriptions of creative thinking can be boiled down to two core processes or components (Beghetto, 2016a; Cropley, 2006). The first is generating possibilities (For example a student generates multiple ideas for a school fundraiser) and the second is evaluating those possibilities (the student carefully considers each idea,

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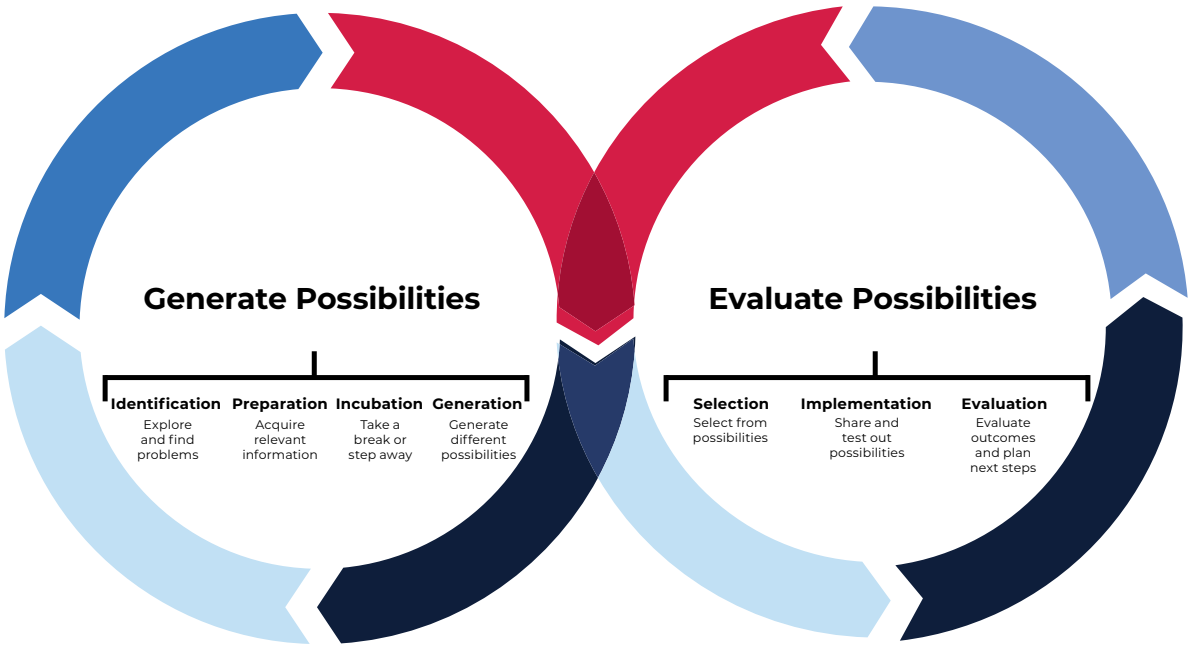

Figure 1. Example components of creative thinking

selects one to share with the student council, receives feedback, makes modifications, and implements the idea, which results in a successful and creative school fundraiser). Both generating and evaluating ideas are explicitly recognised in the definition introduced earlier.

Researchers tend to expand on the two core components of generating and evaluating by including a variety of additional processes or features. These additional components are sometimes labelled differently and placed in different sequential positions, which has resulted in a variety of models that range from two to eight or more components (see Sawyer, 2012 for a detailed overview). Although there is no single model or consensus on all the features or processes involved in creative thinking, there does seem to be general agreement on several of the components, particularly the two major components of generating and evaluating ideas.

Figure 1 provides an illustration of seven common components of creative thinking, which are germane to the questions addressed in this paper. As depicted in Figure 1, generating and evaluating possibilities represent the two overarching components. On the generation side, there is identification, which involves recognising, exploring, and identifying unique features of a topic or situation, including finding a unique problem to solve (see question 2 for a discussion of problem finding). Preparation is a component found in almost all creative process models and refers to knowledge, skills and resources necessary to understand and generate possibilities for addressing the situation or problem.

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Several models also include incubation, which refers to stepping away from the topic or problem and returning to it later with fresh perspective (see Cropley & Cropley, 2010 for an alternative view). Then of course there is generation, which involves generating a variety of candidate possibilities for addressing the situation or problem.

On the evaluation side, there is the selection of potentially viable possibilities, implementation or testing out of the selected possibilities, and evaluation of the results, which can include subsequent steps and new directions. Some models also include recursion (Runco, 2018), which highlights that the process is not always unidirectional and linear, but rather represents a much more dynamic and iterative process of circling back and forth through and across components. The recursive aspect of creative thinking is denoted by the circling arrows in Figure 1.

Taken together, creative thinking represents an often effortful and prolonged process, which differs from the more mysterious and instantaneous way that some people, including some people who have generated highly creative ideas, have characterised it. For instance, Jim Henson, the creator of the Muppets, once said "I don't know exactly where ideas come from, but when I'm working well ideas just appear" (Henson, 2011).

On first blush, Henson's description suggests that creative ideas appear out of thin air. What we sometimes do not acknowledge when we hear such descriptions, is that prior to those ideas appearing and being recognised as creative or viable, there is a great deal of preparation involved, which includes past experiences, development of relevant knowledge, creative confidence and, in the case of highly creative ideas, expertise.

This is all a long way of saying that there tends to be more than meets the eye when it comes to creative thinking and it does not end with generating an idea. Indeed, the implementation of potentially creative ideas often includes setbacks, multiple iterations, and sometimes even the abandonment of highly original ideas in favour of ideas that may be less original, but actually work (Beghetto, 2016a; von Thienen et al., 2017).

A process, not a guarantee

Becoming familiar with components and processes of creative thinking can be helpful for understanding and supporting students' and one's own creative thinking. But it is important to stress that there are no guarantees that following the steps of a process model will yield creative ideas or outcomes. In some cases, process models will effectively describe and potentially even guide a successful outcome, in other cases they may fall flat.

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A student who, for instance, recognises that she is having an unusually difficult time getting along with one of her teachers (identification), might spend time thinking about the situation, comparing it to similar experiences she has had, and gathering information from others who might help (preparation). After spending several days actively thinking about it and feeling like she keeps running into dead ends, she takes a break from it and turns her attention to an upcoming swimming competition (incubation). In the car ride home from her swim meet, she returns her attention to the problem and is able to come up with several unique ideas for how she can address the issue (generation). The next day at school she selects a possibility that seems both unique and feasible (selection), tries it out (implementation) and is able to creatively resolve the situation (evaluation).

The next time this same student confronts a different situation and tries using the same steps, she may find herself circling back and forth between different aspects of the process before generating an idea that works. Yet another time, she may try going through the steps, and fail to yield a viable idea, even after repeated attempts. The point is that creative thinking is a process that involves generating and evaluating possibilities, but there is no single process or set of steps that works all the time for all people in all situations. When it comes to generating creative ideas that can have a real-world impact, much depends on the situation, the people involved, and the socio-cultural and historical context (Amabile, 1996; Glăveanu, 2015).

Moreover, students need to have the confidence and willingness to engage in creative thinking endeavours (Karwowski & Beghetto, 2018). The most direct way of developing this confidence is to provide them with opportunities that require creative thought. This includes inviting young people to tackle challenging problems and issues that matter to them. It also involves establishing a learning environment that encourages the exploration and generation of multiple perspectives and ideas, provides honest, yet supportive feedback and offers multiple opportunities for students to actively reflect on and learn from success and failures. Further discussion of these themes will be covered in the questions and responses of the remaining seven questions.

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2 How does creative thinking relate to other forms of thinking?

Although there are distinguishing features of creative thinking, it does relate to other forms of thinking, in particular problem solving and critical thinking.

Creative thinking is used to explore new possibilities of a settled topic or even anticipate and identify the need for something new, including finding new problems to be solved.

Creative thinking and problem solving

Creative thinking is often used to solve problems, particularly problems that are ill-defined and complex. As discussed, creative thought is needed when confronted with uncertainty about the nature of the problem, how to approach it, or what the outcomes might be. This is because in order to solve such problems, we need to develop new and meaningful ways of thinking through the problem, process and outcomes.

Although creative thinking is often used to solve ill-defined problems, creative thinking goes beyond problem solving. Creative thinking is used to explore new possibilities of a settled topic or even anticipate and identify the need for something new, including finding new problems to be solved.

This aspect of creative thinking has been called problem finding (Kozbelt et al., 2010; Mackworth, 1965) and is often featured in creative process models (see Figure 1).

Problem finding can include asking your own questions about a topic (even seemingly settled topics), detecting the need for something new, identifying and constructing your own problems to solve, and engaging in the exploration of new possibilities about an existing topic or situation – all of which can lead to creative insights, ideas and outcomes. Problem finding and exploration of the problem is often viewed as being as, or even more, important than problem solving (see Mackworth, 1965). Indeed, quotes attributed to highly accomplished creators reflect this sentiment. Two examples from Albert Einstein and Jonas Salk are on page 55.

In this way, problem finding is a feature of creative thinking that is different from more general problem solving experiences. As Mackworth has explained, ‘an activity like problem finding would seem to be close to the heart of originality in creative thinking’ (1965, p. 54). This difference between problem finding and problem solving comes into sharp relief when we consider how students typically experience school-based problem solving.

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In most cases, school-based problem solving involves working through a presented problem, which already has a solution, and a predetermined pathway for arriving at that solution. Problem finding flips this school-based model on its head because it introduces more uncertainty by transforming a predetermined exercise into a to-be-determined process. In such a situation the students would have an opportunity to identify the problems to be solved and develop their own process for solving them (see Beghetto, 2018, and responses to question 8).

Creative thinking and critical thinking

There is clear overlap between creative and critical thinking, but there are also some important differences. Both creative and critical thought include evaluative thinking (making judgments of value or merit of new ideas and different possibilities). Critical thinking and creative thinking differ in that critical thought is not primarily focused on generating new ideas and possibilities.

Indeed, critical thinking can be used to make decisions along well-established lines of thought and action (Given these two existing options, which seems best? Given these two claims, which is most accurate?). That said, critical thinking can and does play an important role when it comes to ensuring that creative ideas lead to beneficial and positive outcomes (Cropley et al., 2010).

> "What people think of as a moment of discovery is really the discovery of the question."
>
> — Jonas Salk

> "If I had an hour to solve a problem and my life depended on the solution, I would spend the first 55 minutes determining the proper question to ask for once I know the proper question, I could solve the problem in less than five minutes."
>
> — Albert Einstein

When educators encourage young people to use critical thinking in conjunction with creative thought, they can help students learn how to focus on more than simply generating and selecting new ideas that work by also considering broader and more critical questions such as: success for whom, under what conditions and at what costs? Two students who come up with a creative idea for selling the same snacks that are sold as part of a school fundraiser for a cheaper cost, for instance, may successfully generate money for the two students, but ultimately undermine and do harm to the school fundraiser that supports families of students in need.

Combining creative and critical thought or even ethical thinking (Moran,

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2014) can thereby help young people actively anticipate, monitor and respond to potentially negative and unintended consequences of their creative ideas. Doing so will enable young people to develop a more principled approach to their creative endeavours – moving beyond creating for the sake of creating and toward ensuring that their ideas and actions are helping and not harming others.

Developing a set of guiding questions, like the following, can help remind students to critically consider the potential impact of the possibilities they are generating and selecting for implementation:

- What is beneficial about this idea?
- How will sharing or implementing this idea impact me and others?
- Who will benefit from this idea?
- What are the potential costs, hazards and risks of sharing or trying to implement this idea?
- Do the costs outweigh the potential benefits – how do I know?
- Who else can I ask for feedback on this idea before trying it out?

Similarly, critical thinking also plays a role in helping young people decide when (and when not) to be creative (Kaufman & Beghetto, 2013). There are many cases where it is most beneficial for young people to be able to critically think through a situation and make decisions about whether the potential costs would outweigh the potential benefits of doing something new or creative. A student deciding to follow previously taught safety procedures when conducting a chemistry experiment rather than try to come up with a new approach is an example.

In sum, creative thinking differs but can benefit from critical thinking. The benefits of helping young people think critically about when and when not to be creative as well as the potential impact of their creative

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thoughts and actions can help ensure that they are developing their skills in a way that can lead to positive and beneficial outcomes for themselves and others (see also responses to question 4 and question 6).

3 How do we determine whether an idea is creative?

Although there are no guarantees when it comes to generating creative thoughts, there are generally agreed upon criteria for judging whether something can be called creative.

Researchers generally agree on two criteria necessary for creativity: originality and meaningfulness as defined within a particular context (Kaufman, 2016; Plucker et al., 2004; Runco & Jaeger, 2012). These criteria are also reflected in the definition of creative thinking introduced earlier. A bit more discussion of these criteria may help clarify how they work together in making judgements about creative thinking in and beyond educational contexts.

Originality and meaningfulness

Originality is necessary for creativity. Something must be considered new, unique, different, or novel to be creative. Most people recognise that something can't be called creative if it is not original. In fact, sometimes originality and creativity are used interchangeably. Doing so is problematic, which becomes evident when we consider why originality cannot serve as a stand-in for creativity.

Imagine a student who is taking a written science exam. The exam asks students to represent the changing states of matter. The student, who is a skilled dancer, jumps up and starts performing an interpretive dance of the changing states of matter. By any account this would be a highly unusual and surprising response. Still, no matter how original the dance, it does not meet the task constraints of the written exam and therefore would not be considered creative. Although this is an extreme example, it illustrates how originality is not the same thing as creativity.

Creativity requires more than unconstrained originality. This is why standard definitions of creativity specify that in order for something to be called creative it also needs to be meaningful, useful, effective, or meet the task constraints of a particular situation, problem or context.

Lest this second criterion seem coldly rational or overly utilitarian, it may be helpful to recognise that the meaningful criterion can also refer to interpreting something as beautiful, moving, or aesthetically pleasing. A group of students who produce an original and moving documentary about the struggles and successes of teenage identity development would certainly qualify as creative.

Creativity therefore can be thought of as structured originality. When making judgements about

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whether an idea is creative, originality is structured by the particular requirements of a task, situation or domain. A student's original poem about life in school submitted to a limerick poetry contest would also need to adhere to the five line format and rhyme scheme of a limerick in order to be considered creative. As these examples illustrate, the student's originality is structured by the requirements of the task, situation, and domain.

A retrospective judgment

Like all determinations about creativity, the judgments we make about creative thinking are made retrospectively. We cannot really know in advance whether the next idea we come up with will be considered creative. There is always some level of uncertainty involved in creativity and thereby some element of surprise (Beghetto, 2019; Simonton, 2018). We retrospectively recognise, "Wow – that's a creative idea!" Of course, we may also later recognise that an idea we thought was creative in the moment, is not really that original once we receive some feedback on it. It is also possible that an idea we view as mundane is recognised by others as quite creative.

In the context of educational environments, it is therefore important for students to share their potentially creative ideas so teachers and peers can provide feedback. This is particularly important in the context of academic topics where corrective feedback and clarifications can be necessary for supporting students' academic understanding. Such feedback can also help students shape their potentially creative thoughts into creative contributions (Beghetto, 2016b).

Different levels of creative ideas

Can we really call a primary student's insight in science class creative when such an idea would be viewed as quite ordinary in a secondary or higher education classroom? The short answer is yes. As noted in the definition of creative thought, although the criteria for making judgements remains the same regardless of context (original and meaningful), the determination about whether a particular idea or thought is creative is situated in particular contexts.

The Four-C model of creativity (Kaufman & Beghetto, 2009) can be helpful for recognising how these different levels of creative magnitude still adhere to the two generally agreed upon criteria of originality and meaningfulness. The four levels of creative magnitude include mini-c, little-c, pro-c and big-c creativity.

Mini-c creativity refers to self-recognised creative ideas, insights, interpretations and experiences. A student who has a new and personally meaningful insight about a recently taught science concept would be an example of mini-c creativity.

Little-c creativity refers to creative contributions recognised by other people in our everyday environment.

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A student who shares a unique and meaningful idea for how to design a science experiment during a class discussion is an example of little-c creativity.

Pro-c creativity refers to creative contributions recognised by professionals and experts in a particular domain or field of study. A scientific study published in a peer-reviewed journal would be an example of pro-c creativity.

Big-c creativity refers refers to creative contributions that have made a lasting and profound contribution to a field or domain. The scientific contributions of Marie Curie are an example of big-c creativity.

In educational contexts, the focus is typically on mini-c and little-c levels of creative thinking. As mentioned, we want to encourage young people to share out their unique mini-c perspectives and receive feedback to ensure that they are meeting the constraints of the subject matter they are learning. Oftentimes students' original ideas benefit from teachers providing guidance on how to meaningfully connect those ideas to the topic at hand. Other times students may need encouragement or prompting to come up with their own unique ideas or interpretations. In both cases, guidance and prompting can help shape mini-c thoughts into little-c contributions.

4 When do we need to think creatively?

We don't always need to think creatively.

In many cases routine and habitual forms of thinking and acting work perfectly well. Providing the expected answer on an exam or following the safety steps in a science lab are examples of when thinking in expected and routine ways are particularly beneficial. Thinking creatively becomes necessary when confronted with uncertainty. If routine ways of thinking no longer work or if we experience an ill-defined problem, then it is a sign that we need to think creatively.

Uncertainty as a catalyst and condition for creative thinking

In this way, creative thinking is a process that starts in a state of uncertainty or what has been called a 'state of genuine doubt' (Peirce, 1958). When we experience states of doubt we do not know how to proceed. In such situations, we are at an impasse because our typical ways of thinking through a situation are no longer viable. When we are confronted with uncertainty, we need to think creatively to resolve it. In this way uncertainty serves as a catalyst and condition for creative thinking.

Uncertainty can be encountered or provoked. When we encounter uncertainty, we are caught by surprise, we

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experience a rupture that 'either disappoints an expectation, or breaks in upon some habit of expectation'(Peirce, 1958). A student who has always been able to resolve conflicts with peers may encounter uncertainty when turmoil emerges amongst team members on a group project and the student is at a loss for how to help resolve it.

Provoked uncertainty, on the other hand, refers to intentionally introducing uncertainty into our experience (e.g. the art student approaches the blank canvas). As with encountered uncertainty, provoked uncertainty serves as stimulus for creativity. Teachers can provoke uncertainty in their lessons by breaking from the routine of simply reading a story and checking comprehension, and introduce a new requirement of having students develop their own, unique alternative endings (for example "Having read this story together, now I'd like you to come up with your own ending to this story").

By introducing uncertainty in the structure of routine lessons and activities, teachers help students break from routine thought and engage in creative thinking. Indeed, Graham Wallas, who is credited with one of the earliest creative process models, described how creative thinkers intentionally break habit as a stimulus for creative thinking:

> This antinomy between the stimulus of habit in time and place and circumstances, and the stimulus of breaking habit, is constantly reflected in the lives of those who are capable of serving mankind as creative thinkers (Wallas, 1926: 82).

Regardless of whether uncertainty is encountered or provoked, it serves as a sign and condition for engaging in creative thought. Helping students to read those signs can go a long way in developing their understanding of when it might be more or less beneficial to engage in creative thinking.

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5 How are creative possibilities generated?

Creative possibilities are generated by thinking processes and procedures that enable people to produce a wide array of new and potentially viable ways of addressing the uncertainty faced in a problem, situation, or endeavour.

Creativity researchers have described a variety of thinking processes and procedures involved in generating possibilities, including: divergent thinking, possibility thinking, combinatorial thinking, abductive reasoning, analogical thinking, trial and error, frame shifting, and assumption flipping (Beghetto, 2016a; Simonton, 2018). Of these, divergent thinking (Guilford, 1968) has, by far, received the most attention in the literature. Divergent thinking is 'the process that allows a person to find original ideas' (Runco, 2018: 477), which includes generating multiple, different and unique ideas.

Regardless of the particular name of the process or procedure used, generating possibilities represents a core component of creative thinking, which is aimed at generating and exploring various options that may help us creatively resolve the uncertainty we are experiencing.

One way to think about generating possibilities is that it involves our imaginative capacity to draw on, but ultimately go beyond, previous knowledge and experiences in order to envision new perspectives and alternative ways of making sense of a problem or situation. Doing so can help us move beyond what is and toward new alternatives for what might or could be (Bruner, 1986; Craft, 2010).

Creativity researchers have described various procedures or tactics for generating new possibilities. Many of these approaches represent the combinatorial feature of creative thinking (Rothenberg, 2015; Ward & Kolomyts, 2010). Creators and creativity researchers have long recognised that creative ideas often emerge from the combination of different stimuli, whether those be ideas, experiences, concepts, materials, styles of music, cuisines, or just about anything that can be combined. In fact, even the definition of creativity itself represents a combination of originality and meaningfulness and the same can be said of the core components of creative thinking (that is, a combination of generating and evaluating ideas).

Janusian thinking (Rothenberg, 2015) is an example of a combinatorial thinking procedure. This tactic is named after the Roman god Janus whose duality of gaze simultaneously combines sight of the past and sight of the future. In practice, this tactic involves combining different, even opposing, concepts (such as friend and enemy, spoon and fork) in an effort to generate a new concept (such as frenemy, spork).

Another example of a procedure for generating ideas

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is to use simple tactics to rethink or transform a situation or problem, such as substituting an existing character in a story with a new character (Eberle, 1996). Substituting an existing element with a new element can lead to new combinations and potentially creative outcomes. Assumption flips are another example (Beghetto, 2016a). Assumption flips are used to generate new ways of thinking about a situation, challenge, or problem (such as viewing two things that seem unrelated as connected; viewing the cause as the effect; seeing the problem as the solution, and so on). Assumption flips also involve combining different ways of thinking with an ill-defined problem or situation in an effort to generate new insights.

Employing such strategies may increase the likelihood of generating new possibilities and they are generic enough to be used across various situations and domains. What worked in a past situation, however, will not always work in similar or future situations. As has been discussed, it is difficult to predict whether a particular tactic will produce a creative possibility because creative outcomes have an element of surprise to them and are determined retrospectively. In addition to tactics or processes, a person's motivation, knowledge, and willingness to explore different possibilities plays a key role both in generating and implementing creative ideas.

Indeed, some of the most heralded creative thinkers (e.g. Albert Einstein, Thomas Edison) admit to having spent more time chasing dead ends than having creative breakthroughs. Generating creative ideas that can be implemented and make a large scale impact on the world are extremely rare (Simonton, 2018). The good news is, creative ideas that can make a more everyday impact on the learning and lives of students, their schools, and communities are much more commonplace.

6 How do we select from possibilities we generate?

We select from possibilities by engaging in another subprocess of creative thinking, often called convergent thinking, which involves making evaluative judgments about the viability of the various possibilities we have generated.

Once we have generated possibilities for resolving the uncertainty we face, we need to evaluate those possibilities. Creativity researchers typically describe this evaluative process as convergent thinking (Guilford, 1968). Convergent thinking involves making evaluative judgements about the merit of particular possibilities we have generated. This is a critical aspect of creative thinking. We need convergent thinking to ensure that the possibilities we generate and select meet the requirements of a specific task or situation. We also need convergent thinking to ensure that we are not recklessly implementing ideas that

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can cause harm to oneself or others (Cropley, 2006; Cropley et al., 2010; see also question 2).

As illustrated in Figure 1, evaluating possibilities can encompass a variety of components. An idea can be selected from a simple thought experiment (for example "Which of these ideas seems the most reasonable or makes the most sense given this situation?") and then directly tested ("Let's give this idea a go and see if it works") only to find out that the selected option did not pan out and must thereby be judged as a failed attempt. The failed attempt may, in turn, prompt us to revisit other options, rethink the nature of the problem, generate new possibilities, or even decide to go in a completely different direction. In this way, failures can be thought of as inconclusive outcomes because they can prompt new directions in thinking (von Thienen et al., 2017).

In other cases, the selection of a possibility may be more aesthetically driven or taste-based. A student taking a photography class may settle on a particular image to include in the school's photography exhibition based on a personal, aesthetic preference. In the context of the classroom it can be helpful to have students go through a somewhat structured process of evaluating possibilities because students may not know how to critique ideas in a productive and helpful way.

Finally, when it comes to the selection of a new possibility that may solve a problem or challenge that students are facing, the selection decision likely will be based on whether the solution or idea is reasonable and feasible (rather than trying to focus on the most original idea). Whereas creativity researchers are often interested in judging or differentiating between different levels of originality of an idea or solution, in educational contexts it often makes the most sense to select not necessarily the most original idea, but a new or different approach that actually has a chance of leading to positive resolution of the problem or challenge. A group of students may, for instance, come up with an ambitious and highly original idea for designing a smartphone app for addressing an identified problem of students asking questions about homework. A more reasonable and feasible solution however might simply involve a new way of using existing technology to solve the problem (such as a Google doc). Both are creative ideas, but the second one is more feasible and thereby increases the chances of successful resolution of the problem.

Educators can establish some basic ground rules or a checklist that can help guide young people as they learn how to provide feedback supportive of creative thinking. The checklist can include explicit reminders based on insights drawn from the creativity studies literature, including:

- providing specific, deep, and useful critiques of ideas (Gibson & Mumford, 2013).
- remaining open to new possibilities, even

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when providing evaluative critiques (Beghetto, 2016a).

- ensuring that unique ideas have some practicality and practical ideas have some uniqueness (Mumford, Medeiros, & Partlow, 2012).
- exploring first steps and potential setbacks to help ensure successful implementation of the ideas (Klein, 2007).

The following is an example of a checklist based on the above insights that can be modified and used to guide young people when working together to evaluate possibilities (adapted from Beghetto, 2016: 63):

- We agree to focus our feedback on ideas, not people (for example "I don't understand how this fits?" vs. "What are you thinking? You must be crazy!").
- We agree to consider each possibility presented, no matter how silly or unusual it may seem.
- We agree to preface our feedback with "What if … " to remind the person hearing our feedback that we are providing a suggestion that may lead to new ways of thinking.
- We agree to make our feedback specific (focus on a particular feature of the idea), deep (provide reasons for our comments and insights that may have been overlooked), and useful (the feedback should be helpful and actionable).
- We agree to try to make seemingly impractical ideas more useful and somewhat common ideas more unique.
- We agree to identify some potential barriers to success, provide ideas for addressing those barriers, and identify some first steps that can be taken to put these ideas into action.
- We agree that we can start the process over at any time, including rethinking the problem or situation and generating a new set of possibilities.

Educators may also find it helpful to consult related materials that can help them and their students develop ground rules (see Littleton & Mercer, 2013), feedback activities (see Beghetto, 2018), and guides for giving and receiving structured feedback (see AITSL 2017).

Inviting students to provide structured feedback to their peers as well as seek feedback from others, including relevant outside experts, can provide several benefits. First, structured feedback opportunities help students learn how to provide honest and supportive critiques of other's ideas (rather than make shallow or hurtful comments). Next, it can help increase the likelihood that the students who are providing the feedback generate more creative solutions for the problems and situations that they themselves face (Gibson & Mumford, 2014). Finally, it can help young people recognise that creative thinking is not a linear set of steps to complete. Creative thinking can and often does require going back to reevaluate selected and discarded options,

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explore new possibilities, and even rethink the problem itself.

7 Is creative thinking domain-specific?

Although there are features of creative thinking that are transferrable, it is helpful to recognise that creative thinking is constrained by specific domains, situations and tasks.

There are several commonalities in creative thinking regardless of domain, including: the criteria used to judge creativity (such as original and meaningful), some of the features of the process (for example generating possibilities) and evaluating those contextual and individual factors (supportive environment, confidence in one's ideas, willingness to explore and try out alternatives). That said, creativity researchers recognise that subject area, domain, and discipline matters – not only in generating creative ideas, but in implementing those ideas.

A couple of quick examples may help illustrate why this is the case. Consider a student who comes up with an idea for a science project, develops a project based on the idea, and submits it to a science exhibition for evaluation from a group of judges. The student's idea and project are evaluated as highly creative. Should we expect this same student to be able to develop a creative idea for a short story that will also be judged as highly creative? The short answer is – it is possible, but not likely.

Although it is possible for students to generate creative ideas in separate domains that would be rated as highly creative, doing so is somewhat unlikely. One reason why it is unlikely is because generating highly creative ideas in a particular domain or subject area requires having developed sufficient knowledge, experience, and skill with the activities and tasks of each domain.

John Baer, a creativity researcher who has extensively examined this question, has consistently demonstrated that student creativity rated in one domain tends not to be predictive of creativity in other domains (see Baer, 2015 for an overview). That said, too much familiarity with a domain can hamper creativity by causing a narrow or overly fixed view of what should be done and how it should be done (Plucker & Beghetto, 2004; Simonton, 2016). We will return to this momentarily. Prior to doing so, let's consider another example.

Creative thinking can and often does require going back to reevaluate selected and discarded options, explore new possibilities, and even rethink the problem itself.

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Imagine a student writes a short story and a poem for two separate contests. The student's short story is rated as highly creative by a panel of experts. Should we expect the student's poem to also be rated as highly creative? Again, it is possible for a student to produce both highly creative short stories and poems, but generally speaking it is unlikely that a student would be highly rated on both, unless the student has developed sufficient knowledge and skills of these two different forms of writing (see Baer, 2015).

As these examples illustrate, domain knowledge matters. Indeed, creativity researchers have long noted that 'no creative person can get along without previous experiences or facts, [that person] never creates in or with a vacuum' (Guilford, 1950: 448.). Creativity researchers generally agree that creativity is domain specific, even though it does include some domain general features. Some have offered a blended or hybrid view, which explicitly recognises that creativity has both domain general and domain specific features (see Plucker & Beghetto, 2004; Baer & Kaufman, 2005).

The Four-C Model (Kaufman & Beghetto, 2009) helps provide additional clarification of this domain specific issue. When young people are having mini-c creative insights while learning about a domain, extensive domain knowledge is less critical because students are still developing their competence. Consequently, young people can have mini-c insights in and across multiple domains. Moreover, the more they learn about various domains, the more likely they will be able to connect those insights to the expectations of particular tasks in domains at the little-c level. However, once creativity is judged by others, particularly experts, then domain knowledge tends to be more important.

Generally speaking, the greater the level of creative magnitude (from mini-c to big-c) then the more likely domain knowledge, experience and expertise plays a role. Developing a deep level of domain knowledge can therefore be beneficial. As mentioned, however, it is also possible that too much formal training in a domain may, at some point, become counterproductive. Dean Simonton, a researcher who has extensively studied big-c creators, has demonstrated that there may be a point of diminishing returns when it comes to formal education. Specifically, his work suggests that the relationship between formal education and big-c creative contributions is not a simple linear association (Simonton, 2016). Rather the relationship is quite complex and can even result in an inverted-u shape, indicating that at some point along the way the positive relationship between formal education and highly accomplished creative productivity can become negative.

One take away from this work is that students' creative thinking likely will benefit from a blend of domain knowledge and skills and opportunities for cultivating

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broader interests, experiences, and explorations of their knowledge in and across domains. In this way, students can develop the knowledge necessary to make meaningful connections, without becoming too narrowly fixated on what is already known.

8 Is creative thinking teachable?

Students already have the capacity to think creatively, so the better question is how can we provide opportunities for young people to become more aware, confident and intentional in using their ability to think creatively?

Creative thinking is something that students already have the capacity to do. Now, of course, students can learn how to be more confident, intentional, and competent at using their ability to think creatively. There is, for instance, evidence that targeted domain and task specific training can be beneficial in enhancing people's ability to generate creative ideas (Scott et al., 2004), particularly if anchored in real world tasks and performance. There are also general strategies that people can learn, which may be helpful for generating new ways of thinking about a problem, situation or task (see question 6).

Does this mean schools should hire teams of creative specialists to help enhance students' creative thinking ability? No. This is not necessary. It is also not necessary to have students spend time on generic creative thinking exercises, like coming up with 1,000 different uses for a paper clip. The good news is creative thinking does not need to be taught as a separate, curricular subject that then needs to be rendered into curricular outcomes and assessment benchmarks.

Rather creative thinking is something students and teachers already do in and across subject areas. Yet it can be done more systematically, not as an add-on but as an enhancement to what is already being done. Although structure and routine are important, we sometimes over plan students' learning experiences. By making small openings into existing lessons and activities, students can be invited to explore, generate, and produce new ways of thinking about what they have been taught. One way of doing so is called lesson unplanning (Beghetto, 2018).

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Lesson unplanning

Lesson unplanning refers to taking a lesson or activity and replacing some predetermined element (i.e. what students are asked to do, how they are asked to do it, the expected outcome) and replacing it with one or more to-be-determined elements (i.e. the students come up with their own task or problem to solve, their own way of completing it and a different outcome).

Here's a quick example. When we typically teach students an approach for solving a mathematics problem, we teach a procedure and then provide them with multiple practice problems to rehearse using the taught procedure. This is a good way to reinforce the taught approach by having them practice using it to solve a set of different problems. To encourage students' creative thinking, we could simply include an additional expectation that requires students to not only use the taught approach but to come up with as many different approaches as they can to solve that type of problem (see Niu & Zhou, 2017).

By making small openings into existing lessons and activities, students can be invited to explore, generate, and produce new ways of thinking about what they have been taught.

Teaching for creative thinking does not require a new curriculum, hiring creative teaching specialists, or establishing new assessment benchmarks. Rather it is about making meaningful openings into existing teaching and learning experiences that encourage and require young people to think creatively. In addition to establishing

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openings for creative thought in the existing curriculum, young people would also benefit from engaging in endeavours that require them to think creatively to address a real-world, complex problem or issue they are facing (such as bullying they experience on social media). One way of doing so is to provide students with opportunities to design and implement legacy projects (see Beghetto, 2018).

Legacy projects

Legacy projects are complex, real-world opportunities for students to:

- **Find problems that matter to them.**
  What is a problem or situation you are concerned about that maybe no one else recognises? What do you already know about this problem? What do you want to know? How can you learn more about it?
- **Develop an understanding and argument for why solving the problem matters.**
  Why do you want to solve this problem? Who is impacted by it? What will happen if nothing is done? How do you know? Who can help you learn more about it?
- **Work with others to generate, evaluate, and implement potential creative possibilities for addressing the problem.**
  Who can help you think through this problem? What are some new ways of thinking about this problem? What are some possible ways of addressing it? What might you be missing? What possibilities seem the most viable and actionable? What might go wrong? How will you test this idea out? Once you test an idea, what kinds of alterations do you need to make? Do you need to take a few steps back? How can you move forward?
- **Work toward developing a solution that makes a positive and lasting contribution beyond the life of the project.**
  Will you carry the work forward? If so, how? If not, who can you involve that will? What kind of impact are you having? How do you know? Are there any unexpected and potentially negative outcomes? How might you address these and anticipate others? How do we know? How can we make sure this work lives on and makes a positive and lasting impact?

Young people would also benefit from engaging in endeavours that require them to think creatively to address a real-world, complex problem or issue.

Legacy projects provide structured and supportive opportunities for students to think creatively.

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In this way they serve as a vehicle for creative thinking. They also provide opportunities for students to experience and develop some of the core attributes of successful creative thinkers, including:

- building creative confidence
- engaging in productive struggles with complex problems
- learning how to weigh the costs and benefits of taking creative risks
- experiencing small successes as well as failures and setbacks
- reflecting on what they have learned about the process, the topic, and themselves

Even if a legacy project completely flops, students can still learn from it if given an opportunity to openly discuss what they tried, what they learned about the situation, and what they learned about themselves. This includes:

- discussing specific features of the failures and setbacks they experienced
- describing the various thoughts and emotions they experienced throughout the process (creative work can be frustrating as well as enjoyable)
- explaining whether and how they overcame the setbacks they faced
- explaining what it taught them about themselves and the nature of that specific creative endeavour

Legacy projects, and similar endeavours, can help round-out an extended experience of using creative thinking to do something that matters to students and others by helping students realise that they do have the capacity to come up with good ideas, they do have the capacity to put those ideas to work, and they do have the capacity to make a positive impact in the lives of others. They will also learn that such a path is not easy and may not work out, but that it is still worth the effort.

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