

Fostering creativity : Understanding the 'flash of insight'

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The conditions under which students are more likely to generate creative outcomes and the thinking processes they use have attracted increasing interest in recent years. A major focus has been on the teaching of thinking skills to achieve this. The present study examined a related issue; students' beliefs about whether they can be successful in producing creative outcomes. This is their self efficacy to be creative.

Evidence for 'self efficacy about creativity' was inferred from the processes Year 12 students of the International Baccalaureate reported they used to complete the Extended Essay. After completion, in a clinical interview context, students recalled the steps they implemented, the decisions they had made and their beliefs. Their accounts were analysed in terms of the display of a set of thinking strategies usually associated with creativity. The outcomes of these analyses were compared for students whose essays received high and low scores for creativity.

Students who achieved a higher creativity score reported the use of processing strategies that suggested a more positive self efficacy to be creative. The paper discusses the implications for instruction.

Creativity is a key goal of contemporary education. A key aspect of the creativity process is the 'flash of insight', when the thinker first links two or more previously unrelated ideas in a 'possible' relationship. This paper examines the conditions under which students are more likely to generate creative outcomes and the thinking processes they use in researching a particular topic. Its aim was to identify the learning and teaching conditions more likely to foster creative outcomes.

At the outset it is necessary to identify the characteristics of creative outcomes. First, the outcome can be either an item or entity or a process. Creativity can be applied both to the quality of particular outcomes and the thinking activity that led to them. Second, it needs to meet various criteria; it is judged to be (1) novel in some way, (that is, it is judged to be relatively new or does things in novel ways), (2) unexpected (that is, sufficiently different from what is known that it elicits surprise), (3) functional (that is, it is potentially useful) and (4) reasonable (that is, while it is novel and surprising, the outcome fits with what is known or 'makes sense', particularly after individuals have had the opportunity to analyse and evaluate the outcome. Creative outcomes usually need to meet the four criteria. Thought is creative when it produces something that is both novel and interesting or valuable, (Simon, 2001). The ideas need to be appropriate or relevant in terms of an intended purpose.

Various theories for explaining the emergence of creative outcomes have been proposed. Some identify the components of knowledge necessary for creative outcomes; the 'componential' theories of creativity. One of the most influential is that of Amabile (1996) that comprises three components: (1) domain-relevant skills (that is, knowledge and technical skills that relate to the topic or issue) (2) task motivation, an intrinsic drive to be creative and (3) creativity-relevant thinking strategies such as planning and exploring new pathways, keeping response options open for as long as possible and suspending judgment. Amabile's theory has been extensively empirically tested (for example, Conti, Coon, & Amabile, 1996; Ruscio, Whitney, & Amabile, 1998)

Others identify the processes necessary for creative outcomes. The theory of creative cognition (Finke, Ward & Smith, 1992) proposes two central cognitive processes that contribute to creativity : (1) generative processes in which an idea is initially created and (2) exploratory processes in which this idea is examined interpreted and evaluated in different ways. Each involves a range of component processes (Sternberg, 1999). Some investigators have noted the need to separate the different domains of creative performance (see Baer, 1998; Plucker, 1998; Runco, 1987).

For creative outcomes, these cognitive processes interact with personality and motivational variables to lead to a high level of inner directedness and ego strength, a strong sense of autonomy and non-conformity, a flexibility in thinking and a tolerance of ambiguity, a self initiated drive for closure, a capacity to balance and to integrate reality and fantasy and a high level of intuitive thinking (Csikszentmihaly

i, 1985; Eysenck, 1997); "After a certain point, levels of ability play a less important role than personality and motivational factors." (Winner, 1996, p. 283).

These models lead to a set of inferences about the instructional conditions most likely to lead to creativity. Most models of creativity identify the following conditions for fostering creativity: creative thinkers need

- (1) access to a body of knowledge that is relevant to the creative outcome. This knowledge needs to be sufficiently extensive (that is, have sufficient breadth) for the topic of the creativity, elaborated and differentiated, properly indexed and to be seen as expert (Simon, 2001).
- (2) access to a set of thinking skills that allow the generation of creative outcomes. There are two aspects to these thinking skills: (1) thinking in particular ways and (2) knowing the value of thinking in these ways, using the ways of thinking selectively. Metacognition is a central aspect of creativity (Davidson & Sternberg, 1998; Jausovec, 1994). It is a key aspect of planning (Feldhusen, 1995). Sternberg (2000) attributes creativity not to what one knows but how individuals decide how to use what they know. This view differs from the traditional notion of creativity as a fixed ability (Guilford, 1968; Sternberg, 1999).
- (3) the motivation to be creative (Amabile, 1996; Cropley & Cropley, 2000). This can have both intrinsic and extrinsic aspects.
- (4) positive attitudes to creativity; helping engineering undergraduates' awareness of the attitudes most likely to lead to creative breakthroughs in engineering (for example, the need for courage and tolerance of unusual or unexpected ideas) increases the likelihood of creative outcomes (Cropley & Cropley, 2000).

An additional condition, that interacts with these conditions, is an individual's preparedness to engage spontaneously these areas of knowledge in a systematic, co-ordinated way. It can be inferred that creativity is more likely when one has a positive belief in one's ability to be creative, that is, a positive 'self efficacy about creativity'.

Self efficacy beliefs influence a range of factors associated with learning: goal setting, problem solving and academic performance across a range of domains (Locke & Latham, 1990; Malpass & O'Neil, 1996; Pajares, 1996). Their influence is via the use of effective self-regulatory strategies, a motivation to achieve, effort, persistence, and perseverance (Bouffard, Bouchard, Parent, & Larivee, 1991; Zimmerman, Bandura & Martinez-Pons, 1992). Students who believe they are capable of performing academic tasks use more cognitive and metacognitive strategies and persist longer than those who do not (see Pintrich & Garcia, 1991). Improving self-efficacy might lead to increased use of cognitive strategies and thereby higher performance, and that "students need to have both the 'will' and the 'skill' to be successful in classrooms" (Pintrich and De Groot, 1990, p. 38). Self-efficacy is a powerful motivation construct that predicts academic self-beliefs and performance and works best when theoretical guidelines and procedures regarding specificity and correspondence are met (Pajares, 1996).

This review of self efficacy suggests that it is reasonable to propose a 'self efficacy about creativity'. It might be inferred that creativity is more likely when one has a positive belief in one's ability to be creative, that is, a positive self efficacy. A more positive self efficacy would be characterised by the spontaneous display of behaviours that suggest a self confidence in one's ability to be creative. A less positive self efficacy, on the other hand, would be characterised by a greater dependence on others during creativity tasks and a reduced preparedness to take risks or to manage one's creativity processes spontaneously. It suggests that it is insufficient to teach higher order thinking skills to foster creativity. Teaching that fosters beliefs about creativity, one's self-image as a creator and innovator and one's attitudes to creativity is also necessary.

Self-efficacy has been assessed in a range of ways. One of the most effective procedures assesses particularized self-perceptions of competence that are highly consistent with the criterial task being assessed.

sed. This can be done in two ways : (1) by asking students to provide judgments of confidence to complete particular tasks (Konstantopolous, 1996) and (2) by monitoring students' spontaneous use of a range of thinking behaviours that indicate a positive belief in one's capacity to be creative or an expectation, when approach task contexts, that they will be creative.

The focus of the present study is on the processes that secondary students use to produce creative outcomes and the extent to which these implicate 'self efficacy about creativity' processes. To minimise the constraints on their thinking, it was decided that the domain for creativity would be chosen by each student. To reduce the extent to which creativity was restricted by technical and manual skills, it was decided that the creative outcomes would be displayed in writing.

The task format used to study creativity was the Extended Essay in the International Baccalaureate. This task allows students to display creativity in a topic area of their choice, in most subject areas in a written report or essay. The level of creativity displayed is scored in terms of a 'holistic' judgment that assesses qualities such as 'intellectual initiative', 'depth of understanding', 'insight' and 'inventiveness'. Of the total score allocated to the essay, 8 per cent is available for this component.

Creative thinking can be displayed in various ways in the Extended Essay : in (1) the development of a novel research question, (2) the 'far transfer' of an established concept, (3) creative operations or processes and (4) the re-prioritisation of ideas. The investigation monitored the thinking processes of thirty seven Year 12 students completing the essay.

The aim of the present study was to investigate the gradual emergence of creative aspects and the processes that lead to them and to infer aspects of 'self efficacy about creativity' processes. Unlike earlier studies that have examined the factors that predict creativity, it studied the thinking and learning activity from a dynamic perspective by asking students to recount their thinking, use of knowledge, beliefs and decisions as they worked through the research task in a clinical interview context. The written essay does not necessarily show these processes.

Method

Design : The investigation used a qualitative case study design.

Participants : The participants were 17 Year 12 students who had completed their Extended Essays and who had been interviewed individually about the sequence of activities that they implemented to complete their essay. Of the group, thirteen had been awarded a holistic score (a measure of the creativity of the essay) by the examiners of the Extended Essays) in the high range (that is, 3-4) and ten had been awarded holistic scores in the low range (that is, 0-1).

Procedure : The students were interviewed individually about the sequence of activities that they implemented to complete their essay. As well, they were cued, through directed questioning, to address aspects not mentioned in their spontaneous re-telling. The aspects targeted include

- the means which they chose the subject or topic area of their essay.
- the means by which they decided the specific question or issue they examined, the path they followed (whether they had earlier selected and then rejected other questions, the investment they made in information sources prior to this decision, the extent to which the development of the question was their choice rather than others'.
- the steps they took to collate information / evidence to evaluate their question / issue.
- the types and extent of support they received from supervisors, teachers and peers.

Each case study was examined in terms of the extent to which the student

- framed up the enquiry or challenge independently of others.
- created spontaneously a plan of action, monitored and revised it as task demands changed.
- operated as an expert learner of the topic, thought strategically about the domain, experimented with and modified this knowledge, trialed questions, searched in new directions, entertained several possibilities, evaluated each in turn.

- reported the flash of insight; the linking of two previously unlinked ideas.
- engaged spontaneously in 'possibilistic thinking' at the time of creativity, used thinking that was intuitive rather than guided by an intact theory of the phenomenon.
- reported an element of surprise at the point of creativity.
- identified spontaneously aspects that 'did not fit' or match what was expected or that violated reasonable expectations.
- synthesised ideas gradually into a picture or theory; integrated observations and feedback into possibilities, interpreted, analyzed and questioned.
- built actively on the creativity of those who have gone before.
- displayed spontaneously far transfer, used metaphor or analogy to transfer ideas from one domain to another, analogistic thinking.
- re-organised, re-prioritised knowledge of the topic.
- examined ideas from different perspectives to examine the extent to which the possibility may be supported by / consistent or 'fits with' the existing information.
- displayed a self directed pursuit of issue, intrinsic motivation.
- accessed independently relevant information and data sources to assist in refining, clarifying the question.

The extent to which each of the criteria above was displayed in each case study was evaluated using a Likert scale that ranged from 'not at all' (rated 1) to 'at a high level' (rated 5). A rating of 2 indicated that the criterion was achieved with a high level of assistance from others, a rating of 3 that the criterion was achieved with some assistance from others and a rating of 4 that it was achieved with little external assistance.

Results

The mean ratings of the ten high creativity scorers and seven low creativity scorers on each of the criteria were compared using the 1-tailed t-test. These data show that the students rated as achieving a high creativity score were more likely to display spontaneity in a range of areas ($p < .05$) on the following criteria: to (1) frame up the enquiry or challenge independently of others, (2) create spontaneously a plan of action, monitor and revise it as task demands changed, (3) re-organise, re-prioritise their knowledge of the topic, trial, question and evaluate possibilities and modify it, (4) report the flash of insight; linking previously unlinked ideas, (5) display far transfer, use metaphor or analogy to transfer ideas from one domain to another, analogistic thinking, (6) report an element of surprise at the point of creativity (6) engage spontaneously in 'possibilistic thinking', used thinking that was intuitive rather than guided by an intact theory of the phenomenon and (7) examine a possibility from different perspectives to examine the extent to which it was supported by existing information. are asterisked.

The range of ways in which students displayed these characteristics is shown in the following abbreviated case studies. The score of the creativity component of each essay (the holistic score) is shown in parenthesis.

Brooke (holistic score of 3). Brooke created the possibility that the motility of horse sperm during transportation was influenced by particular anti oxidants. This enquiry had its source in a family business, an aspect of which involved the transfer of horse sperm. It was important that the sperm be kept alive during transportation.

Brooke spent time with the scientists working in the company's laboratory. This indicated that they believed that transport factors and temperature killed the sperm. Reflecting on what she knew about the topic, she recalled a vague reference she had read to the preservation of live ram's sperm by the use of anti oxidants. She made an analogy to horse sperm.

She began to access data sources re this topic and found that some anti oxidants kill sperm. She reali

sed she needed to identify anti oxidants that might be safe, effective in prolonging the life of the sperm and comparatively inexpensive, because she would need to use them in an investigation. During this time she chose not to talk with the scientists in her father's laboratory.

Based on her reading she selected two that she thought might work. She ran the research using established experimental procedures. Her supervisor assisted her with various procedures, for example, how to measure percentages of sperm. She identified an anti oxidant that kept sperm alive.

Jeremy (holistic score of 3). Jeremy researched the topic that the nuclear volume of a cell is proportional to the degree of evolution of the organism. He did not create this topic but developed it from two sources (1) an earlier essay that looked at the amount of DNA in cell and its degree of evolution and (2) a referral from his supervisor to a colleague who was researching this.

His earlier study of biology had led to an interest in DNA and genetic engineering. With his topic he did a literature research and planned an experiment. He trialed 5 methods. He was motivated by what he discovered as he did it, new methods, problems, solutions, new ideas.

He did not record any flashes of insight and reported applying the classical 'scientific method'. All of the methods he tried seemed logical at the time and it was simply identifying the indicators that would help them see the nucleus. He selected one by rigorous testing.

Toby (holistic score of 3). Toby created the contention that our society is being forced by multiculturalism to be increasing deterministic and this is likely to lead to future moral problems.

The topic evolved gradually. His curiosity was stimulated by encountering determinism in his philosophy subject and decided to explore it further. He investigated a combination of concepts including determinism to see how they influence thinkers and philosophy. His research at this point was driven by questions he had about determinism. He drew flow diagrams to organise his concepts /ideas and used these as a prior organiser to link and compress later information.

He developed an interpretation of determinism as a scientific philosophy, applied it to our culture and perceived it becoming increasing deterministic, more accepting of cause and effect. From this he developed the possibility that determinism may lead to morality deficiency. He saw this link as a 'brain wave'. In his own words, " it wasn't something I had learnt in class but intuitive". In hindsight, he had been interested in morality in science before he began to study determinism.

He then explored the intuitive, 'possibilistic' link rationally, particularly by contrasting deterministic free will with a religious perspective and linked the trend to becoming more deterministic with increasing multiculturalism. He looked for evidence that in cultures that were becoming more multicultural, become less culturally biased and laws evolved to cater for more cultural variation, leading to the society becoming more representative of the people who live there.

In dealing with the possibilistic link, Toby invested effort in prioritising and organising the information. He tried to 'find the right point to enter the idea'. His thinking about determinism needed to be cyclic and he 'needed to throw himself completely into a deterministic view point to see the relevance of it. To work in a linear or bit by bit way is not useful at this point.

James (holistic score of 1). James created the topic : If Hitler had died in 1939, he would have been seen as Germany's Saviour. This possibility grew from his interest in European history during 1920 - 45 and in Hitler's domestic and foreign policies. His original topic was too broad and his supervisor helped him refine it.

He accessed historical information but found it hard to have a consistent point of view and to organise his knowledge of history as there were multiple possible points of view . His supervisor taught him to structure the information into traditionalist versus revisionist approaches and then into domestic, economic, foreign policies. This helped him categorise the information and organise his argument.

His creativity was in how he put the information together. He had a 'flash of insight' when he suddenly saw the ideas in a different way; In his own words "something clicked; I saw that there was a contra argument against each idea I had".

Michael (a holistic score of 1). Michael developed a critical analysis of alternative treatments for obsessive compulsive disorders (OCD). This analysis grew out of his interest in psychology in earlier studies. He judged that the question didn't require much refining.

He accessed information widely, particularly the most recent research. He was not sure precisely what to look for re information initially. He used this to plan and implement a research project that examined aspects of unconscious learning and OCD behaviours.

Discussion

Not unexpectedly, the analysis of the case studies indicated that students displayed creativity in a range of ways. Those who received a higher creativity rating

(1)

were more likely to frame up their own challenge or enquiry rather than adopting a prescribed challenge by someone else. As in the case of Brooke, the challenge could develop from discussion with others or from strategic reading, in the case of Toby. The more creative producers showed they could independently modify their initial question and took steps to evaluate it in terms of its potential to lead to creative outcomes. They were more aware of the notion that an idea could 'possibly be creative' and were more able to evaluate the idea in terms of its potential. James was aware that his original topic was too broad but had difficulty refining it without help. Michael judged his first attempt at framing up a question to be sufficiently likely to lead to creative outcomes, although with hindsight it was too broad.

(2)

were more likely to take responsibility for developing a plan of action. Some of the students didn't write explicitly an action plan but had clear 'mental pathways' for self direction. Their plans of action differed from those of the less creative producers in an 'implementation' sense; the action plans were

(1)

more flexible their capacity to change direction and had a 'self-monitoring' component that allowed the students to decide when to modify the direction of their activity. Their behaviour suggests that they built in 'indicators of progress' and used these in implementing their plans. Their action plans had 'tiers' or levels; their plans had an overall action plan as well as several 'sub - plans', some of which operated simultaneously. Their less creative peers, in the other hand, had more single-tier plans that were more 'set in concrete'.

(2)

'blue prints for thinking'; the plans included reference to how they would use their thinking and learning resources, whereas the less creative producers were more likely to perceive their action plans in terms of the sources of information they accessed and the components of the essay they completed.

(3)

not as linear or 'uni-directional' as those of their less creative peers; their plans often involved them moving in two or more directions at once and taking steps to co-ordinate the activity across the strands of action.

(3)

differed in how they manipulated and used what they knew about the topic. The more creative producers

(1)

worked on the assumption that the topic knowledge was not 'absolute' and was 'available to be questioned'.

(2)

actively worked on their knowledge, re-categorising and prioritising it. Toby, for example, ref

erred to drawing flow diagrams to organise his concepts /ideas and to compress later information. James, on the other hand, was aware of difficulties he had imposing his own consistent point of view on the information he collected and needed considerable help from his supervisor in structuring it.

(3)

examined the ideas from a range of perspectives and 'dry-ran' possibilities mentally. The extent to which the learners engaged in possibilistic reflection discriminated between the more and less creative producers.

(4)

actively searched for and accessed independently relevant information sources to help them to refine and clarify their question. They set their own agendas, often in parallel with what their supervisor suggested. They knew what to look for at any time.

(5) were conscious of building on the creativity of earlier investigators.

(4)

were more likely to report the flash of insight, the linking of two previously unlinked ideas, and recalled this as a memorable event. Toby, for example, recalled linking the concepts of determinism and morality as an intuition. Some students display far transfer and use analogistic thinking to transfer ideas from one domain to another. Brooke made an analogy between the preservation of ram and horse sperm. These processes lead to 'possibilistic thinking'. Toby investigated the possibility that increasingly more deterministic cultures showed greater moral decline. Michael, on the other hand, did not recall either the linking of previously unrelated ideas or possibilistic thinking. He did not recall instances of analogistic thinking. Instead, he reported a straight forward procedure of applying the scientific method. While his Extended Essay achieved a pass score, its creativity rating was low.

(5)

were more likely to display a self directed pursuit of the chosen issue, that is, a high level of intrinsic motivation. They were not deterred by dead ends that they saw as temporary; they knew they could exercise other options, that they would be able to implement other pathways. They had self confidence or self efficacy in their ability to be creative.

These case studies indicate that the students displaying higher levels of creativity in completing their Extended Essays also displayed a higher disposition to being creative. They were more prepared to shape their own challenges, to subjectively organise and work on what they knew and the information available, to develop and regulate their action plans, to seek new possibilities for links between ideas and were not deterred by directions that did not deliver immediate outcomes. Their activity suggests a higher belief in their ability to be successful as creators or innovators.

Creativity in the final analysis is personal. An outcome that is creative for one student may be well known to others. Students can display creativity in their thinking that does not map into a creative outcome. James' creativity was in how he linked historical knowledge. He had a 'flash of insight' when he suddenly realised that there was a contra argument against each idea he had. His written essay did not reflect this awareness.

This analysis has implications for developing teaching that fosters creativity. It shows that it is not it is not sufficient to teach students 'higher order' or 'creative' thinking strategies and skills. Students as well need to learn both a positive self efficacy for creativity and the metacognitive scripts that go with this. Without this, they will be less prepared to use the higher order thinking skills they are taught. As well, they will be less able to integrate the skills with their metacognitive knowledge.

Students need to 'allow themselves' to be creative. This includes

(1)

knowing that it is acceptable to question information, even when it is presented as absolute and certain, aware that ideas that may change in the future knowing both that they are permitted to and how to identify unanswered questions in the area of study,

- (2) knowing that they can impose their own interpretation and structure on the knowledge.
- (3) being aware of the thinking strategies that are more likely to deliver creative outcomes, identifying possible outcomes, possible procedures that they could have used given alternative conditions (additional knowledge, resources)
- (4) knowing how to be intrinsically motivated to achieve creative outcomes.

Future studies may examine in depth student knowledge about how to be creative, their beliefs and their ability to be creative. They may also examine the extent to which their self efficacy knowledge is domain specific.

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