ME450 Design and Creativity

Creativity

Creativity is *the ability to generate ideas*. The basic premise in the course is that *design is a creative process*. The goal in discussing creativity is to enhance our creative potential and thus provide a greater opportunity for creating original designs. The creative process is a subject of study in psychology and it remains a human activity that is difficult to analyze and controversial.

There is general agreement that creativity takes place in five stages.
The Five Stages of the Creative Process
>   1. Preparation
>   2. Concentrated Effort
>   3. Withdrawal
>   4. Insight
>   5. Follow-through.

In the preparation stage, all information about the problem is gathered and studied so that the problem is defined and understood as well as possible. This stage is followed by an intensive concentrated effort to reach a solution. As a solution is not being achieved, frustration may often be a characteristic of this stage. Because of frustration or a distraction, concentrated effort is abandoned and the third stage of withdrawal ensues. During this time, efforts to solve the problem at hand are discontinued and the mind is occupied by other matters. It is during that period that the fourth stage occurs (if it does!): an instant of creative insight that unexpectedly surfaces with a solution to the problem, usually triggered by some apparently unrelated stimulus. The final stage of follow-through deals with evaluating and testing the solution to verify that it is in fact a solution and to study the details for its implementation.

Conceptual Blockbusting

There are two assumptions we make regarding creativity:

1. Everybody can be creative.
2. Everybody has some *conceptual blocks* limiting creativity.

A conceptual block is a "mental wall" that blocks the problem-solver from correctly perceiving a problem or conceiving its solution. Although the primary cause of conceptual blocking is <u>mental inflexibility</u>, many specific kinds of blocks have been identified. Understanding the types of conceptual blocks we may have, allows us to break them and thus enhance our creative potential. Here is a list of common conceptual blocks; it is by no means exhaustive:

1. PERCEPTUAL BLOCKS

    a. Seeing what you expect to see; stereotyped seeing; premature labelling.

    b. Inability to view problem from various viewpoints.

    c. Saturation.

    d. Difficulty in isolating the problem.

    e. Tendency to delimit the problem area too closely.

2. EMOTIONAL BLOCKS

    a. Fear to make a mistake, to fail, to risk.

    b. Excessive zeal; over-motivation to succeed quickly; can only see one direction to go (ours).

    c. Inability to tolerate ambiguity; overriding desire for security, order, "no appetite for chaos".

    d. Cannot relax, incubate, "sleep on it".

3. CULTURAL BLOCKS

    a. Taboos.

    b. Fantasy and reflection are waste of time, lazy -- even crazy.

    c. Playfulness is for children only.

    d. Reason, logic, number, utility, practicality are good; feeling, intuition, qualitative judgments, pleasure are bad.

4. ENVIRONMENTAL AND ORGANIZATIONAL BLOCKS

    a. Distractions -- phone, easy intrusions.

    b. Lack of support to bring ideas into action.

    c. Lack of cooperation and trust amongst colleagues -- insecurity in job.

    d. Autocratic boss who only values his own ideas; does not reward others.

e. Inhibiting organizational management styles.

5. INTELLECTUAL AND EXPRESSIVE BLOCKS

a. Lack of information, incorrect information.

b. Inflexible or inadequate use of intellectual problem-solving strategies.

c. Formulating problem in incorrect language (e.g., verbal, math, visual).

d. Inadequate language skill to express ideas (verbally, visually, musically, etc.).

Formal techniques for trying to remove conceptual blocks have been developed and they are often successful in design problem-solving. Two such techniques are brainstorming and synectics.

Brainstorming

The purpose of a formal brainstorming session is to remove conceptual blocks by generating first a large number of ideas without attempting to evaluate them. In a brainstorming session, an individual or a group takes a given problem statement and tries to generate as many alternative solutions as possible in a very short time.

The four rules that must be followed during brainstorming are as follows.
       <u>Rules of Brainstorming</u>
       1. Keep a record of all ideas generated.
       2. Defer judgement.
       3. Generate quantity, and do not worry about quality.
       4. Think wild and take risks..

A brainstorming session can be conducted in three steps:

1. Write the statement of the problem to be addressed.
2. Brainstorm according to the above rules.
3. Examine the list of ideas generated and select the most promising ones for further evaluation.

Note that brainstorming can be used at any time during the design process, whether at the early conceptual design stage, or later for much more specific and narrow problems. The key to success is to follow the rules mentioned above.

After some experience with brainstorming, it is realized that there are certain instances where a new flow of ideas is generated during the session. The cause of this flow is what we may term idea triggers. A short list of idea triggers is as follows.

> <u>Idea Triggers</u>
> 1. Analogies
> > Personal
> > Direct or natural
> > Functional
> > Appearance
> 2. Boundary examination
> 3. Attributes
> 4. Subdivision in parts.

Recalling this list one may be able to quickly shift to another line of thinking that provides a new flow of ideas.

Synectics

Synectics is a more elaborate form of conceptual blockbusting. It is best explained by giving an outline of a typical synectics session.

<u>Outline of a Synectics Session</u>

I. Participants
   A. *Client* - Provides the problem and gives some direction to the solution process by selecting concepts, etc.
   B. *Leader* - Directs the meeting but does not contribute his own ideas. Duties include encouraging group progress and checking with the client to get his inputs. The leader writes ideas, etc. on a large sheet where everyone can see them.
   C. *Participants/Resources* - The rest of the group is responsible for generating ideas and must work to generate as many different ideas as possible.

II. The Meeting Format

   A. *Preliminaries* - The leader and the client meet to discuss <u>PAG</u> and <u>Analysis</u> so that the leader is well informed in advance. The meeting need last only a few minutes.

      a. *Problem As Given (PAG)* - The client gives a one sentence definition of the problem (the leader writes it on the board).
      b. *Analysis* - The client spends about five minutes to provide:
         i.   background information
         ii. explain why it is a problem for him
         iii. discuss what has been tried
         iv. explain what he wants most from this meeting - fantasy solution

B. (Leader is listening, participants are writing down "How To's.)

C. *How To's* - While the client is presenting the analysis, the participants are picking up or thinking up goals and wishes which are applicable to the problem. These are stated as "How To's", e.g., "How to get around the laws of gravity." The "How To's" can take many forms, for example:

    i.   they can restate the problem
    ii. they can express a fantasy
    iii. they can be a negative "How Not To"
    iv. they can imply a solution
    v.   they can defy physical laws
    vi. they can in fact be anything that comes to mind, but they should be open, imaginative and numerous

D. The group leader writes each "How To" on the board. While doing this he encourages

E. the group and often paraphrases a "How To" before writing it up to ensure that he understands what the participant intended. The leader can also check back with the client occasionally in the event the client wishes to contribute a "How To" or to respond to the "How To's" already presented. After 10-15 "How To's" have been written on the board the leader asks the client to select one for further work. The process can go directly to the Idea Stage or through the Idea Generation Step.

F. E. *Idea Generation* - There are many established methods for generating novel ideas. Probably the earliest and most well known is brainstorming. Synectics has developed a number of other techniques, such as analogies and word fantasy. Analogies include personal analogy, direct analogy, and fantasy analogy. The word fantasy starts with the client selecting a word from the "How To" and each participant responding to the previous word with the first word to come to mind (the leader writes up approximately 10 words). Each participant then selects a word and fantasizes on it for a couple of minutes. The leader then instructs the group to take the fantasy and "force fit" it to a problem solution (based on the selected "How To"). The wilder the forced fit the better.

G. *Idea* - The leader then asks the client if any of the forced fit solutions gives him an idea for solving the problem.

H. G. *Itemized Response* - When the client presents the idea he must then do an itemized response. This simply requires the client to state all the positive aspects of the idea (at least three) before stating a concern. The concern should be expressed as a "How To" and the group should generate ideas to overcome the concern. All concerns are handled in this manner.

I. *Final Steps* - The client must state:

    i.   what new elements or ideas has he found
    ii. is it a feasible solution
    iii. what steps will he take next

J. If it is a solution detail, what is it, how it works, and what it does.

K. *Recycle* - After the process is completed, whether a solution has been found or not, the leader selects a starting point, either at the "forced fit" or at the "How To's" and repeats the cycle.

Morphological Analysis

This method is based on the premise that creative ideas may be generated by forcing the design engineer to consider combinations of conceptual alternatives generated in a possibly random way.

A typical morphological analysis strategy has four steps.

1. Break problem into two or more (generally n) dimensions based on the required design functions, each function being one dimension.
2. Brainstorm each dimension as a separate problem to create a list of ways to solve it.
3. Place the list in a (generally n-dimensional) matrix format.
4. Examine combinations of "dimension values" and evaluate feasibility. As combinations are random, some unexpected solutions may be discovered.

As an example, consider development of a new concept in personal transportation. The problem may be decomposed to three different functions: passenger support, power source, medium. Each function is now treated as a subproblem and brainstorming each subproblem we generate three dimensions with "values" as follows.

Passenger Support	Power Source	Medium
Hanging	Nuclear	Tube
Standing	Gravity	Air
Chair	Spring	Water
Sling	Flywheel	Belt
Bed	Magnetic Fields	Hard surface
	Steam	Cable
	Electric Motor	Rollers
	Gasoline Engine	Rails
	Pneumatic	

Typical combinations from the above dimensions may be:
- Steam driven, runs on rails and has passengers in chairs (train)
- Electric driven, runs on a cable and has passengers in chairs (ski lift)
- Pneumatic powered, with people lying down transported through a tube (?)
- Gravity powered with people standing transported through a belt (?)

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