CREATIVITY AND PROBLEM SOLVING: AN OVERVIEW

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OVERVIEW

Creativity is defined as the ability to create–to bring into existence. Using this broad dictionary definition, it would be difficult not to be creative. Activities such as crayon drawings in school and developing the theory of relativity are creative acts - something was brought into existence. There is, of course, a difference in the depth, quality, and usefulness of that which is brought into existence. The higher order of creativity is generally characterized as demonstrating uniqueness and relevance.

Creative genius has been recognized and respected throughout history. Prior to 1950, there was very little known about how a highly creative person differs from the less creative or whether the creative characteristics can be learned. At his inaugural address of the American Psychological Association in 1950, Dr. J.P. Guilford, of the University of Southern California, presented his hypothesis about the abilities involved in creativity resulting from three years of theoretical thinking and planning of research. Guilford's hypotheses are credited with the recent upsurge in the research of creativity.

Prior to Guilford's research, it was generally assumed that creativity and intelligence were directly linked, although there was considerable evidence that indicated the contrary. The following is a dramatic example of the contrary evidence.

An Austrian boy was so quiet and different in school that his classmates and teachers suspected he might be simple-minded. His elementary school headmaster assured his father that it made no difference what the lad chose as a profession because he would "never make a success of anything". He was expelled from high school on the grounds that his "presence in the class is disruptive and affects the other students". Somehow, despite this sorry academic record, he gained admission to a technical university, where he compiled a decent but not remarkable record; he was not invited to stay on and teach, as outstanding graduates were, but instead took a job as a technical expert (third class) in a patent office. Although he was liked by fellow workers he was not considered especially brilliant. Or sociable: he went home each evening to the poor, sparsely furnished rooms his low salary allowed and thought and scribbled. Yet, Albert Einstein's scribblings outlined one of the most momentous scientific breakthroughs of this century, the theory of relativity.[1]

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1. *Human Behavior*, Vol. 1, Time-Life Books, Inc., 1974

Recent research revealed that there is no correlation between intelligence and creativity: high intelligence does not necessarily indicate high creativity, nor does high creativity imply high intelligence. Where intelligence tends to increase throughout the years, creativity tends to decrease. One study[2] indicated that among 5-year-olds, 90 percent are highly creative. At the age of 7 years, only 10 percent are highly creative. After 7 years, this figure becomes constant at 2 percent and remains at this level throughout adulthood.

Increase of intelligence and the decrease in creativity are influenced by what we are taught and how we are taught in our formal and informal education. There is a tendency toward teaching those things that have one correct answer, and to be tested on our recall of answers through true-false, multiple choice, and completion type questions. All of us have been trapped, at one time or another, by seeing a set of conditions where a statement could be true while the taught answer is false. Eventually, we learn not to question the question but to furnish the answer that is expected. The inquisitive questions of the 5-year-old child soon disappear from our thought process and with it our creative capabilities. As the child struggles with the educating bureaucracy, he is taught early on, that to "pass" is more important than to "learn".

Dr. Guilford identified several traits that have significant correlation with creativity. His findings have been substantiated by many subsequent investigations. The identification of these traits led to investigating whether these traits could be taught and developed so as to increase the creativity of the individual. Research has demonstrated that creativity can be developed. Techniques have been designed to encourage the development of creative traits and methodologies have been designed to apply these traits toward problem solving.

Problem solving can be defined as:
an organized effort for developing unique and relevant solutions for opportunities or undesirable situations.

The types of problems that are addressed in problem solving are those that have a number of alternate solutions. These problems can be expressed as opportunities:

How to market our product to the third world countries ...

or they can be expressed as undesirable situations:

How to eliminate or minimize customer complaints.

Problem solving techniques are generally not applicable to single-answer problems such as analytical problems:

How many miles per gallon do I get in my car?

The techniques would be applicable in solving for alternate approaches in determining fuel consumption, but not in the computation of the data to derive the solution.

Problem solving is a creative endeavor since it is a search for unique (statistically infrequent) and relevant (satisfies a need) solutions. Should a common solution be selected, after searching for a unique solution, the quality of the problem solving effort is not necessarily diminished. The fact that creative solutions were searched for, but not found to be more desirable than conventional solutions, merely strengthens the credentials of the conventional solution. If common solutions are desired, then there is little or no need to problem solve. We would merely adopt prior solutions for the problem without attempting to improve the solution.

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2. Papanek, V.J., *Solving Problems Creatively - Management Views*, IX, U.S. Army Management School, Fort Belvoir, Va. (1964).

Uniqueness is achieved by expanding our perception of a problem and by allowing ourselves the freedom to think of solutions beyond the conventional - to engage in expanded or divergent thinking. Relevance is achieved by evaluating the applicability of an idea to solve a problem - to engage in narrowing or convergent thinking. This relationship is illustrated below:

CREATIVITY

UNIQUE	RELEVANT
↓	↓
DIVERGENT THINKING	CONVERGENT THINKING
↓	↓

APPLICATION OF CREATIVE TRAITS + APPLICATION OF LOGIC (ANALYSIS) = CREATIVITY

Divergent thinking requires the application of the creative traits identified by Dr. Guilford. The identified traits that promote and encourage divergent thinking in order to arrive at unique ideas are:

PROBLEM SENSITIVITY = AWARENESS OF PROBLEMS
FLUENCY = FREE FLOW OF IDEAS
FLEXIBILITY = DIVERSITY OF IDEAS
ORIGINALITY = NEW USES OR TRANSFORMATIONS

The monograph - *Creative Traits* - discusses these traits and how they can develop during daily activities. These are the traits that have been suppressed since early childhood. Convergent thinking requires logic and analysis and encompasses the type of education that we have primarily received in our formal and informal training. To become proficient in problem solving, it is necessary to reawaken the creative traits in which we were once highly proficient.

Recent research has added a new dimension to Dr. Guilford's findings. It is now known that we have two interconnecting brain halves, each of which function in completely different manners. The left brain is used for logical, linear thinking. The right brain is used for abstract, spacial, and relationship thinking. It is the right brain that needs reeducation. For most of us, our left brain, because it is better trained, tends to overwhelm the right brain and suppress the creative thoughts.

Through the development and strengthening of the creative traits, the right brain can become more functional without diminishing the capabilities of the left brain. Ideally, we want to take advantage of the capabilities of both halves by engaging the one we want when we want it.

In order to utilize the creative traits when we want in a manner that produces ideas for possible solutions, creative techniques have been developed and are discussed in the monograph, *Ideation Techniques*. Among the techniques covered are:

IDEATION TECHNIQUES

BRAINSTORMING	= Divergent Thinking and Deferred Judgement
CHECKLIST	= One-dimension Forcing Technique
MATRIX	= Two-dimension Forcing Technique
MORPHOLOGICAL	= Three-dimension Forcing Technique
SYNECTICS	= Making Strange Familiar; Making Familiar Strange

Refering to the definition of problem solving, it is an organized effort. It may appear contradictory to organize creativity when creativity is a departure from the conventional. Research of the procedures that known creative persons use in problem solving lead to the identification of their informally applied procedure. This procedure has been structured as a methodology for the purpose of developing these skills. As these skills are developed, a formal use of the methodology will be replaced by an informal use - even to the extent that the methodology may not be identifiable in the process. The methodology steps, which are covered under separate monographs are:

PROBLEM SOLVING METHODOLOGY

DIVERGENT THINKING	Problem Identification Fact Finding Ideation
CONVERGENT THINKING	Evaluation - Judgment & Selection Development & Implementation

By developing the creative traits, the ideation techniques and the problem solving methodology, the problem solver has the tools to resolve a variety of problems. As an example, the PERT-type problem concerns planning and scheduling of events; work simplification is directed toward developing better methods of performing an activity; the General Electric procedure is essentially *Value Engineering* where the problem is one of achieving the required functions at the lowest cost.

The problem solving methodology has been developed through extensive research. The following is a partial listing[3] of the methodology used for various problem solving approaches. The description of the steps vary slightly, but the content of the basic methodology is present in all approaches.

3. McPherson, J.H., *The People, The Problems, and The Problem Solving Methods*, The Journal of Creative Behavior, Vol. 2 No. 2

Various Problem-Solving Methods

Steps	I. *Walles*	II *Dewey*	III *Rossman*	IV *Guilford*	V *Alex Osborn (early)*	VI *Osborn, Parnes Creative Problem Solving*	VII *Work Simplification*	VIII *Morphological Analysis*	IX *Pert Program Evaluation Review Technique*	X *Synectics*	XI *General Electric*
1	Preparation (information)	Difficulty is felt	Need or difficulty is observed	A cyclic looping model that is difficult to present in a linear fashion	Orientation	Looking at "The Mess" to find problems	Select a job to improve	Problem statement	Define the objective	The general statement of the problem to be solved. (Problem as given) (P.A.G.)	Recognition
2	Incubation (unconscious mental work goes on)	Difficulty located and defined	Problem formulated		Preparation	Finding a "Fuzzy Problem"	Get the facts	Selection of independent variables of the problem	Develop a network	Analysis and discussion to make the strange problem familiar	Definition
3	Illumination (solution emerges)	Possible solutions are suggested	Available information surveyed		Analyses	Fact finding	Challenge details, list possibilities	Develop the subclassification for each independent variable	Gathering time estimate	Purge of immediate solutions	Search for methods
4	Verification (solution tested & evaluated)	Consequences are considered	Solutions formulated		Ideation	Problem finding	Develop better methods	Construct a matrix that provides a "cell" for each of the relationships between the subcategories	Development of critical path	New statement of the problem. (Problem as understood) (P.A.U.)	Evaluation of methods
5		A solution is selected	Solutions critically examined		Incubation	Idea finding	Install improvements	Search the combinations from the matrix for new directions	Analysis of problem areas	Use of evocative questions that force analogical answers (direct personal, symbolic)	Selection of method
6			New ideas formulated		Synthesis	Solution finding			Solution of problems	Play analogies develop to understand the implications	Preliminary solution or design
7			New ideas tested		Verification	Acceptance finding			Develop a new network	Application of this understanding to P.A.G. and P.A.U. to see if new viewpoint can be developed	Interpretation of results
										If new viewpoint exploit it. If no new viewpoint - repeat.	Detailed solution or design

In addition to the deliberate application of creativity in problem solving, an intuitive application is generally developed for day-to-day problems. As the proficiency is developed, the following creative behavior characteristics will become more pronounced. An inclination toward these characteristics, prior to problem solving training, will increase the probability of a highly developed proficiency.

Creative Behavior is Courageous Behavior

It takes "guts" to be creative. If you have a new idea, a really unique, original idea which no one has ever had before, you are a minority of one. Further, you must demonstrate to the world that your idea is a profitable idea.

Creative Behavior is Confident Behavior

You must operate on the premise that you have imagination. Nothing attempted, nothing gained. In fact, one creative principle is *Realize You Have Imagination*. Albert Einstein said, "Imagination is more important than knowledge."

Creative Behavior is Divergent Behavior

It seeks many answers. It is divergent in contrast to convergent "one answer" behavior. It is not merely two-valued, it is multi-valued as is scientific behavior. It does not assume things are hot or cold; it knows there are many degrees of temperature and that everything is relative.

Creative Behavior is Discriminative

Creative behavior uses all the senses to be aware of all elements in the environment and to discriminate between those elements. The creative person is also verbally discriminative, which accompanies his ability to be verbally manipulative.

Creative Behavior Contains Humorous Behavior

Surprise is actually the basis of all humor; the new, the unexpected, surprises us and we laugh. For this reason, we have always cartooned inventors as quaint characters. They surprise us with newness. Unfortunately, too often laughter is considered criticism. Especially do our curious children cringe when we laugh at their surprising questions. All too soon, they learn to avoid our laughter. With that learning comes conformity; stupid, uncreative conformity.

Creative Behavior is Questioning Behavior

It is exploratory; it probes and questions. Further, and more important, questioning behavior has a sense of timing. It senses when to ask questions which evoke divergent, many-answer behavior; when to ask fact-finding questions; and when to ask evaluative questions. It knows that there is a successful sequence of such questions and an unsuccessful sequence of such questions, and that there is even a time to be silent and allow people to think.

Creative Behavior Creates Creative Behavior

It can improve itself; it can invent new techniques, new sequences, new learning techniques to improve itself. Further, cooperative creative behavior can improve and optimize group creative behavior.

Creative Behavior is Persistent Behavior

We think very slowly. It took Galileo 34 years - from 1604 to 1638 - to become confident, as he wrote to his friends, that the velocity of a freely falling body is a function of time. Thomas Edison said, "It takes about seven years to convert the average man to the acceptance of a solved problem."

Creative Behavior is Instinctive Behavior

Creative behavior cannot be correlated with "intelligence", whatever that is. Average intelligence is necessary, but if we went by IQ tests alone, we would overlook 70% of our highly creative people. Charles Kettering said, "An inventor is simply a person who doesn't take his education too seriously."

Creative Behavior is Manipulative

A creative person physically manipulates things when studying them. He picks them up, feels them, turns them over, examines all sides closely, even smells and tastes them. A creative person is also verbally manipulative. His sense of expression permits him to combine, rearrange, reverse, magnify or minify words to satisfy his need.

Creative Behavior is Evaluative

Evaluation is a process of comparing or contrasting. When evaluating, the creative person understands the degree to which we actually compare "words" rather than "things" or "events" and, therefore, the need to have a close correlation between those words and things.

Creative Behavior is Emotional

Like scientific behavior, creative behavior contains both intellectual and emotional factors. One must have the "urge", the "desire", to create in order to create.

Creative Behavior is Learned Behavior

Although creative potential must first exist, a large part of creative behavior is learned behavior. Edison, as a baby, could not invent anything. He had to learn to invent. Something in his environment reinforced his persistent exploratory responses. Creative behavior can be deliberately developed, and creative behavior can be impressively improved.

Creative Behavior is Free Behavior

Its divergent - many-answer - approach gives us more choices. Having more choices is the essence of freedom. Incidentally, some people believe that cooperation negates the individual's freedom. Actually, because cooperation can generate many more choices, cooperation can generate more freedom.