4

How Advances in Gifted Education Contribute to Innovation Education, and Vice Versa

David Yun Dai

STATE UNIVERSITY OF NEW YORK AT ALBANY, USA

Summary: Gifted education can be seen as a frontier of innovation education, wherein the nurturing of creativity has been an educational priority. Parallel to the first two stages of research on creativity, with its emphasis on person and process, gifted education has focused on two aspects of innovation education: how to provide a good educational match for those who demonstrate unique creative potential, and how to nurture creativity through curricular and instructional designs. These explorations have proved highly meaningful for general innovation education. In recent years, creativity researchers have broadened their perspectives beyond person and process to encompass complex social-cognitive dynamics and synergistic power. Technological advances and availability of cyber resources also make it possible to design an education gearing toward developing personal creativity on all fronts of human endeavor. It is argued that gifted education can learn from these new movements in innovation education and broaden its education scope accordingly.

Key words: Gifted education, innovation education, creativity enhancement, the person, process, and context dimensions.

Introduction: links between innovation education and gifted education

> To give a fair chance to potential creativity is a matter of life and death for any society.
>
> *(Arnold Toynbee 1964)*

It is not without reason that, in education settings, the term "creativity" is used more often (e.g., development of creative productivity, Renzulli, 2005; creativity enhancement, Beghetto & Kaufman, 2010), while in work settings, innovation is used more frequently (e.g., Estrin, 2009). For the former, the concern is more about developing desired characteristics conducive to mature creative expressions, and increasing the chances that youths will become more capable of producing novel and useful ideas and products in their adulthood. When the term "innovation" is used, the concern is more over facilitating creative products and services that have a direct social impact and practical consequences. Thus innovation is always context-specific, product-driven, while creativity could refer to more general conditions and characteristics conducive to development and expression of creativity. Defined this way, we might think of innovation education as having two phases: general preparation in K-12 education and direct application in college and beyond. Whether we use creativity education and innovation education interchangeably or make a distinction between the two is a matter of convention.

Gifted education has a natural connection to innovation education, given its goal of producing next generations of leaders who can lead; that is, who can innovate in varied and many ways on all fronts of human endeavor. At least three links can be established between gifted education and innovation education: theoretical, practical, and social ones, which almost guarantee the reciprocation of the two.

The first link is theoretical in nature. Gifted education is particularly keen on creativity as (a) an aptitude variable (personal characteristics, cognitive or affective, conducive to creative expressions, broadly defined), (b) a contextual variable (environmental structures and social conditions that induce or inhibit creativity), and (c) an educational outcome variable (what kind of educational experiences promotes creativity enhancement and development). Therefore, gifted education has a huge overlap with innovation education in seeking a deep understanding of how the creative potential can be unleashed, identified, carefully nurtured, and systematically developed.

The second link is more practical. Gifted education arose partly as a reaction to the traditional age-graded schooling, with a fixed curriculum for all, the transmission model of learning and pedagogy, and a uniformed evaluation system. Gifted education seeks a more individualized mode of education, responsive to individuals' strengths and interests, rather than adhering to a one-size-fits-all curriculum and teaching to the average. Pedagogically, it seeks a more productive mode of learning rather than mere regurgitation or passive absorption of information for testing purposes (Renzulli & Dai, 2001; Renzulli & De Wet, 2010). It can be argued that an emphasis on creative and critical thinking in classroom now advocated by leading educational scholars (e.g., Halpern, 2008; Resnick, 2010) as well as prominent advocacy groups (e.g., Partnership for 21st Century Skills, 2008) dates back to the early years of gifted education (e.g., DeHaan & Havighurst, 1957; Torrance, 1963).

Finally, the third link, the social one, refers to the fact that many leading researchers and scholars in gifted education have also been educational psychologists and active researchers on creativity (e.g., Bonnie Cramond, John Feldhusen, Jane Pirrto, Jonathan Plucker, Joseph Renzulli, Robert Sternberg, Paul Torrance, and Donald Treffinger). It is natural that the practical ideas and models they have developed based on educational psychology to enhance creativity in gifted education has generality in application for all learners.

How advances in gifted education have contributed to innovation education

To understand the advances made in gifted education with respect to creativity enhancement and development, we need to put them in the context of both the psychological research on creativity and the rise of gifted education and ensuing changes in the American history. On the research side, there are three broad phases of creativity research (Sawyer, 2006b). The first phase roughly started with Guilford's (1950, 1967) presidential speech at the 1950 annual convention of the American Psychological Association (APA), and epitomized by the Utah Conferences held between 1950 and 1963. The focus during this period was on identifying personal characteristics conducive to creativity and nurturing creative potential of individuals by developing these characteristics (e.g., MacKinnon, 1962). The second phase started in the wake of cognitive revolution with a focus on underlying cognitive and motivational processes that lead to creative products (e.g., Getzels & Csikszentmihalyi, 1976; Finke, Ward, & Smith, 1992; Weisberg, 1999), and social conditions that either facilitate or hinder these processes (Amabile, 1983). The third phase started in late 1990s and continues to date, with a focus on synergistic group dynamics and distributed cognitive and social processes leading to creativity (e.g., Dunbar, 1997; Sawyer, 2003). Different zeitgeists during these distinct historical periods have had a strong impact on how creativity enhancement in education is conceptualized and implemented.

On the educational side, the rise of gifted education in the US was prompted by the launch of the first satellite (the Sputnik) in the former Soviet Union in 1957. The focus was on a unique group of gifted children, the "creatively gifted" (Getzels & Jackson, 1962). In its later development, leading scholars in gifted education have paid increasing attention to the dynamic, developmental, and contextual nature of creativity (Renzulli, 1978, 1986, 2005), hence the role of educators in creating optimal conditions for developing students' creative potential.

First phase: from IQ to creativity – a shifting focus

IQ had been the gold standard for gifted identification since Louis Terman (1925), who launched the first ever longitudinal study of over 1,500 children whose IQs were 135 or above. Guilford (1950) suggested that correlations between intelligence measures and creativity measures were low enough to justify treating them as distinct constructs. Guilford's (1967) theory of Structure of Intellect was one of the major theories that provide a model for the differentiation. But it was Getzels and Jackson (1962) who made a strong argument, based on their research and Guilford's theory, that the "creatively gifted" would be overlooked by exclusively using the IQ criterion for identification purposes. Although the "creatively gifted" Getzels and Jackson identified turned out to have a mean IQ of 127, not "average" by any standard, the notion that there is a distinct quality called "creativity" that is different from but as equally important as "intelligence" gained currency. It was cemented by the Marland Report (Marland, 1972), which provided an "official" definition of giftedness and identified "creative giftedness" as a distinct feature of gifted potential (see also Gagné, 2005; Tannenbaum, 1997 for further elaboration). But it was Paul Torrance who truly laid the foundation for something we might call "education for creativity."

Paul Torrance

Torrance was one of the earliest scholars who systematically conducted research and developed ideas on how teachers can foster creativity in their classroom teaching. His 1963 book entitled *Education and the Creative Potential* was a mixture of theoretical exposition and empirical research attempting to map out social and educational conditions that either facilitate or inhibit creative thinking and the long-term development of creativity. Although building on Guilford's (1950) notion of divergent production as a source of creativity, and Getzels and Jackson's (1962) focus on the "creatively gifted," Torrance's approach was much richer in his conception of creativity (e.g., defining creativity as finding and resolving discrepancies), and much more educationally and developmentally oriented; that is, how to create an environment conducive to the flourishing of the creative potential in all children. Torrance contrasted "learning and thinking creatively" with "learning by authority":

> A child learns creatively by questioning, inquiring, searching, manipulating, experimenting, even by aimless play; in short, by always trying to get at the truth. Learning and thinking creatively take place in the process of sensing difficulties, problems, and gaps in information; in making guesses or formulating hypotheses about these deficiencies; in testing these guesses and possibly revising and retesting them; and finally in communicating the results.... We learn by authority when we are told what we should learn, when we accept an idea as true on the word of some authority.
>
> *(Torrance, 1963, p. 47)*

In his 1970 book *Encouraging Creativity in the Classroom*, Torrance further expounded what teachers can do to promote creativity. He identified several pedagogical steps to engage creative learning, such as heightening anticipation for what the learner will be exposed to, sustaining the momentum by creating the unexpected, building creative skills, going beyond textbooks, classrooms, and curricula.

Major contributions

Torrance's work epitomizes early seminal contributions to innovation education in the mid-20th century. First, creativity was seen as originated from the primary ability to produce novel ideas, ideas deviating from norms and familiar ones; this ability is a different kind than intelligence as we know based on IQ tests. Guilford's influence was palpable. Second, some individuals display strong "creative needs," such as intellectual curiosity, the need for meeting challenge, the need to give oneself completely to a task (i.e., task commitment), the need to be honest and search for the truth, and the need for being oneself (Torrance, 1970, Chapter 2). Teaching that responds to these "creative needs" would naturally bring students' creative ability into play. Third, the unruly childhoods of Edison, Franklin, the Wright Brothers were used as prototypes of the youth of the creatively gifted. Fourth, divergent thinking tests were considered a good instrument for measuring individual differences in creative potential (Torrance, 1972). Although his work was clearly influenced by the zeitgeist of his times, being an educator himself, Torrance's legacy for creativity or innovation education is much richer than the above theoretical abstractions. His focus on teaching for creativity went beyond the "creatively gifted" to reach out to all children, and the pedagogy he advocated for "learning and thinking creatively" pre-dates the later movement of inquiry learning (Aulls & Shore, 2008). In effect, his education focus went beyond the then popular psychometric view of creativity in considering a combination of endogenous and exogenous factors, not the least of which is the intrinsic motivation to know (Torrance, 1970).

Second phase: from traits to processes – teaching creative problem solving and encouraging and supporting the development of creativity

Although in his later years, Torrance was exposed to the cognitive revolution and used ideas about creative problem solving developed by cognitive psychologists (e.g., Newell, Shaw, & Simon, 1962), Torrance's times were dominated by the psychometric view of traits and their contributions when creativity is concerned, be it IQ, divergent production, or personality traits of creative individuals (MacKinnon, 1962, 1978). This trend changed after cognitive psychology took hold (e.g., Newell & Simon, 1972); gradually the focus shifted from what characteristics creative people possess to the issue of what people do when they engaged in tasks involving complex problem solving and creativity. Getzels and Csikszentmihalyi (1976) conducted a longitudinal study on art and found problem finding (or representation) and intrinsic motivation to be predictive of creative productivity in arts in later years. In contrast, Finke et al. (1992) developed their "creative cognition" approach based on their lab experimentation; they specified two phases of creative cognition, generate and explore (hence the Geneplore Model). About the same time, Amabile (1983) developed her "social psychology of creativity," focusing on social-contextual influences on performance on creative tasks. Taken together, processes gained primacy over traits, a move that had an impact on gifted education as well.

In gifted education, Guilford and Torrance continued to influence scholar discourse, research, and practice regarding how to define, identify, and nurture creativity in 1970s and 1980s (e.g., Feldhusen & Treffinger, 1986). However, a major shift occurred during that period from treating creativity as an aptitude variable to an outcome variable; that is, learning and thinking creatively becomes a major educational goal for the gifted (Feldhusen & Treffinger, 1986; Gallagher, 1975; Renzulli, 1977; Renzulli & Callahan, 1973). This change was important because creativity, however defined, was seen not as an enduring characteristic of the person but as developmental in nature, subject to educational interventions. Gifted education researchers developed two distinct approaches to enhancing creativity, each with its own theoretical underpinnings.

The first approach is based on the problem solving model, specifying steps involved in solving complex problems. This approach treats creativity as a set of teachable skills that can be trained and modeled. For example, Treffinger (quoted in Feldhusen & Treffinger, 1986, p. 45) identified six steps of creative problem solving:

1 selecting parameters;
2 listing attributes for each parameter;
3 developing evaluation criteria;
4 examining many combinations;
5 checking up on other resources; and
6 following up on promising ideas.

To scaffold students to be creative problem solvers, Feldhusen and colleagues developed the Purdue Three-Stage Model of creative enrichment (Feldhusen & Kolloff, 1986; Feldhusen & Treffinger, 1986). Stage One activities are teacher-directed, aimed to develop basic, discrete thinking skills necessary for higher-level thinking; Stage Two activities are teacher-guided and designed to develop broader strategies for tackling given, circumscribed problems, but there is more self-direction on the part of students; Stage Three activities are independent projects by which students are given more freedom and self-direction to use skills developed in the previous two stages in tackling more realistic, open-ended problems (see Treffinger & Isaksen, 2005, for a review of recent developments in the Creative Problem Solving model).

Alternatively, the second approach sees creativity as an emergent property when people, through their high task commitment, bring their abilities, skills, and knowledge to bear upon a task that has authentic meaning and potential impact on an audience. The three-ring conception of giftedness (gifted manifestations as the interplay of above average ability, task commitment, and creativity), developed by Renzulli (1978, 1986), represents such an approach. It treats creativity as a contextually emergent capability of making authentic inquiry to its fruition. This capability cannot be dissociated from one's domain-specific and general abilities, task commitment (a distinct motivational component), and environmental support for such a productive activity. Renzulli (1986) also distinguished between two kinds of giftedness: schoolhouse giftedness in terms of good lesson learners and test-takers, and creative-productive giftedness in terms of producing solutions and fashioning products that have a real impact on an audience. In so doing, Renzulli departed from the Guilford tradition, which defines creativity as divergent thinking. In stressing the importance of task commitment, he also differed from a purely "creative cognition" approach. His Enrichment Triad model (Renzulli, 1977) identified three types of enrichment: Type I activities expose students to a variety of real life topics and domains of human endeavor not often featured in school curriculum; strengths and interests can be identified. Type II activities teach students relevant skills necessary to carry out independent inquiries; abilities and commitment can be assessed to determine suitability for Type III activities; Type III activities are independent or group investigative projects meant to produce tangible products of real impact; while a student's "above average ability" may be gauged by cognitive ability tests, task commitment and creativity can only be assessed during the productive process.

Major contributions

Theoretical contributions during this period include a shift in focus from traits to developmental processes leading to creativity, from person accounts of creativity to process accounts of creativity. This shift led to pedagogical innovations such as the Schoolwide Enrichment Model (Renzulli & Reis, 1997), Creative Problem Solving (Treffinger & Isaksen, 2005), initially designed for gifted students but later applied to all students. Because of these changes, there is a shift in assessing creativity. Beyond the objective, psychometric measurements such as the *Torrance Test of Creative Thinking* (TTCT), other techniques were developed, such as Consensual Assessment Technique that incorporates expert judgments (Amabile, 1982), and performance assessment based on authentic inquiry (Renzulli & Reis, 1997). A complete model of person, process, and product necessitates a new view of creativity assessment that involves evidence of changing behaviors, strategies, and performance in a more dynamic, contextualized fashion.

How advances in innovation education can contribute to gifted education

Gifted education has long been a pioneer for teaching and learning for creativity and innovation (Renzulli, 1977; see Tomlinson & Callahan, 1992). However, it also tends to see itself as having a separate identity, apart from the rest of education, in the name of serving "special needs" of gifted students. Conceptualized this way, gifted education has been somewhat insulated from a broader educational perspective. The third phase of research on creativity goes beyond a focus on the differential creative potential of individuals, which characterizes research in mid-20th century (the first phase), or on cognitive and motivational processes involved in creative thinking, which characterizes research in late 20th century (the second phase); the new trend is characterized by exploring new possibilities for creative learning through social interaction, technological support, and personalization of learning and knowledge. This body of research is conducted outside of gifted education, and, as I submit, can potentially make important contributions to gifted education.

The third phase: naturalizing creativity or the inherently creative nature of inquiry activities

The thrust of this new wave of research on teaching and learning for creativity comes from a realization, attained a long time ago, that learning can be truly a creative act or a form of creative cognition in that learning is generative (Bruner, 1960) and that novelty in thinking can be engendered through learning (Torrance, 1963). This new movement is poised to "naturalize" creativity. Naturalizing creativity means that creativity is not some kind of special processes humans deployed for special purposes (making creations) but is the product of natural human quests for meaning, truth, and optimality. For instance, Sawyer (2006b) quoted Heisenberg's remarks that "science is deeply rooted in conversations" (p. 276) as a strong support for collaborative and synergistic creativity (see also Sawyer, 2003); that is, creative activity is fundamentally social and interactive. Naturalizing creativity is also based on the argument that creativity origins with situated actions rather than mere ideation; namely, creativity does not start with novel ideas but with meaningful tasks, actions, and interactions from which creativity emerges over time (Sawyer, 2006b). Consequently, creativity enhancement efforts need to be repositioned seamlessly in daily transactions in natural settings. Several educational innovations take on this tack.

Historically, learning has been defined as an act of absorbing knowledge created by others, with the teacher serving as a medium. There is a correspondence between the teacher's input and students' output. Scardamalia and Bereiter (2006) challenged this notion of learning. In their model of the Knowledge Building community that engages students in what they called "creative knowledge work" (p. 98), the line between learning and creative thinking is blurred. For example, the work of fifth graders on Gregor Mendel's problem of genetics is seen as "continuous with that of Gregor Mendel, addressing the same basic problem" (p. 98). A key concept meant to materialize this transformation is "idea improvement." Pedagogical features that ensure its effectiveness are high levels of student control and collective cognitive responsibility, coupled with its "launching pad": Knowledge Forum, a technological platform for organizing publicly expressed ideas (Zhang, 2012). This way, the role of learners as creative agents is redeemed. Different from static, individualistic conceptions of intelligence and creativity, based on which giftedness is attributed to individuals, this new approach is committed to "relational ontology" of human functioning (Barab & Plucker, 2002; Gresalfi, Barab, & Sommerfeld, 2012). So construed, gifted learners are those who continually engage in an active, critical way of learning through which information is transformed and new insights into the world are achieved (Dai, 2012; Gee, 2007; Perkins, 2009). Learning in this sense is not merely preparation for creativity. Learning is a way of keeping an innovative edge.

One question that has long plagued research on learning and creativity and divided researchers is how to deal with the fact that school-age children are in the process of developing their knowledge and skills and may not have the cognitive infrastructure to build their creative representations and thoughts on important matters (e.g., Kirschner, Sweller, & Clark, 2006). In gifted education, the problem is presented as a gap between what Renzulli (1986) called two kinds of giftedness: "knowing a lot" through textbooks and secondary sources in childhood on the one hand, and creative productivity in adulthood on the other. Schwartz and Bransford (1998; Bransford & Schwartz, 1999) built on Hatano's work and proposed efficiency and innovation as two dimensions of adaptive expertise. Seeking innovation without efficiency, one will end up as a frustrated novice; achieving efficiency without an innovative spirit, one will end up as a routine expert. They argue that there is an "optimal adaptivity corridor" leading to adaptive expertise (Bransford et al., 2006, p. 27). Building a curriculum that balances the acts of building efficiency while developing an innovative edge is a fundamental task for gifted education that can ultimately fill in the gap between two kinds of giftedness (Renzulli, 1986).

Another way of "naturalizing" creativity is to highlight personal creativity as ubiquitous to human beings when they are allowed to freely choose and develop their repertoire of knowledge, skills, and values (Runco, 2010; see also Beghetto & Kaufman, 2010; Collins & Halverson, 2009). An advantage of this conception for school-age populations is that we emphasize demonstration and nurturance of creative potential and agency, rather than mature creative "performance" or "product." Ultimately, little "c" in the form of personal knowledge (Polanyi, 1958) is a primary source of eminent adult creative productivity (big "C"; Csikszentmihalyi, 1996). New advances in technology clearly enhance the opportunity for developing personal creativity, when student learning is less dictated by a fixed school curriculum and more "customized" based on individuals' strengths and interests (Collins & Halverson, 2009). Many digitally engendered or -enhanced resources, platforms, and tools can be used to help children think more creatively and participate in knowledge creation (Craft, 2010). This new vision represents a new direction gifted education can take, from serving "special needs" of advanced students beyond the confines of regular classroom, as it currently stands, to building a personal (and sometimes social) network of ideas, skills, values, and worldviews for advanced students to enhance their personal creativity.

Major contributions

Torrance (1963) and Renzulli (1977) foretold the "naturalization" of creativity. But the recent work has explicated many principles and avenues to realizing creative potential. It takes two forms, to leverage the power of a community in building new understandings and cognitive apparatus, and to develop personal creativity by carving one's own niche. Assessment of creativity is taking an increasingly flexible approach, tracking processes rather than merely gauging products, moving away from parametric assumptions of individual differences to contextualized diagnosis of progress and shortfalls (e.g., Shute & Kim, 2012). Instead of using individuals as a unit of analysis, dialogic interactions and collaborative discourses become an empirical basis for assessing creative dynamics (Sawyer, 2006a). Gifted education apparently needs to reposition itself in the midst of these fundamental changes.

Prospects of interactions between gifted education and innovation education

If the purpose of innovation education is identifying, developing, and transforming child talent into adult innovation (Shavinina, this volume), gifted education should be the central part of this endeavor (see Delcourt & Renzulli, this volume; Fox, this volume; Rogers, this volume; VanTassel-Baska, this volume). As I suggest in the previous sections, explorations in gifted education and innovation education have a history of reciprocation given their overlapping concerns. Gifted education, as conventionally defined, is concerned with those students who demonstrate unusual capability and potential, such that their educational needs are typically not well met within the regular classroom (Marland, 1972; Ross, 1993). Defined as such, gifted education shares the concerns of turning talents into creative use with innovation education, while having the extra tasks of identifying the *most promising* youth for interventions. In the following section, I attempt to identify areas in which the fruitful reciprocation can continue.

A life-span perspective on the development of creativity and innovation

A common trend in gifted education and innovation education, as Shavinina (this volume) defines it, is to take a life-span developmental perspective (Matthews, 2009). This means that we see high-level creativity demonstrated in the production of novel and valuable ideas and tangible artifacts not as a characteristic possessed by few individuals but as the outcome of a prolonged developmental process, involving a unique formation of knowledge, skills, dispositions, and values vis-à-vis a particular line of work. The traditional, psychometric view of intelligence and creativity can be recast in this developmental framework as indicative of the probability with which some may be more inclined than others to engage in novel ways of thinking and doing that prove valuable. For example, conceptions of fluid and crystallized intelligence (Cattell, 1971), of fluid analogizing (Geake, 2008) are still meaningful for understanding individual differences in their creative potential and inclinations. The tradition of understanding creativity as underpinned by particular cognitive structures and processes can also be incorporated into a developmental account. For example, in Finke et al.'s (1992) Geneplore Model of creative cognition, generating new possibilities entails pre-inventive cognitive structures (i.e., unique organization of knowledge); explorations of these possibilities involve evaluation and decision on the most promising avenues. These cognitive processes leading to real life creativity last for months and years, even decades (e.g., Charles Darwin), and are best characterized as developmental in nature in that the cognitive system undergoes changes in itself while acting upon a particular aspect of the world. Finally the tradition of motivation research would find its own niche in contributing to a life-span developmental account by explicating what propels some individuals to pursue their unique visions, take calculated risks, and stay at the edge of chaos (Dai & Renzulli, 2008).

From this life-span perspective, what can educators do to make changes that respond to the need for developing creative talents and an innovative ethos in education? In the following section, I propose four imperatives as an agenda for innovation education.

Identifying and cultivating creative potential: the curriculum imperative

Naturalization of creativity means that creative agency can manifest itself everywhere in every aspect of human life. A life-span perspective on education for innovation would naturally pay attention to those transitions, from childhood to adolescence, and from adolescence to adulthood, where both challenges and opportunities are present for creativity. Individuals' creative potential is enhanced when differential development in terms of various trajectories, pathways, and niches are encouraged and supported. The rationale for differential development is that when individual strengths and interests are identified and supported, the end result is more cognitive diversity in the talent pool, hence the better chance for innovation. In that regard, a one-size-fits-all education coupled with rigid, uniform evaluation standards is detrimental to the development of creativity and ultimately innovations in practical settings.

Does gifted education have a distinct place in innovation education? Are there individual differences in creative potential? The answer is definitively yes. There are prerequisites for pursuing a particular creative career leading to eminent contributions (Ackerman, 2003; Lubinski, Webb, Morelock, & Benbow, 2004). One cannot be a creative engineer without a strong mathematics background, just as one cannot become an eminent composer without a strong foundation of musical knowledge and skills. However, creative potential is not unitary and can take many forms and shades. Even within the same domain, creativity may entail different sets of skills and penchants. Thus classic music composers differ from jazz musicians, and molecular biologists differ from more "naturalistic" biologists. Because of this diversity, generic divergent thinking tests cannot capture a unique aspect of creative potential, just like generic intelligence tests cannot capture specific intellectual propensities. Therefore, educators are better off when identifying high creative potential through student performance in a particular domain, be it a traditional school subject (e.g., mathematics) or non-traditional topic (robotics or computer animation). Selectivity and high-level excellence is what distinguishes gifted education from general education (Dai, 2010). But that does not negate a common vision for all educators: to look for a unique combination of knowledge, skills, dispositions, and values in individual students that eventually leads to distinct "personal knowledge" (Polanyi, 1958), and unique representations or visions of the world (Shavinina, 2009), which is the foundation for innovation.

Playing the whole game: the pedagogical imperative

As alluded earlier, there are two schools of thought on how to nurture creativity; one believes that creative processes are discrete and teachable, and should be explicitly taught. The other believes that creativity is a by-product of inquiry and action, and can only be nurtured in a holistic manner, Feldhusen's (Feldhusen & Kollof, 1986) and Renzulli's (1977) enrichment programs incorporate both features (engaging students in authentic activities, and provide some structural guidance as needed). There is an increasing realization in cognitive psychology that how to think (process) can never be completely separated from what to think about (content) (Anderson, 1987); in other words, it is erroneous to treat "higher-order thinking" as a separate process that can be brought to bear upon whatever content one is dealing with. On the other hand, higher-order thinking can be deliberately engaged through instructional guidance if the learning goal is deep understanding. Scardamalia and Bereiter's (2006) "knowledge building" engages learning and thinking that is by nature generative (i.e., creative). Schwartz and Bransford (1998) provide ways of determining when to give students full freedom to explore and "when to tell" in building adaptive expertise. Lehrer and Schauble (2006) suggest engaging students in model-based reasoning and imagination as a way of building deep understandings. It should be pointed out that cognitive modeling is fundamental for creativity, whether it takes the form of analogical thinking (Holyoak & Thagard, 1995) or embodied mental simulation (Barsalou, 2003). In addition, a certain dose of critical thinking is always present in order to generate ideas and solutions that are novel and valuable (i.e., creativity) (Fairweather & Cramond, 2010; Langer, 2012). Consequently, the best metaphor for a pedagogy of creativity is that of "playing the whole game" (Perkins, 2009). Any distinct domain of human practice is a "game" with a particular design; learning for creativity means learning how the game is designed to achieved its goals, how to play the game (not merely learning about the game), and how the game might be improved by modifying its components or design features (Gee, 2007; cf. Sawyer, 2010). This kind of generative learning involves gaining new perspectives on a game, building instruments for tackling problems the game presents, and reflecting on how the game should be played (Dai, 2012). The process is fundamentally social in that participants who play the same game share information and build on each other's ideas (Gee, 2007; Zhang, 2012).

Would the whole game be played differently for gifted and talented students, given that they typically achieve automaticity faster, develop deeper insights into the issue at hand, and taking more promising avenues with less instructional guidance (Borkowski & Peck, 1986; Kanevsky, 1990; Steiner, 2006)? In other words, does Aptitude-Treatment Interaction (ATI; Cronbach & Snow, 1977) matter? A strong version of the ATI argument states that students with Aptitude A would be best served when matched with Treatment A, but not Treatments B or C; thus, those who prefer a more creative way of learning would benefit most from a creative style of teaching (Grigorenko & Sternberg, 1997). A weak version of the ATI argument states that while certain pedagogical strategies would work for most students, they carry value-added benefits for gifted and talented students. For example, there is a plenty of evidence that inquiry-based learning can benefit all students (Hmelo-Silver, Duncan, & Chinn, 2007). The Integrated Curriculum Model developed by VanTassel-Baska and her colleagues (VanTassel-Baska, 1986; VanTassel-Baska & Brown, 2007) leverages three cognitive components in enhancing high-end learning: (a) advanced content, (b) high-level process and product work, and (c) intra- and interdisciplinary concept development and understanding. Such a model is not exclusively applicable to gifted students, but gifted students clearly stand to gain more from such an inquiry-based curriculum (Aulls & Shore, 2008; see also Ceci & Papierno, 2005). Thus, there is no "gifted pedagogy," a pedagogy suitable only for gifted and talented learners (Tomlinson, 1996), but different doses of instructional guidance may be needed depending on how much support is needed for the learner to advance to the next level of competence (Vygotsky, 1978). Knowing that gifted and talented students are often autodidactic (i.e., self-taught and self-educated in skill development), what Collins and Halverson (2009) prescribed as the 21st century learning, customization, learner control, and interactivity, may be especially beneficial to gifted learners. On the other hand, because of the more advanced levels which gifted learners characteristically attain, it is also crucial that mentorship experiences with experts in a field be provided (Grassinger, Porath, & Ziegler, 2010) so that the learners will develop deep insights into a domain of human endeavor and social practice.

Developing resources, tools, and support for "junior version" innovations: the capacity building imperative

Although it is not always feasible for school-age students to engage in "real play" in work settings when it comes to exercising their newly acquired knowledge and skills, according to Perkins

(2009), we can always design some "junior versions" of a game so that students will get a feel of what the game is about and how to play it. Lave and Wenger (1991) aptly called it "legitimate peripheral participation." How to develop resources, tools, and support systems to enable students to play the whole game is a practical as well as intellectual challenge. At the conceptual level, what makes a "whole game?" Can we define its boundary, or can one move from one "game" to another? What are the essential elements for such learning, or, more accurately, an apprenticeship game? Gee (2007) drew inspirations from the video gaming community. Sawyer (2003, 2010) got clues from jazz musicians and artists at work. In general, of course, we can roughly equate "playing the whole game" with inquiry and project-based learning (Hmelo-Silver et al., 2007; Krajcik & Blumenfeld, 2006), in which students have to tackle real world problems (at least their "junior" versions) similar to what scientists, artists, and scholars, other professionals deal with in work settings.

Conceptualizing learning for creativity is one thing; practically making it happen is another. It seems essential to build an infrastructure of support for playing the whole game, with resources earmarked, tools available, and coaches on the side. Digital technologies clearly have created new possibilities for this endeavor (e.g., Barab, Gresalfi, & Ingram-Goble, 2010). What practical constraints on the part of students as well as the learning environment are involved in "playing the whole game" effectively needs to be fully understood before we can put to test the proposition that this is a viable approach to enhancing creativity. How can practical innovations in gifted education contribute to the capacity building effort for playing the whole game in general? One example is Renzulli Learning System (RLS), a fully integrated technological system for creating and managing inquiry and creative activities for primary and secondary school students (Renzulli & Reis, 2009). The system begins by providing a computer-generated profile of each student's academic strengths, interests, and learning styles. A search engine then *matches* internet resources to the student's profile by subject area, grade level, state curricular standards, and degree of complexity. Then a management system called the Wizard Project Maker guides students in the *application* of knowledge to teacher- or student-selected assignments, independent research studies, or creative projects that individuals or small groups would like to pursue. Although the system is designed to help teachers differentiate curriculum for gifted students, it can be used to engage all willing students to engage in projects chosen by themselves or suggested by teachers. There is much to learn about the support system for developing creativity and innovation. For instance, each year more than 1,500 high school students nationwide in the US apply for Intel Science Talent Search program (www.intel.com/about/corporateresponsibility/education/sts/index.htm). The basis for selecting finalists and final winners is the products of their scientific projects. It would be highly instructive to know how what kind of resources, tools, and technical and social support systems were behind these undertakings, and what makes some efforts more successful than others.

Developing a taxonomy of creativity-innovation enhancement: the assessment imperative

Finally, in order to have effective modules or curricula of innovation education, we need a system of assessment that is conceptually sound and technically reliable in gauging the effectiveness of educational interventions. In the past assessment of creativity was plagued by the confusion surrounding how to define creativity. Some researchers adhere to product-based criteria (Csikszentmihalyi, 1996) and others advocate use of person-centered criteria (Runco, 2010). Fortunately, the field has come to realize that creativity and its practical incarnation, innovation, can take many forms and shades. Indeed it is meaningful to talk about different magnitude and degrees of creativity (Beghetto & Kaufman, 2010). Furthermore, in the spirit of naturalizing creativity, it is no longer tenable to treat creativity as a personal characteristic; rather, whether social and pedagogical conditions are conducive to creative thinking and expression of creative agency should also be assessed.

In developing such an assessment system for creativity-innovation enhancement, several conceptual issues need to be considered. First, the age-old person-process-product distinction should be honored. The focus on creativity enhancement can be personal qualities (based on dispositions and characteristics; see Runco, 2010), optimal conditions and processes (based on some critical aspects of the creative process; see Treffinger & Isaksen, 2005), and product qualities (based on professional standards; see Amabile, 1982). Second, the competence-performance distinction is also relevant to creativity enhancement. According to Vygotsky (1978), *performance before competence* is a developmental trajectory that needs to be captured in assessment; namely, initial fledgling performance may not show the kind of sophistication desired but may reflect a burgeoning creative talent nevertheless. Third, an assessment system needs to distinguish domain-specific and domain-general characteristics. Personal attributes can be domain-general (e.g., broad interests, polymaths, propensity for risk-taking), but creative products (innovations) are always domain-specific. If the main goal is to improve products, domain-specific criteria are more important. If, on the other hand, the purpose is to arouse the creative spirit and create an ethos of exploring knowledge frontiers (e.g., building a knowledge creation community; Scardamalia & Bereiter, 2006), then an exclusive product focus in assessment may be inappropriate. In general, a trajectory of increasing differentiation (i.e., becoming more domain-specific, more fine-tuned to task requirements and criteria) can be followed, whereby strengths and interests become increasingly focused, and technical proficiency and the value of the novelty in thinking and products more manifest. The logic is the same as the one used by Beghetto and Kaufman (2010), who argued that big-C (i.e., transformative creativity) always evolves from little-c (everyday creativity; Richards, 2007) and mini-c (informal, interpretive creativity), and there are many levels and degrees in-between (e.g., pro-c, standing for professional creativity, which characterize most of scholarly, artistic, and practical innovations). As big-C is rare and often beyond what is "educable," the assessment for creative enhance may target pro-c (professional creativity).

Technically, creativity and innovation is likely multidimensional, rather than psychometrically unitary. The traditional method of indexing creativity or creative potential using a single number might have to give place to a more complex analysis of performance and behavior, similar to cognitive diagnostic assessment (Leighton & Gierl, 2007). Modeling adaptive expertise in problem solving and reasoning provides a good benchmark for such diagnosis (Shute & Kim, 2012). When dynamic problem solving is assessed, non-obtrusive methods need to be used. Shute (2011) uses stealth assessment in computer game play situations, an assessment innovation that is potentially capable of capturing "teachable moments" than otherwise possible (see also Gee & Shaffer, 2010). Measurement of creative potential and even "creative giftedness" may rely on an appropriate assessment of the product, but understanding of how it comes about will rely fundamentally on investigating the underlying process. The primary goal of developing such an assessment system for innovation education is to assess and access creativity in person, process, and product (Feldhusen & Goh, 1995) so that the workforce we produce is capable of self-direction and innovative work in a knowledge economy. For gifted education, such a system would help identify (and sometimes select) high creative potential through their authentic performance for further advancement. The traditional notion of identifying the "creatively gifted" once and for all should be put to rest. There is no litmus test or shortcut for assessment, as creative potential evolves and changes, and indeed even dwindles if not nourished.

Summary and conclusion

In this chapter, I delineate the historical and theoretical connections between gifted education and innovation education. The changing focus since the 1950s, from personal attributes to cognitive and motivational processes to social dynamics, provides rich heuristics as to how human creative potential can be harnessed and nurtured. It is clear that person, process, content, and context are all important elements to reckon with in the equation of innovation education. What is worth noting is an increasing realization that creativity is a result of the natural human tendency to seek truth, optimality, and variation. Scholars and researchers in gifted education clearly have contributed many practical ideas as to how we can cultivate this creative potential through education. Current thinking puts more emphasis on personal creativity (little c) rather than epoch-making creativity (big C). This focus is appropriate for education, whose main charge is to lay a good foundation for talented students so as to increase the likelihood of creative productivity in their adulthood. For that purpose, I suggest four educational imperatives on curriculum, pedagogy, capacity building, and assessment, respectively, which can put creativity and innovation back to the educational landscape as a priority. In an age of accountability, how well a school protects and nurtures students' creative potential should be a main criterion for judging its efficacy, as the vitality of the new generation is at stake.

References

Ackerman, P. L. (2003). Aptitude complexes and trait complexes. *Educational Psychologist, 38*, 85–93.
Amabile, T. M. (1982). Social psychology of creativity: A consensual assessment technique. *Journal of Personality and Social Psychology, 43*, 997–1013.
Amabile, T. M. (1983). *The social psychology of creativity*. New York: Springer-Verlag.
Anderson, J. R. (1987). Skill acquisition: Compilation of weak-method problem situations. *Psychological Review, 94*, 192–210.
Aulls, M. W., & Shore, B. M. (2008). *Inquiry in education: The conceptual foundations for research as a curricular imperative*. New York: Erlbaum.
Barab, S. A., Gresalfi, M., & Ingram-Goble, A. (2010). Transformational play: Using games to position person, content, and context. *Educational Researcher, 39*, 525–536.
Barab, S. A., & Plucker, J. A. (2002). Smart people or smart context? Cognition, ability, and talent development in an age of situated approaches to knowing and learning. *Educational Psychologist, 37*, 165–182.
Barsalou, L. W. (2003). Situated simulation in the human conceptual system. *Language and Cognitive Processes, 18*, 513–562.
Beghetto, R. A., & Kaufman, J. C. (2010). Broadening conceptions of creativity in the classroom. In R. A. Beghetto & J. C. Kaufman (Eds.), *Nurturing creativity in the classroom* (pp. 191–205). Cambridge, UK: Cambridge University Press.
Borkowski, J. G., & Peck, V. A. (1986). Causes and consequences of metamemory in gifted children. In R. J. Sternberg & J. E. Davidson (Eds.), *Conceptions of giftedness* (pp. 182–200). Cambridge, UK: Cambridge University Press.
Bransford, J. D., Barron, B., Pea, R. D., Meltzoff, A., Kuhl, P., Bell, P., et al. (2006). Foundations and opportunities for an interdisciplinary science of learning. In R. K. Sawyer (Ed.), *The Cambridge handbook of the learning sciences* (pp. 19–34). Cambridge, UK: Cambridge University Press.
Bransford, J., & Schwartz, D. L. (1999). Rethinking transfer. A simple proposal with multiple implications. In A. Iran-Nejad & P. D. Pearson (Eds.), *Review of research in education* (Vol. 24, pp. 61–100). Washington, DC: American Psychological Association.
Bruner, J. S. (1960). *The process of education*. Cambridge, MA: Harvard University Press.
Cattell, R. B. (1971). *Abilities: Their structure, growth, and action*. Boston: Houghton Mifflin.
Ceci, S. J., & Papierno, P. B. (2005). The rhetoric and reality of gap closing: When the "have-nots" gain but the "haves" gain even more. *American Pshchologist, 60*, 149–160.
Collins, A. M., & Halverson, R. (2009). *Rethinking education in the age of technology*. New York: Teachers College Press.
Craft, A. (2010). *Creativity and education futures: Learning in a digital age*. Sterling, VA: Trentham Books.

Cronbach, L. J., & Snow, R. E. (1977). *Aptitudes and instructional methods: A handbook for research on interactions*. New York: Irvington.

Csikszentmihalyi, M. (1996). *Creativity: Flow and the psychology of discovery and invention*. New York: HarperCollins.

Dai, D. Y. (2010). *The nature and nurture of giftedness: A new framework for understanding gifted education*. New York: Teachers College Press.

Dai, D. Y. (2012). From smart person to smart design: Cultivating intellectual potential and promoting intellectual growth through design research. In D. Y. Dai (Ed.), *Design research on learning and thinking in educational settings: Enhancing intellectual growth and functioning* (pp. 3–40). New York: Routledge.

Dai, D. Y., & Renzulli, R. S. (2008). Snowflakes, living systems, and the mystery of giftedness. *Gifted Child Quarterly, 52*, 114–130.

DeHaan, R. G., & Havighurst, R. J. (1957). *Educating the gifted*. Chicago: University of Chicago Press.

Dunbar, K. (1997). How scientists think: On-line creativity and conceptual change in science. In T. B. Ward, S. M. Smith, & J. Vaid (Eds.), *Creative thought: An investigation of conceptual structures and processes* (pp. 461–493). Washington, DC: American Psychological Association.

Estrin, J. (2009). *Closing the innovation gap: Reigniting the spark of creativity in a global economy*. New York: McGraw-Hill.

Fairweather, E., & Cramond, B. (2010). Infusing creative and critical thinking into the curriculum together. In R. A. Beghetto & J. C. Kaufman (Eds.), *Nurturing creativity in the classroom* (pp. 113–141). Cambridge, UK: Cambridge University Press.

Feldhusen, J. F., & Goh, B. E. (1995). Assessing and accessing creativity: An integrative review of theory, research, and development. *Creativity Research Journal, 18*, 231–247.

Feldhusen, J. F., & Kolloff, M. B. (1986). The Purdue three-stage model for gifted education. In R. S. Renzulli (Ed.), *Systems and models for developing programs for the gifted and talented* (pp. 126–152). Mansfield Center, CT: Creative Learning Press.

Feldhusen, J. F., & Treffinger, D. J. (1986). *Creative thinking and problem solving in gifted education*. Dubuque, IA: Kendall/Hunt Publishing Company.

Finke, R. A., Ward, T. B., & Smith, S. M. (1992). *Creative cognition: Theory, research, and applications*. Cambridge, MA: The MIT Press.

Gagné, F. (2005). From gifts to talents: The DMGT as a developmental model. In R. J. Sternberg & J. E. Davidson (Eds.), *Conceptions of giftedness* (2 ed., pp. 98–119). Cambridge, UK: Cambridge University Press.

Gallagher, J. J. (1975). *Teaching the gifted child* (2 ed.). Boston: Allyn & Bacon.

Geake, J. G. (2008). High abilities at fluid analogizing: A cognitive neuroscience construct of giftedness. *Roeper Review, 30*, 187–195.

Gee, J. P. (2007). *What video games have to teach us about learning and literacy*. New York: Palgrave/Macmillan.

Gee, J. P., & Shaffer, D. W. (2010). Looking where the light is bad: Video games and the future of assessment. *EDge, 6*, 3–19.

Getzels, J. W., & Csikszentmihalyi, M. (1976). *Creative vision: A longitudinal study of problem finding in art*. New York: Wiley.

Getzels, J. W., & Jackson, P. W. (1962). *Creativity and intelligence: Explorations with gifted students*. New York: Wiley.

Grassinger, R., Porath, M., & Ziegler, A. (2010). Mentoring the gifted: A conceptual analysis. *High Ability Studies, 21*, 27–46.

Gresalfi, M., Barab, S. A., & Sommerfeld, A. (2012). Intelligent action as a shared accomplishment. In D. Y. Dai (Ed.), *Design research on learning and thinking in educational settings: Enhancing intellectual growth and functioning* (pp. 41–64). New York: Routledge.

Grigorenko, E. L., & Sternberg, R. J. (1997). Styles of thinking, abilities, and academic performance. *Exceptional Children, 63*, 295–312.

Guilford, J. P. (1950). Creativity. *American Psychologist, 5*, 444–454.

Guilford, J. P. (1967). *The nature of human intelligence*. New York: McGraw-Hill.

Halpern, D. F. (2008). Is intelligence critical thinking? Why we need a new definition of intelligence. In P. C. Kyllonen, R. D. Roberts, & L. Stankov (Eds.), *Extending intelligence: Enhancement and new constructs* (pp. 293–310). New York: Routledge.

Hmelo-Silver, C., Duncan, R. G., & Chinn, C. A. (2007). Scaffolding and achievement in problem-based and inquiry learning: A response to Kirschner, Sweller, and Clark (2006). *Educational Psychologist, 42*, 99–107.

Holyoak, K. J., & Thagard, P. (1995). *Mental leaps: Analogy in creative thought*. Cambridge: MA: The MIT Press.

Kanevsky, L. (1990). Pursuing qualitative differences in the flexible use of problem-solving strategy by young children. *Journal for the Education of the Gifted, 13*, 115–140.

Kirschner, P. A., Sweller, J., & Clark, R. E. (2006). Why minimal guidance during instruction does not work: An analysis of the failure of constructivist, discovery, problem-based, experiential, and inquiry-based teaching. *Educational Psychologist, 41*, 75–86.

Krajcik, J. S., & Blumenfeld, P. C. (2006). Project-based learning. In R. K. Sawyer (Ed.), *The Cambridge handbook of the learning sciences* (pp. 317–333). Cambridge, UK: Cambridge University Press.

Langer, J. A. (2012). The interplay of creative and critical thinking in instruction. In D. Y. Dai (Ed.), *Design research on learning and thinking in educational settings: Enhancing intellectual growth and functioning* (pp. 65–82). New York: Routledge.

Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. Cambridge, UK: Cambridge University Press.

Lehrer, R., & Schauble, L. (2006). Cultivating model-based reasoning in science education. In R. K. Sawyer (Ed.), *The Cambridge handbook of the learning sciences* (pp. 371–387). Cambridge, UK: Cambridge University Press.

Leighton, J., & Gierl, M. (Eds.). (2007). *Cognitive diagnostic assessment for education: Theory and applications*. Cambridge, UK: Cambridge University Press.

Lubinski, D., Webbs, R. M., Morelock, M. J., & Benbow, C. P. (2004). Top 1 in 10,000: A 10-year follow-up of the profoundly gifted. *Journal of Applied Psychology, 86*, 718–729.

MacKinnon, D. (1962). The nature and nurture of creative talent. *American Psychologist, 17*, 484–495.

MacKinnon, D. (1978). *In search of human effectiveness: Identifying and developing creativity*. Buffalo, NY: Bearly.

Marland, S. P. (1972). *Education of the gifted and talented: Report to the Congress of the United States by the U.S. Commissioner of Education*. Washington, DC: Government Printing Office.

Matthews, D. J. (2009). Developmental transitions in giftedness and talent: Childhood to adolescence. In F. D. Horowitz, R. F. Subotnik, & D. J. Matthews (Eds.), *The development of giftedness and talent across the life span* (pp. 89–108). Washington, DC: American Psychological Association.

Newell, A., Shaw, J. C., & Simon, H. A. (1962). The process of creative thinking. In H. E. Gruber, G. Terrell, & M. Wertheimer (Eds.), *Contemporary approaches to creative thinking* (pp. 65–66). New York: Atherton Press.

Newell, A., & Simon, H. A. (1972). *Human problem solving*. Englewood Cliffs, NJ: Prentice-Hall.

Partnership for 21st Century Skills. (2008). 21st century skills education and competitiveness guide. Retrieved online at www.p21.org/documents/21st_ century_skills_education_and_competitiveness_guide.pdf.

Perkins, D. N. (2009). *Making learning whole: How seven principles of teaching can transform education*. San Francisco: Jossey-Bass.

Polanyi, M. (1958). *Personal knowledge: Toward a post-critical philosophy*. Chicago: University of Chicago Press.

Renzulli, J. S. (1977). *The enrichment triad model: A guide for developing defensive programs for the gifted and talented*. Mansfield Center, CT: Creative Learning Press.

Renzulli, J. S. (1978). What makes giftedness? Re-examining a definition. *Phi Delta Kappan, 60*, 180–184, 261.

Renzulli, J. S. (1986). The three-ring conception of giftedness: A developmental model for creative productivity. In R. J. Sternberg & J. E. Davidson (Eds.), *Conceptions of giftedness* (pp. 53–92). Cambridge, UK: Cambridge University Press.

Renzulli, J. S. (2005). The three-ring conception of giftedness: A developmental model for promoting creative productivity. In R. J. Sternberg & J. E. Davidson (Eds.), *Conceptions of giftedness* (2 ed., pp. 98–119). Cambridge, UK: Cambridge University Press.

Renzulli, J. S., & Callahan, C. M. (1973). *New directions in creativity*. New York: Harper & Row.

Renzulli, J. S., & Dai, D. Y. (2001). Abilities, interests, and styles as aptitude for learning: A person-situation perspective. In R. J. Sternberg & L. F. Zhang (Eds.), *Perspectives on learning, thinking, and cognitive styles* (pp. 23–46). Mahwah, NJ: Lawrence Erlbaum.

Renzulli, J. S., & De Wet, C. F. (2010). Developing creative productivity in young people through the pursuit of ideal acts of learning. In R. A. Beghetto & J. C. Kaufman (Eds.), *Nurturing creativity in the classroom* (pp. 24–72). Cambridge, UK: Cambridge University Press.

Renzulli, J. S., & Reis, S. M. (1997). *Schoolwide enrichment model: A how-to guide for educational excellence*. Mansfield Center, CT: Creative Learning Press.

Renzulli, J. S., & Reis, S. M. (2009). A technology-based application of the Schoolwide Enrichment Model and high-end learning theory. In L. Shavinina (Ed.), *International handbook on giftedness* (pp. 1203–1223). New York: Springer.

Resnick, L. B. (2010). Nested learning systems for the thinking curriculum. *Educational Researcher, 39*, 183–197.
Richards, R. (Ed.). (2007). *Everyday creativity and new views of human nature*. Washington, DC: American Psychological Association.
Ross, P. O. (1993). *National excellence: A case for developing America's talent*. Washington, DC: US Government Printing Office.
Runco, M. (2010). Education based on a parsimonious theory of creativity. In R. A. Beghetto & J. C. Kaufman (Eds.), *Nurturing creativity in the classroom* (pp. 235–251). Cambridge, UK: Cambridge University Press.
Sawyer, R. K. (2003). *Improved dialogues: Emergence and creativity in conversation*. Westport, CT: Greenwood.
Sawyer, R. K. (2006a). Analyzing collaborative discourse. In R. K. Sawyer (Ed.), *The Cambridge handbook of the learning sciences* (pp. 187–204). Cambridge, UK: Cambridge University Press.
Sawyer, R. K. (2006b). *Explaining creativity: The science of human innovation*. Oxford, UK: Oxford University Press.
Sawyer, R. K. (2010). Learning for creativity. In R. A. Beghetto & J. C. Kaufman (Eds.), *Nurturing creativity in the classroom* (pp. 172–190). Cambridge, UK: Cambridge University Press.
Scardamalia, M., & Bereiter, C. (2006). Knowledge building: Theory, pedagogy, and technology. In R. K. Sawyer (Ed.), *The Cambridge handbook of the learning sciences* (pp. 97–115). Cambridge, UK: Cambridge University Press.
Schwartz, D. L., & Bransford, J. (1998). A time for telling. *Cognition and Instruction, 16*, 475–522.
Shavinina, L. (2009). A unique type of representation is the essence of giftedness: Toward a cognitive-developmental theory. In L. Shavinina (Ed.), *International handbook on giftedness* (pp. 231–257). New York: Springer.
Shute, V. J. (2011). Stealth assessment in computer-based games to support learning. In S. Tobias & J. D. Fletcher (Eds.), *Computer games and instruction* (pp. 503–524). Greenwich, CT: Information Age Publishing.
Shute, V. J., & Kim, J. Y. (2012). Does playing the World of Goo facilitate learning? In D. Y. Dai (Ed.), *Design research on learning and thinking in educational settings: Enhancing intellectual growth and functioning* (pp. 243–267). New York: Routledge.
Steiner, H. H. (2006). A microgenetic analysis of strategic variability in gifted and average-ability children. *Gifted Child Quarterly, 50*, 62–74.
Tannenbaum, A. J. (1997). The meaning and making of giftedness. In N. Colangelo & G. A. Davis (Eds.), *Handbook of gifted education* (2 ed., pp. 27–42). Boston: Allyn & Bacon.
Terman, L. M. (1925). *Genetic studies of genius: Vol. 1, Mental and physical traits of a thousand gifted children*. Standford, CA: Stanford University Press.
Tomlinson, C. A. (1996). Good teaching for one and all: Does gifted education have an instructional identity? *Journal for the Education of the Gifted, 20*, 155–174.
Tomlinson, C. A., & Callahan, C. M. (1992). Contributions of gifted education to general education in a time of change. *Gifted Child Quarterly, 36*, 183–189.
Torrance, E. P. (1963). *Education and the creative potential*. Minneapolis, MN: University of Minnesota Press.
Torrance, E. P. (1970). *Encouraging creativity in the classroom*. Dubuque, IA: Wm. C. Brown Company.
Torrance, E. P. (1972). Predictive validity of the Torrance Tests of Creative Thinking. *Journal of Creative Behavior, 6*, 236–252.
Toynbee, A. (1964). Is America neglecting her creative minority? In C. W. Taylor (Ed.), *Widening horizons in creativity* (pp. 3–9). New York: Wiley.
Treffinger, D. J., & Isaksen, S. G. (2005). Creative problem solving: The history, development, and implications for gifted education and talent development. *Gifted Child Quarterly, 49*, 342–353.
VanTassel-Baska, J. (1986). Effective curriculum and instruction models for talented students. *Gifted Child Quarterly, 30*, 164–169.
VanTassel-Baska, J., & Brown, E. (2007). Toward best practice: An analysis of the efficacy of curriculum models in gifted education. *Gifted Child Quarterly, 51*, 432–358.
Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Cambridge, MA: Harvard University Press.
Weisberg, R. W. (1999). Creativity and knowledge: A challenge to theories. In R. J. Sternberg (Ed.), *Handbook of creativity* (pp. 226–250). Cambridge, UK: Cambridge University Press.
Zhang, J. (2012). Designing adaptive collaboration structures for advancing the community's knowledge. In D. Y. Dai (Ed.), *Design research on learning and thinking in educational settings: Enhancing intellectual growth and functioning* (pp. 201–224). New York: Routledge.