Fostering Creativity in the Academic Disciplines

A Review of Research on the Relationship between Intelligence, Knowledge, and Creativity

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Outline

- Reflect on current status of creativity in gifted education and the academic disciplines
- Summarize research on the relationship between creativity and intelligence
- Review research on the relationship between creativity and knowledge
- Use the lens of expertise to examine creativity
- Briefly introduce current research project on adolescents' knowledge and creativity in science
- Explore implications for classroom practice

Something to think about…

- In your opinion, what are the three greatest human advances or accomplishments of the past 50 years?
- In your opinion, what are the three most significant challenges likely to face humankind over the next 50 years?
- In each list, underline those items that will not (or did not) require creative thinking.
- In each list, circle those items that will not (or did not) require a high level of knowledge or expertise.

Creativity happens in context

- Research on children and non-experts to date has done little to advance our understanding of creativity “as a psychological process and as observable behaviour and products”, because it has considered creativity as though it happens “in a vacuum” and has failed to acknowledge and examine the fundamental role of the knowledge base (Feldhusen, 2002, p.179).

- Creativity: “the process of bringing into being something novel and useful” (Sternberg & O’Hara, 1999)

Creativity out of context…

- A synonym for hands-on learning
- A set of general thinking skills (separate from content)
- An optional extra
- Art and music

i.e. Not an integral part of the core academic curriculum

A note of caution…

"Anyone who peeks over the fence into this field is apt to be astonished at the visible chaos."

McNemar, 1964, p.876.

Creativity and giftedness

- Feldman and Benjamin (1998) described the relationship between creativity and IQ as “adversarial.”
- What do we know about the relationship between creativity and IQ that could inform a more meaningful alliance?

Creativity and intelligence

- The highly intelligent and the highly creative: Getzels and Jackson (1962) attempt to distinguish creativity from psychometric intelligence; Torrance; Wallach and Kogan
- Threshold Theory
- Longitudinal studies of high IQ individuals
- Studies of creatively eminent individuals

Catching our breath…

- IQ required for high-level creative work, but not a sufficient predictor, and unclear which abilities or processes are related to creative performance
- Some evidence for low correlation between IQ and divergent thinking, and IQ and high level creativity
- Other factors involved in creative accomplishment probably include motivation, interest, specific personality traits and environmental conditions.
- Very little is known about the relationship between intelligence and creativity across cultural and ethnic groups or across the lifespan
- Alternative conceptions of intelligence and giftedness suggest different relationships between intelligence and creativity, but research into these is not well developed
- So what?

What does it mean for gifted education?

- What is the goal of gifted education?
- What do divergent thinking tests tell us in the context of gifted identification and service delivery?
- What are the implications for curriculum and instruction in the content areas?

Creativity and knowledge

- Shift in creativity theories towards more contextual, domain-specific models, most of which include domain knowledge
- Very little research on role of knowledge in creativity
- Very little research on relationship between creativity and knowledge in children and adolescents
- What does the study of experts tell us?

Lessons from experts

- Expertise: “the capacity to perform at a high level, acquired through practice, or the possession of exceptional knowledge, acquired through study” (Weisberg, 2006, p.7)
- Knowledge rather than general reasoning ability distinguishes novices from experts

Expert knowledge facilitates problem solving through:

- Depth of knowledge representation
- Knowledge structure
- Problem representation – understanding of a problem

Two views of the relationship between knowledge and creativity

- Is more knowledge always better for creativity?
- Tension view – too much knowledge impedes the ability to break set
- Foundational view – more knowledge = greater likelihood for creativity (creativity is a form of expertise, since all domains require creativity at the most expert levels)
- What about the relationship between knowledge and creativity in non-experts?

Knowledge in the creative process

- Problem construction or definition
- Information encoding
- Concept selection
- Conceptual combination
- Idea generation
- Idea evaluation
- Implementation planning
- Monitoring

Mumford et al. (2003)

Knowledge and creativity in adolescents

- To what extent does physics domain knowledge contribute to creative performance on an ill-defined physics task over and above general intellectual ability and divergent thinking ability?
  - **Quantitative**: (regression analysis)
- To what extent do high-creativity and low-creativity participants differ in the depth and structure of their domain knowledge?
  - **Qualitative** (description)
- How do individuals apply domain knowledge as they work on a creative problem solving task in physics?
  - **Qualitative** (think-aloud protocol analysis)

PHYSICS PRINCIPLES

SURFACE FEATURES OF PROBLEMS

	1. Newton's First Law of Motion	2. Newton's Second Law of Motion	3. Law of Conservation of Momentum	4. Law of Conservation of Energy
A. Physical Objects: Vehicles	When you are traveling in a car that brakes suddenly, why might you be thrust forward into the windshield if you are not wearing a seatbelt?	A sports car and a moving van are traveling at a speed of 30km/h. If the same force is applied to both, which will stop first?	A 1200 kg car going 13 m/s collides with a 4200 kg truck at rest. Their bumpers lock. What is their speed afterwards?	Why do you become tired as you push a broken-down car to get it moving?
B. Physical objects: Ice Skaters	A skater stands still on a frozen pond. She reaches her arms around behind her and pushes herself in the back. Why doesn't she start moving forward?	An ice skater with a mass of 58 kg accelerates at 6 m/s^2. What is the force acting on the skater?	If two ice skaters moving at 5 m/s bump into each other, how will their momentum before the collision relate to their momentum after the collision?	If two ice skaters moving at 5 m/s bump into each other, how will their energy before the collision relate to their energy after the collision?
C. Attributes of Objects: Traveling in Space (Frictionless)	In a science fiction movie, a spaceship far from any planet or star shuts off its rocket engine. It immediately stops moving. Does this obey the laws of physics? If so, which law?	A force of 16N is applied to a piece of space junk moving through space, and it accelerates at 2 m/s^2. What is its mass?	How can a rocket begin moving in outer space when there is nothing to push it?	An astronaut in a space shuttle wants to unscrew a bolt with a resistance of 12N. Can the use of a lever reduce the amount of work that needs to be done in unscrewing the bolt? Why or why not?
D. Motion of Object: Falling	A ball is thrown straight up in the air. According to Newton, what is the reason for the ball falling back to Earth?	A skydiver weighing 600N spreads her arms as she falls. The force of air resistance is 200N. What is the acceleration of the skydiver?	True or false: As an apple falls towards the Earth, gravity is the only force acting on the apple.	As an apple falls towards the Earth, what happens to its potential energy?

What does it mean for the classroom?

- More research is needed to determine how creativity operates in the context of the academic content areas
- BUT, since creativity occurs in context, we need to consider how to teach and nurture it (and perhaps to assess it) in context
- Evidence to date suggests that concept-based curriculum should best facilitate creative thinking
- What might this look like?

Creativity in the classroom

- Focus on developing deep understanding of key concepts within and across disciplines
- Opportunities to explore relationships among concepts, patterns and principles
- Focus on how knowledge can be organized and reorganized within a discipline
- Focus on generating new ideas or applications from existing deep knowledge structures (conceptual knowledge)
- Opportunities to explore connections across disciplines at a deep, meaningful level (at the level of concepts, principles, and mental models)

More creativity in the classroom

- Since the application of knowledge in creativity is likely to be different across disciplines, efforts to nurture creativity should stem from the authentic nature of each discipline, its structure and its criteria for creative work
- Opportunities for problem finding and definition rather than simply problem solving
- Parallel Curriculum Model

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