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What Do We Know About Creativity?

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Abstract

Creativity has been defined in many different ways by different authors. This article explores these different definitions of creativity; the relationship between creativity and intelligence, and those factors which affect creativity, such as convergent and divergent thinking. In addition, the article explores the importance of computer technology for testing ideas and the importance of reflective thinking and the evaluation of thoughts. It concludes with a synthesis of the basic attributes of highly creative students and present some ideas of what scholars have said about strategies we can use to enhance creativity in students. Although originality and creative imagination are private, guidance and training can substantially increase the learner's output.

Keywords: Creativity, intelligence, convergent thinking, divergent thinking, reflective thinking.

David Bohm's opening words in his book *On Creativity* were "Creativity is, in my view, something that is impossible to define in words" (Bohm, 1998, p. 1). Reid and Petocz (2004) mention that creativity is viewed in different ways in different disciplines: in education it is called "innovation"; in business "entrepreneurship"; in mathematics it is sometimes equated with "problem-solving", and in music it is "performance or composition". A creative product in different domains is measured against the norms of that domain, its own rules, approaches and conceptions of creativity (Reid & Petocz, 2004, p. 45). The World Conference on Higher Education proclaimed creativity as "an innovative educational approach" in Article 9 of their statement of Missions and Functions in Higher Education (Reid & Petocz, 2004, p. 51).

Cannatella (2004) mentions that the need for creativity is biologically, physically, and psychologically an essential part of human nature, and that it is necessary for human reproduction, growth and cultural striving (p. 59). Clarkson (2005) has mentioned that there are many traits which have been associated with creativity, such as divergent thinking, introversion, self-esteem, tolerance for ambiguity, willingness to take risks, behavioral flexibility, emotional variability, ability to absorb imagery, and even the tendency to neurosis and psychosis (p. 6).

In this paper, I will attempt to make an exhaustive review of the literature as it pertains to different kinds of creativity, the relationship between creativity and intelligence, factors

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which affect creativity, such as convergent and divergent thinking, environmental factors, access to manipulative tools for testing ideas such as computer technology, and the importance of reflective thinking and evaluation of thoughts. I will conclude with a synthesis of the basic attributes of highly creative students and present some ideas of what scholars have said about strategies we can use to enhance creativity in students.

Different kinds of creativity

The literature on creativity is sparse, but it is becoming apparent that there may be several kinds of creativity. Donald N. MacKinnon (2005) has outlined three different kinds of creativity used as a basis for research at the Institute of Personality Assessment and Research Laboratory (IPAR), Berkeley, California. The first is artistic creativity, which reflects the creator's inner needs, perceptions and motivations. The second type is scientific and technological creativity, which deals with some problem of the environment and results in novel solutions but exhibits little of the inventor's personality. The third type is hybrid creativity, found in such fields as architecture that exhibits both a novel problem solution and the personality of the creator (p. 290-295).

In studying creativity, the IPAR group, along with most other research groups that have investigated this process, have assumed that all kinds of creativity share common characteristics, and these assumptions seem to be true. It appears that most creative persons are relatively uninterested in small details or facts for their own sake; that they are more concerned with meaning and implications. Creative people have considerable cognitive flexibility, communicate easily, are intellectually curious, and tend to let their impulses flow freely (MacKinnon, 2005, p. 308-309).

Relationship between creativity and intelligence

For many years, it was assumed that creativity and intelligence were closely related. The incidence of highly creative individuals, such as Edison, Churchill and Einstein, who at some time experienced difficulty in school, led to a closer examination of the issue sometime during the 1960s. One of the most widely publicized studies was done by Getzels and Jackson (1992), who produced evidence that creativity and intelligence were largely independent traits (p. 24). On the other hand, just a few years later Hasan and Butcher(1996) found creativity and intelligence so highly correlated that they were almost indistinguishable (p. 10).

Since the late 1960s, these and other conflicting studies have made the issue of creativity and intelligence a controversial one. Perhaps the most prevailing view today is that beyond a minimum level of intelligence necessary for mastery in a given field, additional intelligence offers no guarantee of a corresponding increase in creativity. The idea that the more intelligent individual is necessarily the most creative person is fallacious. According to Reeves & Clark, all available tests of creativity suggest there is merely a relationship between intelligence and creativity. In no way do they suggest that one causes or necessarily contributes to the other. Most IQ tests measure convergent thinking almost exclusively. In essence, such tests require the student to apply what he or she has learned

to new problems or to abstract some rule from previously developed examples. Usually, there is only one correct answer, and correctness is determined on the basis of logic, rules, or laws. However, even the best known creativity tests are somewhat invalid because of the subjective nature of the elements they measure and the lack of any predetermined right answer (Reeves & Clark, 2000, p. 118).

Factors that affect creativity

Convergent and divergent thinking

There are at least two different ways of thinking: (a) convergent thinking, which emphasizes reproduction of existing data and adaptation of old responses to new situations in a more or less logical manner; and (b) divergent thinking, characterized by flexibility and originality in the production of new ideas. Convergent thinking is characterized by the reproduction of known concepts and the adoption of known responses to new situations. Divergent thinking, on the other hand, involves fluency, flexibility, and originality, and is essentially concerned with production of large numbers of new ideas (Copley, 1998, p. 212). Both convergent and divergent thinking are essential to the problem-solving experience, but when students are developing possible solutions to a problem, evaluation of each solution as it is presented tends to inhibit the flow of ideas.

An idea is creative when it brings a new insight to a given situation. The process of creativity includes the ability to change one's approach to a problem, to produce ideas that are both relevant and unusual, to see beyond the immediate situation, and to redefine the problem or some aspect of it (Kneller, 2005, p. 77). All individuals are to some extent creative, although some are much more creative than others are. While a small part of this difference may be due to heredity, a large part likely results from the failure of individuals to express their creative potential. In fact, many essential attributes of creativity are discouraged in the typical college classroom.

In addition, there is the myth that to the truly creative and talented, their skill comes naturally, and the creative works they produce come with ease. However, the evidence shows that the creative experience only comes after considerable effort and time has been put into the project (Samuels, 2004, p. 111).

The creative act often occurs suddenly and is short lived. It originates in the right side of the brain (Left Brain/Left Brain Studies, 2005, p. 2). This moment of insight usually occurs after a prolonged period of searching, sometimes comprising months or even years of observation and search (Parnes & Harding, 2001, p. 98). It seldom follows a period of intensive reflection; often it occurs much later, when least unexpected. The educational principles that support creative learning are that students need to be supported as they determine the problems to be solved and that they need to be given enough latitude to reach a conclusion (or product) that enables them to make interesting and innovative connections (Reid & Petocz, 2004, p. 52).

Environmental factors

It also has been known for a long time that in order to exercise creativity students need a responsive environment. Torrance defines the term as "one which involves absorbed listening, fighting off criticism and ridicule, stirring the unresponsive and deepening the superficial; one which requires that each honest effort to learn be met with enough reward to insure continued effort: the focus is on the potential rather than norms" (Torrance, 2005, p. 312).

Creative processes can be encouraged in all instructional activities. Creative teaching could be said to consist of setting up a learning environment that encourages students to see the essence as well as the detail of the subject, to formulate and solve problems, to see the connectedness and interrelations between diverse areas, to take in and react to new ideas, and to include the elements of surprise in their work (Reid & Petocz, 2004, p. 45).

Experts on creativity repeatedly stress the importance of discovering both problems and solutions. Original ideas should be actively sought. For example, a student assigned an oral report might be encouraged to add a personal evaluation and to employ any unique techniques that he or she wishes. Too often, correct thinking requiring one solution and one method has been emphasized. Alternative solutions to a problem need not have been previously suggested by others to be viable. Alternatives not found in textbooks should be solicited from students. Students should be forced to advance more than one alternative, and computer technology can help (Axelrod, 1997, p. 8).

For many years, educators also have viewed creative thinking as a process that could only be pursued on an individual basis. Recognizing the innate developmental quality of creativity, educators placed relatively little emphasis on furthering and enhancing creativity through group-teaching methods until Osborne and his associates developed the brainstorming technique for sales personnel in the 1950s and early 1960s. Today's widely known Synetics Education Systems Laboratory of Cambridge, Massachusetts is devoted exclusively to techniques for class use. Like all attributes of learning, creativity can be developed through carefully selected class experiences; although like other approaches to problem solving, much individualized instruction is also needed.

Creative problem solving in carefully organized group situations is not only effective, but probably also an economical use of time. Although the processes of creativity are individualistic in nature, they are often imitated and developed in-group settings, as when teachers use the technique of brainstorming. In many cases, creativity is not fully exploited because the teacher is not aware of the factors that tend to block the creative process. In addition, although people tend to express admiration and high regard for creativity and those who exhibit it, students who exhibit creativity in the classroom are often regarded as nonconformist by their teachers (Tuckman, 2001, p. 78). Thomas A. Edison, one of the world's greatest inventors, was declared mentally "deficient" by one of his early teachers. Almost immediately after, his mother withdrew him from school and

taught him herself. Edison contributed numerous inventions even after he was eighty-years old (Copley, 1998, p. 214).

However, group activities, although helpful, should be used with care. Hillmann (2006) mentioned that misuse or an over-emphasis on cooperative learning could contribute to degeneration of individual creation, imagination, and production; and that this could weaken intrinsic motivation, hinder the development of problem-solving and decision-making capabilities, and inhibit personal freedom to be creative (p. 5).

Access to manipulative tools for the test of ideas (Computer Technology)

Some authors have mentioned that the technology explosion is already enhancing creativity without educators doing anything. Clements & Sarama (2003) wrote that whether used to read or write, to acquire knowledge and insight into science, mathematics and other areas; to express oneself; or to learn content in a new medium, computers can support the expression and development of creativity (p. 35).

Research and various studies have shown that using multimedia in the classroom increases creativity, innovation, problem-solving and improves communication between people (Hollenbeck & Hollenbeck, 2006, p. 1). Multimedia software appeals to all senses and stimulates high interest, appealing to students and teachers (Marsh II, 2002, p. 6).

Computer technology, and especially the World Wide Web, has revolutionized speed and access to information and aided in problem solving (Marsh II, 2003, p. 4). Marsh II mentions a popular computer program called Oregon Trail, which creates problems for students to solve in a hypothetical wagon trip in 1850. Schell (2004) mentions the existence of LSP, a computer program available in both PC and Mac versions, which allows students to determine their particular learning style and provides recommendations about the best ways to take advantage of this style in both educational and social situations (p. 14). Marsh II (2001) also mentions the futuristic view that in the future every college student will have a database of knowledge and information available through attachments to his or her body, and maybe even a personal intelligent agent that advises, consults, and tutors (p. 26).

Reflective thinking and evaluation of thoughts

Reflective thinking and evaluation of thoughts is basic to the process of creativity. In general, ideas are evaluated for the purpose of facilitating the problem-solving process at every step. However, continuous evaluation limits the generation of ideas. A suspension of judgment enables one to further examine seemingly wild or impossible ideas. Wrong ideas may be right in the final analysis. Emphasis shifts from the validity of a particular point to its usefulness in producing new arrangements or patterns. Withholding judgment enables an idea to survive long enough to generate other ideas and encourages those who may have useful input, but are afraid to state their viewpoints for fear of being wrong. This technique can be used in a variety of ways in the classroom. For example, a quota on the number of hypotheses for the potential causes of a problem can be established and

judgment on each suggestion withheld until the quota has been met (University of Maryland University College, 2000, p. 17).

Basic attributes of highly creative students

Creative students show certain characteristics that make them "stand out" from their peers, and these characteristics can be enhanced through computer technology and hypermedia, especially the ability to use graphics more than text to convey meaning and provide links (Marsh II, 2002, p. 25). Among these characteristics are:

Originality. This is the ability to produce unusual ideas, to solve problems in unusual ways, and to use things or situations in an unusual manner. Sometimes, originality is viewed. as uncommonness of response, the ability to make remote or indirect connections. Creative students, being skeptical of conventional ideas, are willing to take the intellectual risks associated with creative discovery. However, it is unlikely that originality alone will provide sufficient creativity, because it also needs to be combined with other factors, such as a strong cultural presence, an intellectual mind, sensitivity toward form, the involvement of rational trains of thought, the acquisition of certain occupational skills such as writing, engineering, architecture, painting or music, and even the temperament to experience emotional and phenomenological wonder (Cannatella, 2004, p. 61).

Persistence. Creative students are usually persistent individuals who are willing, if necessary, to devote long hours to a given task and to work under adverse conditions. Above all, creative people are willing to face failure. Frustrations seem to motivate them to increased effort (McKinnon, 2005, p. 309).

Independence. Creative students are independent thinkers, who look for the unusual, the unexplored. Such people notice things that other people do not, such as colors, textures, and personal reactions. Frequently, these people explore ideas for their own sake to see where they may lead. Unlike the nonconformists who flout convention because they feel a compulsion to be different, independent thinkers maintain a balance between conformity and nonconformity. Unlike conformists, creative persons are open to experience and confident in the worth of their ideas. However, they are often their own most severe critics (Samuels, 2004, p. 112). Rockman has reported that students independently using laptops spend more time with computers, spend substantial amounts of out-of-school time completing schoolwork on their notebook computers, and improve their research and analysis skills (McKinnon, 1995, p. 310).

Involvement and Detachment. Once a problem has been identified, creative students become immersed in it, first researching how others have tried to solve it, and becoming acquainted with its difficulties and complexities. Thus, involvement sets the stage for their own creations. Creative students soon become detached enough to see the problem in its total perspective. By setting work aside temporarily, creative persons give ideas the freedom to develop (Schell, 2004, p. 14).

Deferment and Immediacy. Creative students resist the tendency to judge too soon. They do not accept the first solution, but wait to see if a better one comes along. This tendency to defer judgment seems to be an attribute of an open-minded person, one who is unwilling to reach a decision prematurely (Hillman, 2006, p. 5).

Incubation. By putting the problem aside temporarily, creative students allow the unconscious mind to take over, make various associations and connections that the conscious mind is unable to do. The incubation may be long or short, but it must be utilized. Sleep or almost any change of activity helps to encourage illumination. This period of purposeful relaxation permits the mind to run free (Reeves & Clark, 2000, p. 118). After a long period of frustrated effort, creative students may sometimes suddenly solve a problem. This sudden flash of insight is the fruit of unconscious inner tensions. It may be that the powers of association are enhanced when the mind runs freely on its own. The flash usually occurs after a period of incubation, when individuals are not actively pursuing the problem. A Japanese inventor says that his most creative ideas come when he forces himself to dive in his swimming pool until his lungs run out of oxygen (Reeves & Clark, 2000, p. 117).

Verification. Although illumination provides the necessary impetus and direction for solving a problem, the solution must be verified through conventional objective procedures. Sound judgment must complete the work that imagination has set in progress. Activating the imagination puts the intellect in touch with deeper levels of the psyche and arouses positive feelings of well being (Clarkson, 2005, p. 2). A flash of insight may be partially if not totally unreliable and merely serve as a catalyst for liberating the creator from a restricted approach to the problem. Sometimes, one flash of inspiration will precipitate others.

Discovers problems. Until recently, most studies of creativity focused on the problem-solving aspect of creative behavior. It is clear that the divergent thinker solves problems differently from the convergent thinker. The question of how the divergent thinker, or creative person, finds problems, however, has not been given much attention. Is the process essentially one of evolving a new solution to an old problem? Or is it more likely to be finding a new solution to a new problem, discovered by the creative person? On the basis of some three decades of research, Getzels & Csikszentmihalyi (2001) believe that the way in which a person discovers problems is the essence of the creative process (p. 67). They have identified three problem situations in which the learner is given both a problem and a method for solving it. The first situation is, for example, to find the area of a rectangle, which requires the subject to multiply side a by side b. The second is the situation in which the learner is given a problem, but not a method. For example, find the area of the rectangle. Here, the individual must engage in reasoning and analysis in order to solve the problem. The third situation is one in which the learner is given neither a problem nor a method for solving it. For example, how many important questions can you ask about a rectangle? Here, the problem solver must become a problem finder. Once each problem has been formulated, solutions must be sought.

Getzels and Csikszentmihalyi (2001) believe that many potentially creative learners prefer to work in problems they discover themselves. Others may be more comfortable in more structured situations. Certainly, problem finders, as well as creative students in general, have been sorely neglected in our educational institutions. Cannatella (2004) has expressed that problem solving, conceptual ability, aesthetic experience, intuition, observational analysis, imagination, and experimentation are among the indispensable guides that promote and enhance creative activity (p. 63).

Generates alternatives. One of the basic characteristics of creative thinking is finding different ways of viewing problems. In convergent or logical thinking, the process of searching for alternatives usually stops after a few approaches are suggested and one is selected as the final solution. All unreasonable or far-fetched approaches are summarily dismissed.

In creative thinking, one deliberately searches for as many alternatives as possible. A promising solution suggested early in the process is acknowledged and put aside for later reference. The generation of other alternatives continues. Unlikely, wild or very unreasonable possibilities are tentatively accepted without evaluation, which is done later. Basically, the objective is to delay a final decision by loosening up fixed patterns of thinking. Most problems can be solved in a variety of ways. While a logical approach may seem ideal, there is no guarantee that it is the best solution. A deliberate generation of alternatives enables one to consider other possibilities that appear unacceptable at first (Osborn, 2000, p. 133).

In addition to generating alternatives in-group problem-solving processes, individualized assignments for generating them can be developed in a variety of ways. According to deBono (1990), who studied creativity in elementary school children, geometric figures are ideal, since they can be developed in an unequivocal forms. The student is merely asked to generate different ways of describing a figure. As students find out what the generation of alternatives is all about, they move on to less artificial situations (p. 156).

Pictures provide another useful way of generating alternatives. Students are requested to describe what they think is happening in the picture. The different interpretations are then used to disclose alternative ways of seen things. According to deBono, there are different levels of description: what is shown, what is going on, what has happened, what is about to happen, etc. He suggests that the teacher leaves the assignment quite open at first, but later requires more specific descriptions.

Brief anecdotes also provide excellent sources for generating alternatives, especially when the anecdotes concern different people or animals (deBono, 1990, p. 160). The assignment becomes one of asking for a point of view from each of the parties concerned. Kimball (2000) illustrates with an example: A boy and his dog are watching a squirrel in a tree; in the background are a man and a woman; describe what is happening from the viewpoint of the boy, dog, squirrel, man, and woman (p. 11). Again, the variety of responses can be used to illustrate differences in perception. Sometimes, a favorable description of an event may be changed to an unfavorable description by merely altering the

emphasis given to the various facts, but not the facts themselves. While all those techniques apply more to elementary school children than college students, there may be ways in which the professor could adapt those findings to encourage creativity in other educational settings.

Challenges basic assumptions. In solving problems, one must begin with basic assumptions. These are any ideas, principle, or truth deemed self-evident. They provide the foundational structure for problem solving. Unfortunately, they also set boundaries for reducing problems to manageable proportions. If one or more basic assumptions are false, however, the resulting solution will also be false. Many assumptions are handed down by tradition. To challenge them may be considered unfair, sacrilegious, or downright stupid. Certain verifiable false assumptions have been held above suspicion for years. At one time, for example, the tomato was considered poisonous (Williams, 2001, p. 33). For years, scientists were thwarted in their attempts to learn about the human body because it was considered sacrilegious to examine cadavers (Scholl & Inglis, 2001, p. 313-314).

In a similar manner, the boundaries imposed on problem solving often lead to faulty conclusions. These boundaries, often self-imposed, are rarely challenged because they represent a natural structuring process of the human mind. If someone steps outside the boundaries and solves the problem, this person is considered to be operating unfairly. Yet the boundaries are arbitrarily imposed (Scholl & Inglis, 2001, p. 316).

In challenging basic assumptions, both the limits and validity of individual concepts should be questioned for the purpose of restructuring established patterns of thinking. This can lead to different and sometimes improved results.

Professors often discourage creativity by emphasizing the mistakes on written exercises. A better procedure would be to call attention to what was done well and then to point out sources of difficulty, leaving the student with the task of discovering the exact mistakes. The student can then rework certain assignments for credit (Eble, 1996, p. 8).

Minimizes labels or categories. By using labels, one risks misrepresenting information. It is convenient to function with relatively few categories, but this often results in polar thinking, one must be either right or wrong. Sometimes even those categories that at one point were rather functional tend to become outdated over time. However, the label remains permanent and contributes to rigid thinking. Hoover (2000) mentions that all young adults, for example, are aware of the restrictive influence of the term "son" or "daughter". It is appropriate to supervise young children closely; but when children get older, close supervision may even be harmful. Some parents fail to realize that the reality behind the fixed term is changing constantly as they grow. They may even seek to control a young person's behavior even after he or she has entered college (p. 113).

Despite the problems they present, labels or categories are necessary. They can be used effectively if qualified. For example, an individual may be "partly right" and "partly wrong", not for or against something but someplace in between (Davis, 1993, p. 88). One learns to use labels cautiously by engaging in experiences designed to challenge them, to

do without them, or to establish new ones. Teachers might ask students to pick out certain words in the newspaper that seem to generalize or categorize ideas and concepts. For example, students might examine how the words "justice", "equality", "disadvantaged youth", "women's liberation", and "patriotism" are used (Kozma, Belle, & Williams, 2000, p. 99). A class debate also provides an excellent opportunity for examining how certain labels can be used to influence listeners. Technology expands the horizons of the students, and is now an indispensable tool in society, which allows students to engage in real-world interactions with people by means of electronic mail, computer conferencing, video conferencing, and groupware. The computer may be more useful in serving as a basis for solving real-world problems than the passive lectures many of us have been accustomed to use in the past (Marsh II, 2000, p. 32).

Strategies for enhancing creative-thinking skills

Creativity can also be encouraged by establishing a class environment that accepts and reinforces new ideas. These ideas can be weighed on their own merits. It should be emphasized that most creative achievements seem revolutionary when first introduced (Berte, 1985, p. 22). Osborne (2000, p. 15) reminds us of some of them:

- When John Kay invented the flying shuttle, it was considered such a threat to labor that weavers mobbed him and destroyed the mold.
- When Charles Newbold worked out the idea of a cast-iron plow, the farmers rejected it on the grounds that iron polluted the soil and encouraged weeds.
- When Doctor Horace Wells used gas on patients while pulling teeth for the first time, the medical profession scorned his new ideas as humbug.
- When Samuel P. Langley built his first heavier-than-air machine flown by steam, the newspapers dubbed it "Langley's folly", and scoffed at the whole idea of self-propelled planes!

It has also been proposed that rather than present fact or theory, the instructor should place students in situations where they are forced to seek out the information for themselves (Lancaster, 2000, p. 8). Above all, creativity involves self-direction (Ericksen, 2004, p. 1). From time to time, students should be placed on their own to work on projects, to make their own mistakes, to toy with ideas, and to follow up hunches that may not seem promising at first. Students, in turn, will be encouraged to evaluate for themselves the fruits of such endeavors. Curiosity motivates one to analyze problems that others have taken for granted. By constantly probing with such questions as "What would happen if...?" curiosity can be enhanced (Entwistle & Hounsell, 2005, p. 2).

Perhaps, the greatest deterrent to creativity is the conventional college teacher (Milton, 2002, p. 6). Ideas tend to "pop up" at any moment, often catching the teacher by surprise (Crutchfield, 1993, p. 16). All too frequently, instructors may view this behavior as the student's impertinence or criticism of their teaching methods (LaFauci & Richter, 2000, p. 1). Actually, such a suggestion may merely reflect an individual's "brainstorming" an idea. Such brainstorming may be encouraged by permitting the individual (and the group that may be involved) to develop a plan for putting the idea to work.

Tremendous creative potential can be lost by inadequate planning. The typical college student tends to postpone term projects until the last minute. When he or she get started, it is necessary to rush through, perhaps borrowing heavily from established sources. Any ideas or insights that may emerge are quickly pushed aside to save time. Although there is no established pattern for activating the imagination, Osborn (2000) suggests a number of guidelines that many creative people have found to be effective, such as:

Make a start. Too often, a person defers action until the mood strikes, or until one can "find the time." There is no substitute for getting started. By setting up intermediate check points for term projects, for example, the professor can see that students make an early start.

Taking notes. Most really creative individuals carry a pencil and note pad with them at all times. Whenever they attend a lecture or meeting of any kind, they take notes.

Setting deadlines and quotas. In a sense, this is a form of self-discipline. Deadlines and quotas intensify emotional power, since we fear the failure of not meeting our goals. The pressure of deadlines tends to force one to become more efficient in carrying out daily routines that take time away from creative effort.

Fixing a time and place. We should take time for thinking up ideas. This activity should take precedence over our daily routines. By setting a time and place for such cognitive thought, one may "lure the muse." Some people allow ideas to incubate by napping, listening to soft music, or just sitting quietly in a dark corner. Of course, sudden illumination can come at any time, even in the middle of the night. Here again, a handy pencil and note pad ensures retention of an idea (Osborn, 2000, p. 123). The process, of course, can be helped with computers. A practical application with integrating technology in the classroom is the use of personal digital assistants or PDAs. These electronic devices when equipped with graphic organizers, electronic dictionaries and word processing programs can assist students in a multitude of learning tasks. The PDA can help the students take notes, record lab data and even produce short audio-visual files. These electronic helpers can provide learners with the ability to interact more effectively in class, acquire language skills and even improve their science learning (Hollenbeck & Hollenbeck, 2006, p. 6).

The instructor must assume responsibility for guiding learners into creativity. Too often, teachers concentrate on the less motivated student at the expense of the truly creative individual.

Although originality and creative imagination are private, individual virtues, guidance and training can substantially increase the learner's output, as in any other area of education.

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