

# A Simple Theory Underlying Structured, Problem-Solving Methodologies

– ASIT, TRIZ, USIT and Others

Ed Sickafus, PhD

The way we think during structured-problem solving differs from the way it is taught.

Understanding this difference and how we use our mental resources can aid our **innovative** application of structured methodology.

Structured problem-solving methods are logical and organized while our natural thinking is not.

## Assumption

A cause of methodology complexity is its logical idealization as compared with our natural method of thinking.

Although neither organized nor logical,  
natural thinking has resources often  
overlooked.

## Assumption

Our **innovative** problem-solving skills  
can be improved with more natural  
thinking and the use of all our thinking  
resources.

We will examine

- natural thinking,
- thinking resources
- innovation ,

and their relation to how we mentally execute structured problem-solving.

## **Two halves of our brains think**

Both perform reasoning, remembering, communication, and problem solving. But they do them differently and share their results.

Example:

One is better at logic and the other better at understanding metaphors.

LH and RH simultaneously receive the same sensor information but process it by their own protocols.

Each is aware of the other through the joining corpus callosum.

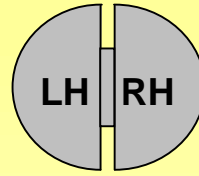
How they think is unknown.

LH usually controls language and logic.

Technologists are considered to be influenced more by their LHs and artisans more by their RHs.

RH is better at visualization of spatial relationships and use of metaphors.

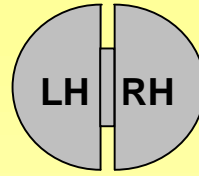




## **Problem solving in dreams**

History has many tales of technologists being stymied by a problem for long periods, then discovering the answer metaphorically in a dream.

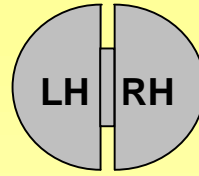
Is this RH finally being heard?



**RH analyzes spatial information  
but can't verbalize its results.**

Try describing a spiral staircase while  
sitting on your hands.

Psychologist David Galin



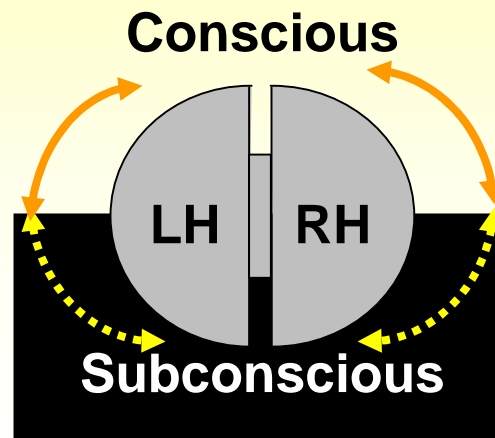
## Definition of a creative person

“ ... someone who can process in new ways information directly at hand – the ordinary sensory data available to all of us.”

Betty Edwards, PhD

**= one having a new point of view.**

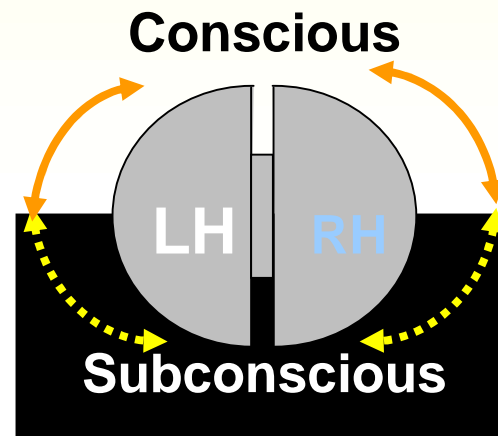
Herein, thinking refers to the conscious and subconscious processes used in problem solving.



**We are aware of the conscious, we cannot know the subconscious.**

While we cannot know the activities of our subconscious we can, through introspection, make useful deductions about thinking and use them to engage best practices for **innovation**.

This requires language – an LH trait.



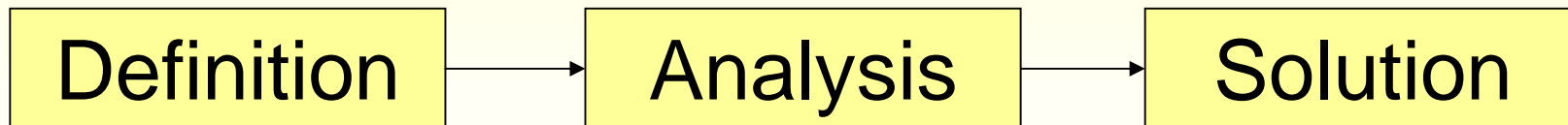
# **Our natural thinking is unorganized and uncontrolled.**

It is at times logical, other times illogical.  
It can be rational and whimsical.

It jumps uncontrollably between different  
topics interrupting concentration.

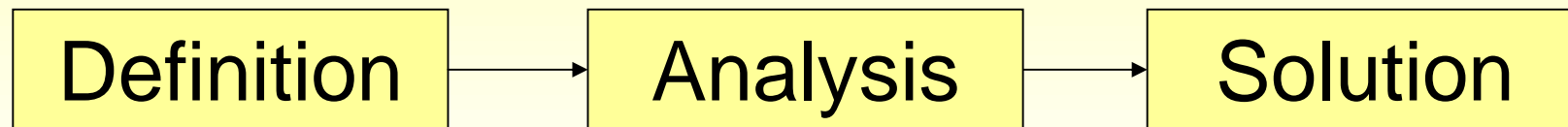
It pulls together unusual objects and  
functions creating wholly new concepts.

Communication of problem solving  
is orderly,  
like this ...

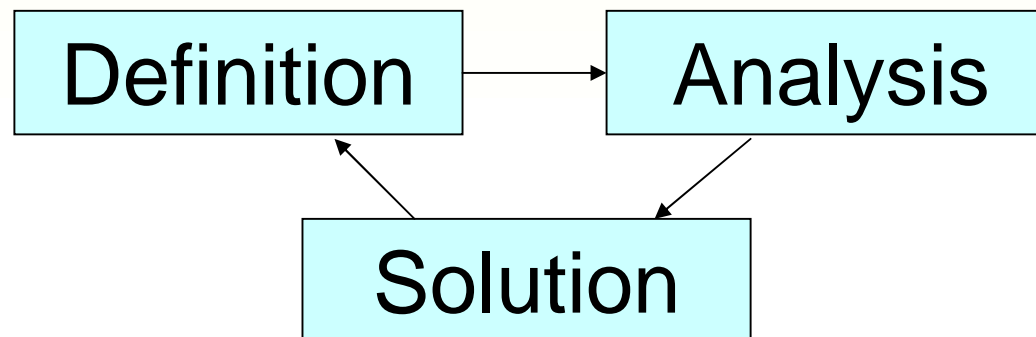


Thinking while problem solving is not orderly.

It is not like this ...

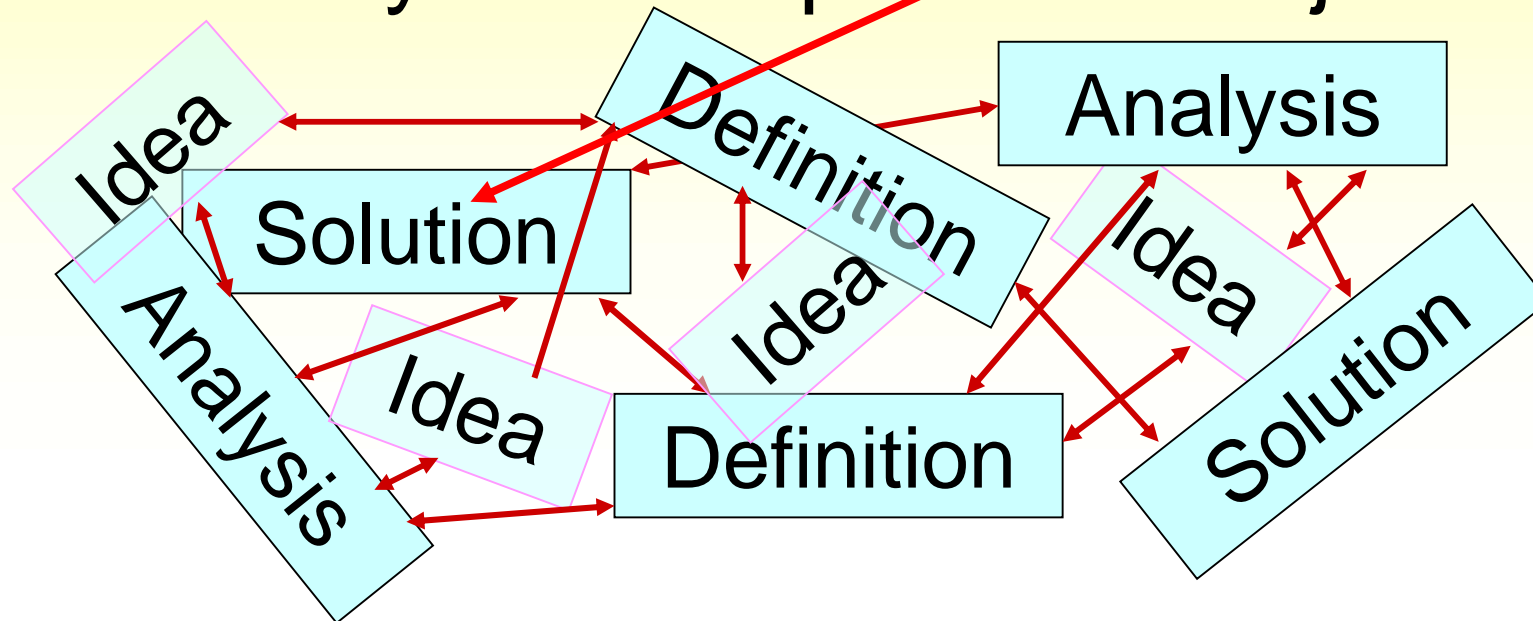


nor this ...

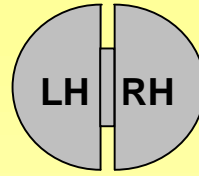




Typically, we begin with an instantaneous, intuitive, solution concept. It is tested and modified iteratively as necessary for acceptance or rejection.



**Definition simplifies / Analysis clarifies**



From this observation we learn that in our natural mode of thinking, while problem solving,

**the content of structure is important not its order.**

Communication must be organized

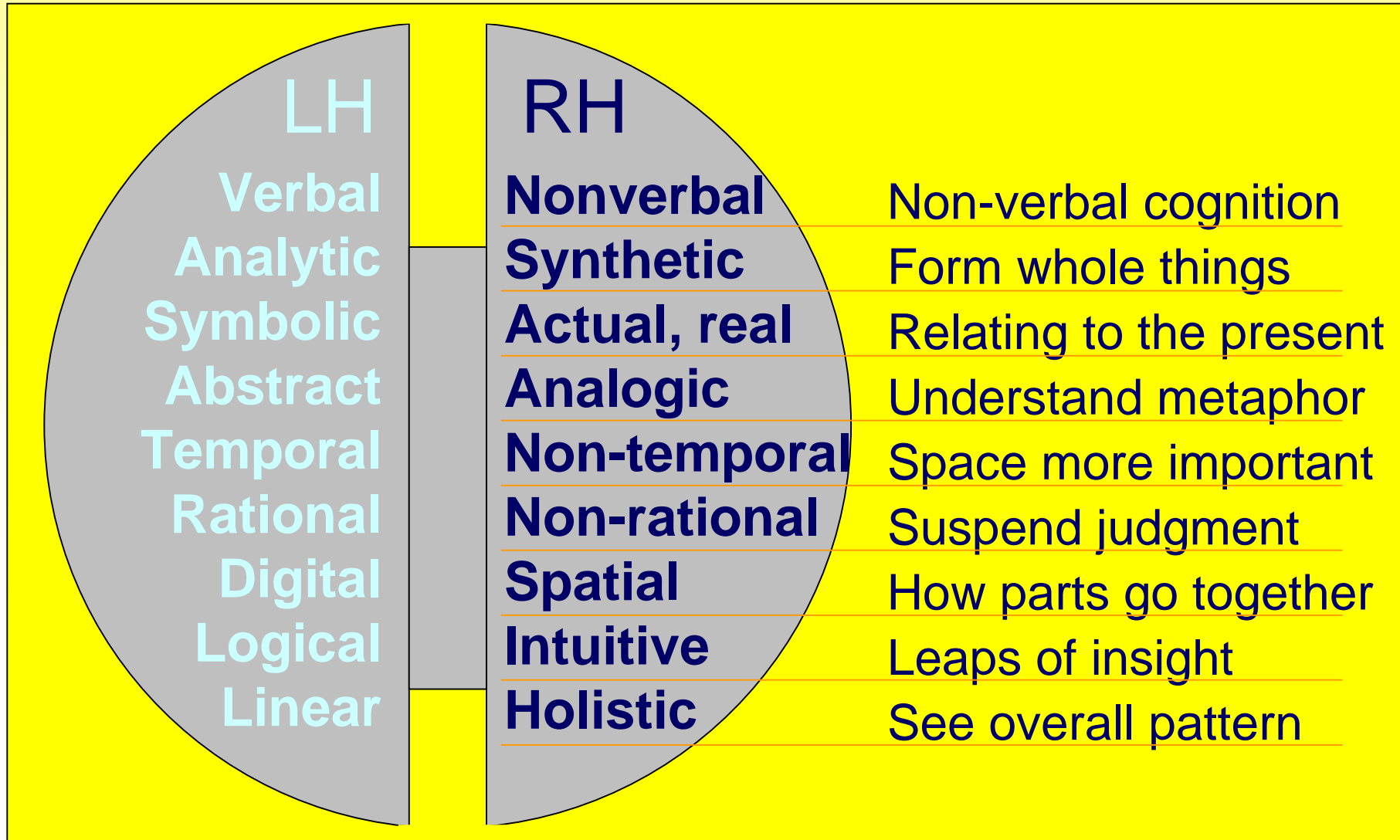
**Organization is a heuristic for communication not for thinking.**

We think disorganized thoughts but must organize them for communication – a tedious process.

Several types of thinking have been identified with tendencies for LH and RH preferences.

<b>Left Hemisphere</b>	<b>Right Hemisphere</b>
Language skills	Copying of designs
Skilled movement	Discrimination of shapes
Symbolic relationships	Reading faces
Higher-order mathematics	Music
Keeping time	Understanding metaphors
	Holistic processing
	Experiencing & expressing emotions

# Summary of our thinking traits



To maximize our **creative** thinking (not communication) we need to subdue LH's logical reasoning while encouraging RH's metaphorical thinking.

Structure and language are the tools of logical communication.

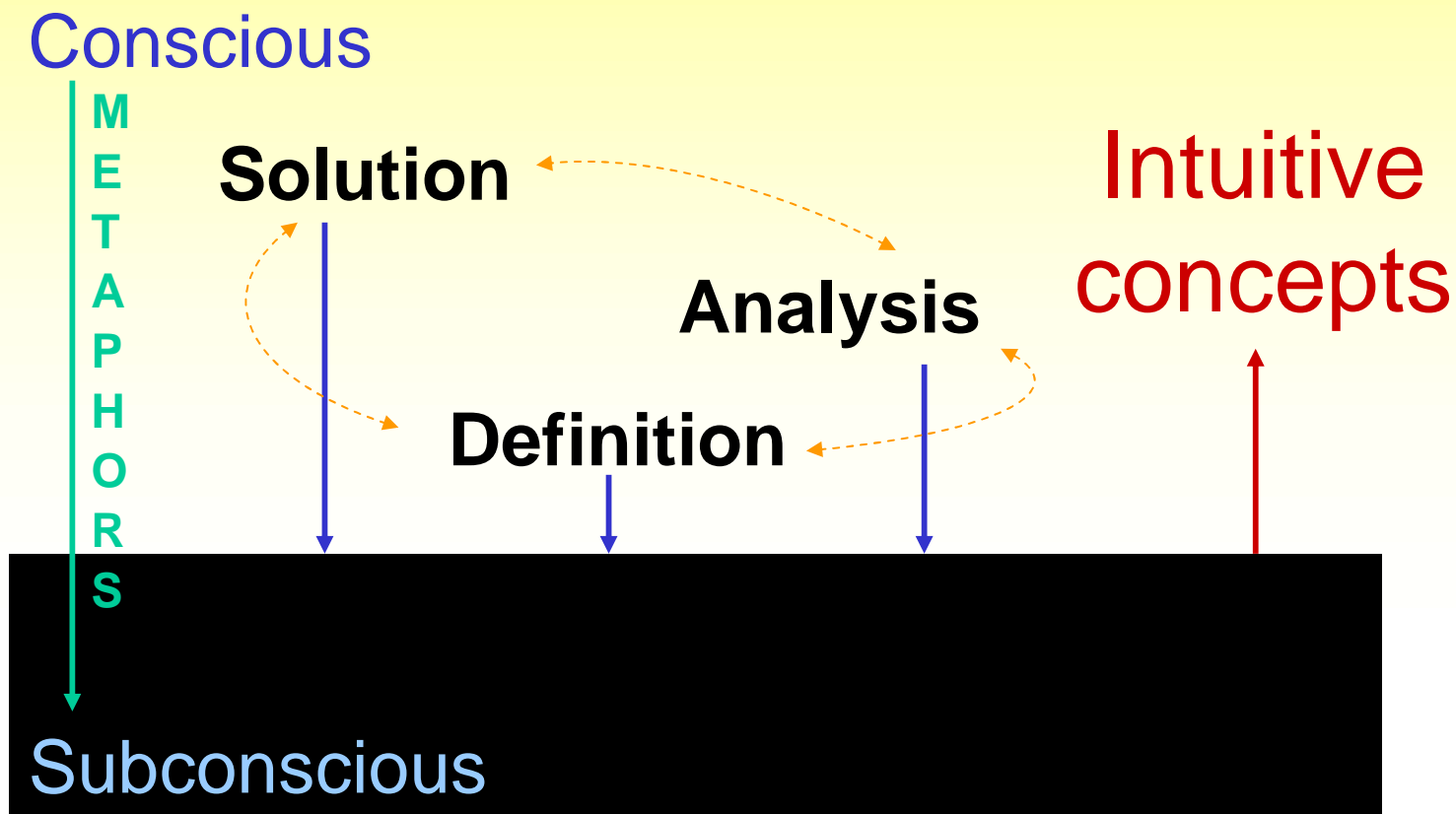
**Image and metaphor are the tools of creative thinking.**

A flowchart is not needed, it is too organized and works against unregulated random thinking.

A simple model of consciously seeding the subconscious can be used instead.

A model →

# Consciously seed the subconscious with verbal and graphic metaphors



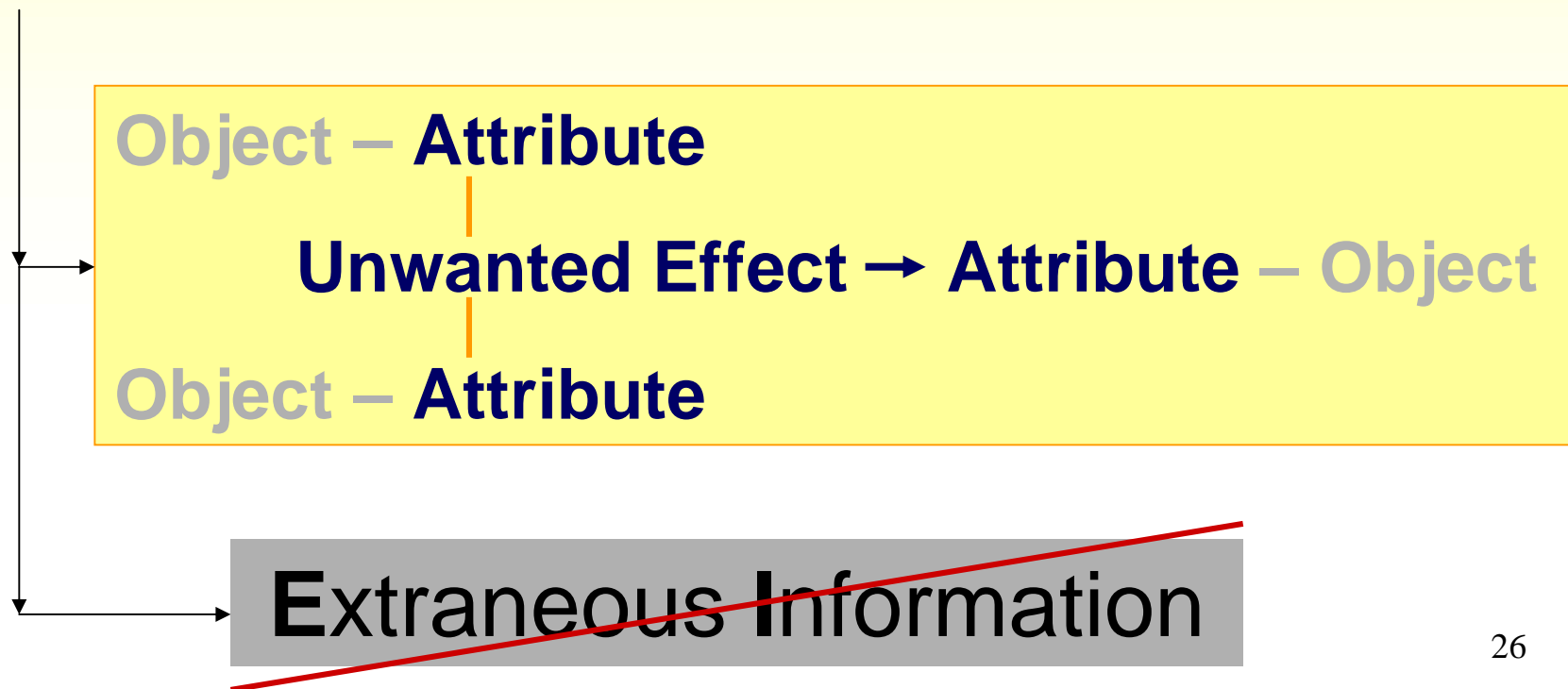


Intuitive concepts are of two types:

- Instant recall of past experience -- known problems;
- Recall of experience that approximates the given problem.

**Innovation** requires new and unusual assembly of parts with leaps of insight.

Problem situations arise as collections of objects, attributes, functions, unwanted effects, causes, and extraneous information, which we must identify, sort, cull, and minimize – logical thinking.



## Goal of DEFINITION

... to reduce a problem situation consisting of objects, attributes, functions, unwanted effects, extraneous information, and images ...

to a **well-defined problem**

# DEFINITION

Input:

Objects, Attributes, Functions, Unwanted effects,  
Extraneous information, Images

Simplify:

Sort, cull, and minimize

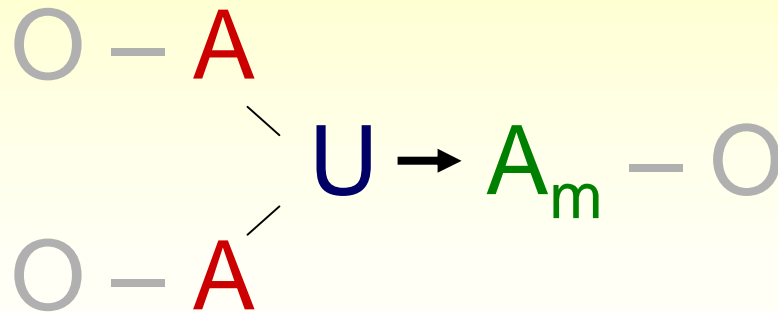
Well-defined problem  
-- rational and logical

Generify:

Use verbal and graphic  
metaphors.

New perspective  
innovative insight

# Graphic of a well-defined problem:



One **U**,  
Two causal **A**'s,  
One affected **A<sub>m</sub>**,  
Subdued **O**'s

Two active attributes support a function  
or an unwanted effect.

# Goal of ANALYSIS

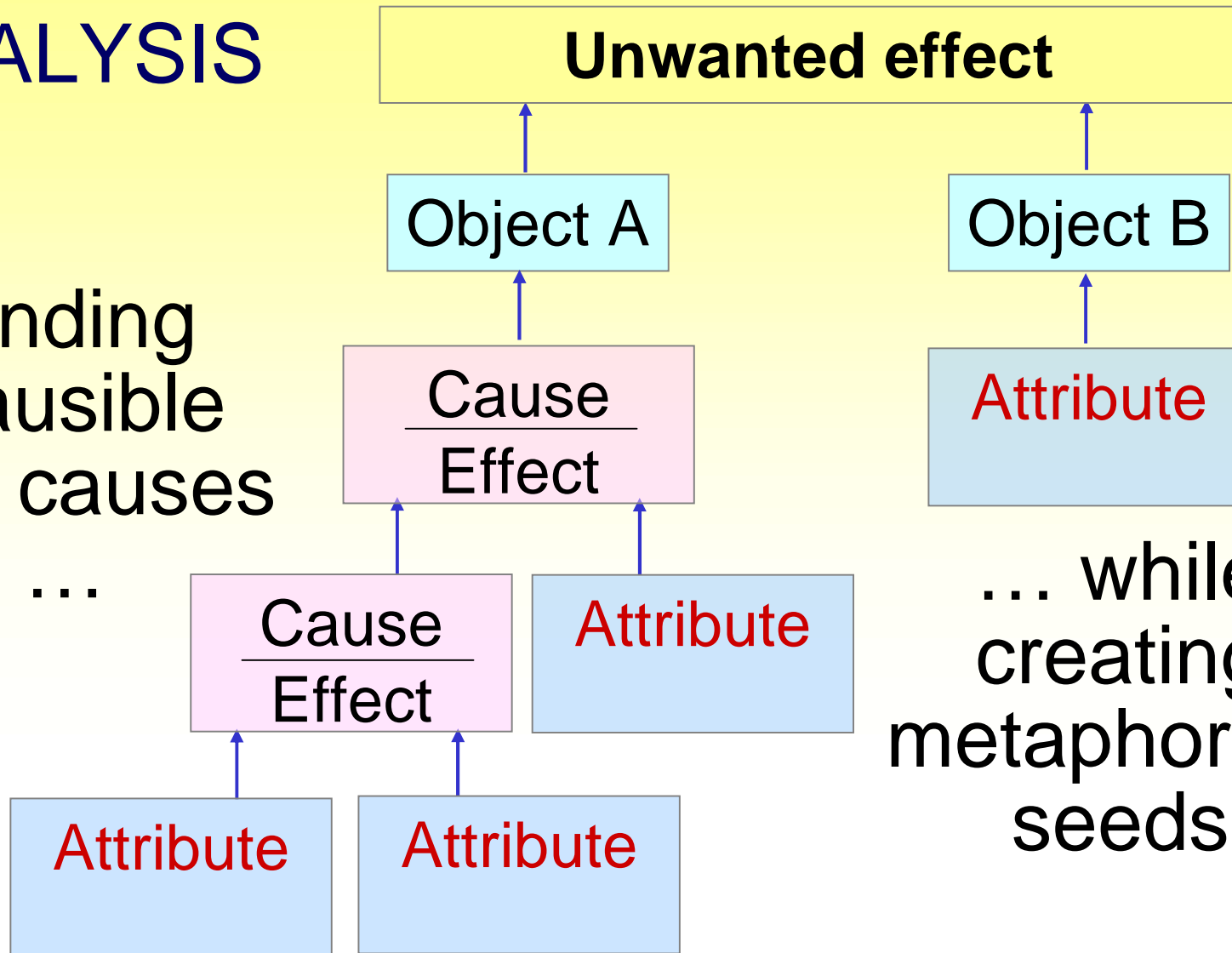
... to identify root causes for clarification of a problem through its phenomenology.

... and to generate new and effective insights.

A tool →

# ANALYSIS

finding  
plausible  
root causes

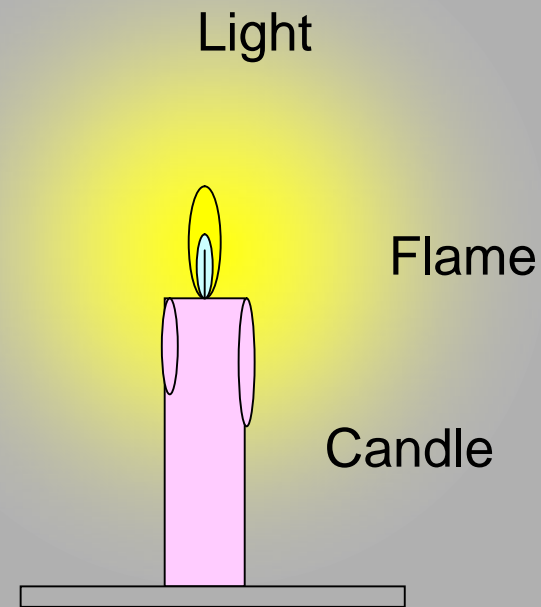


... while  
creating  
metaphorical  
seeds

# Problem Definition and Analysis

## Problem Situation

Our Company makes candles. It is loosing market share and needs a better product in order to compete.



A simple model for how to invent →



Pick an unwanted effect,  
it defines the problem

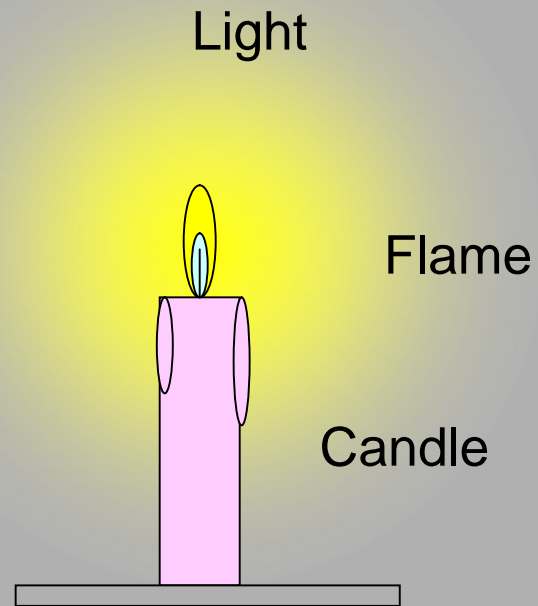
An Unwanted Effect

- an improved function

or

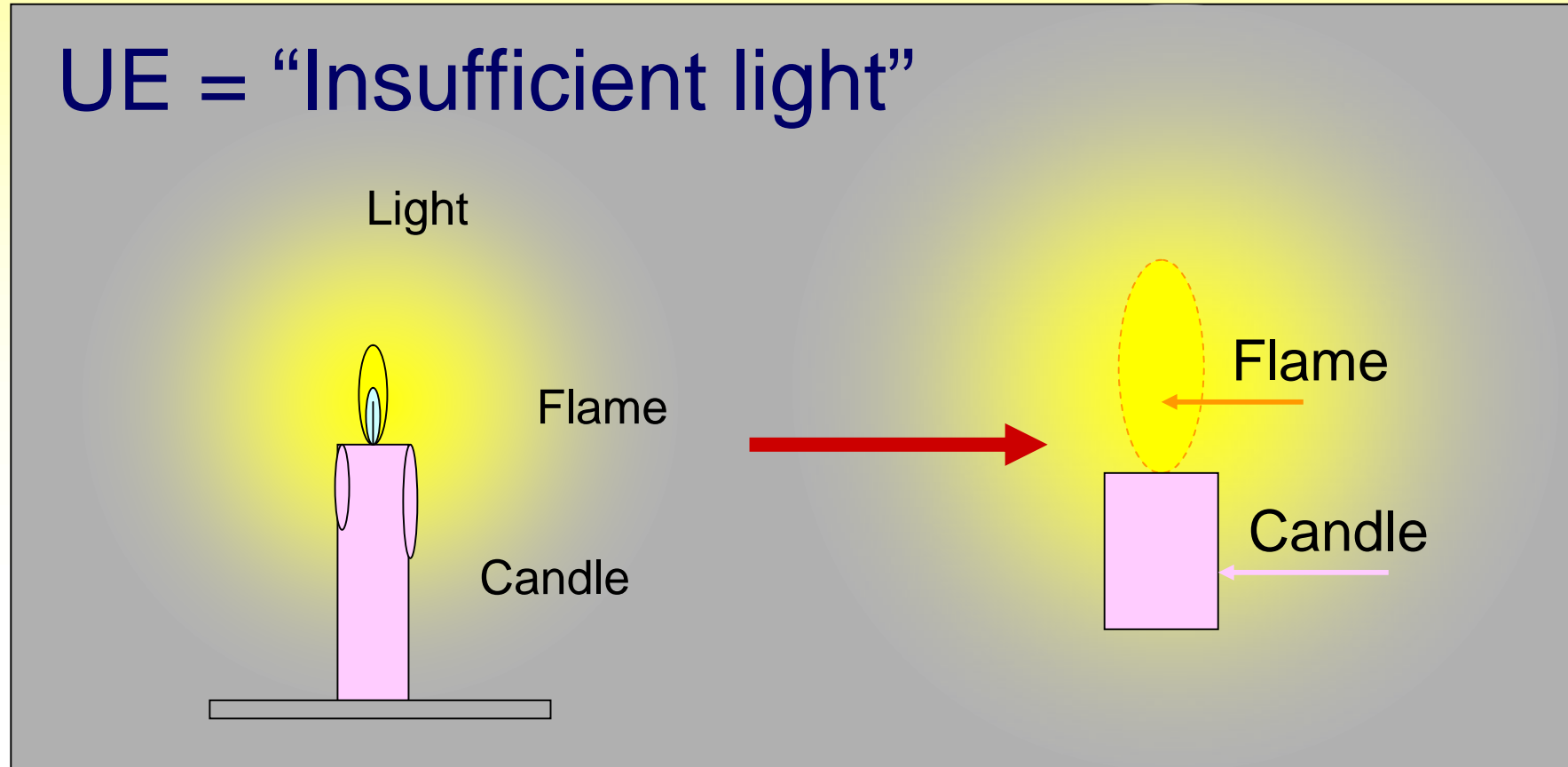
- a new function

UE = “Insufficient light”



Simplify to two objects in contact  
containing the problem

UE = "Insufficient light"



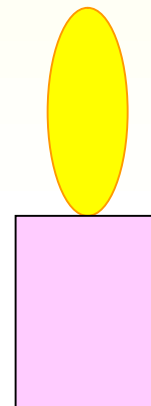
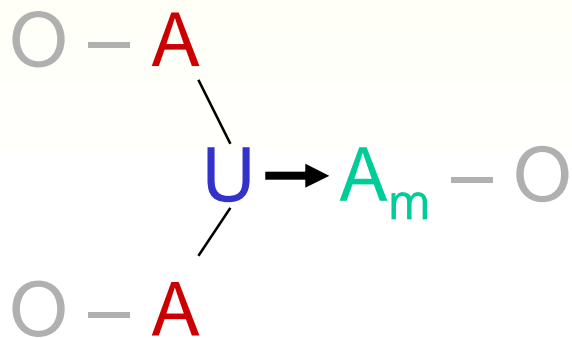
Analyze & model for clarity →

Simple model:

Flame – Temperature

Insufficient light → Visibility – Table

Fuel – Rate of combustion



Two objects

Flame

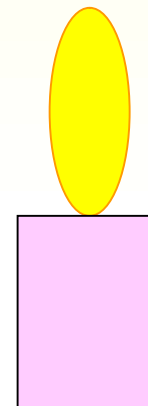
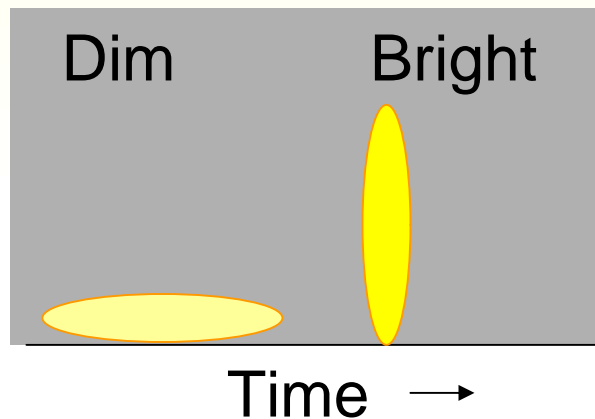
Fuel (generic name for candle)

# Analyze & modify

Plasma – Temperature

Insufficient light → Visibility – Table

Fuel – Rate of combustion



Two objects

Flame

Fuel

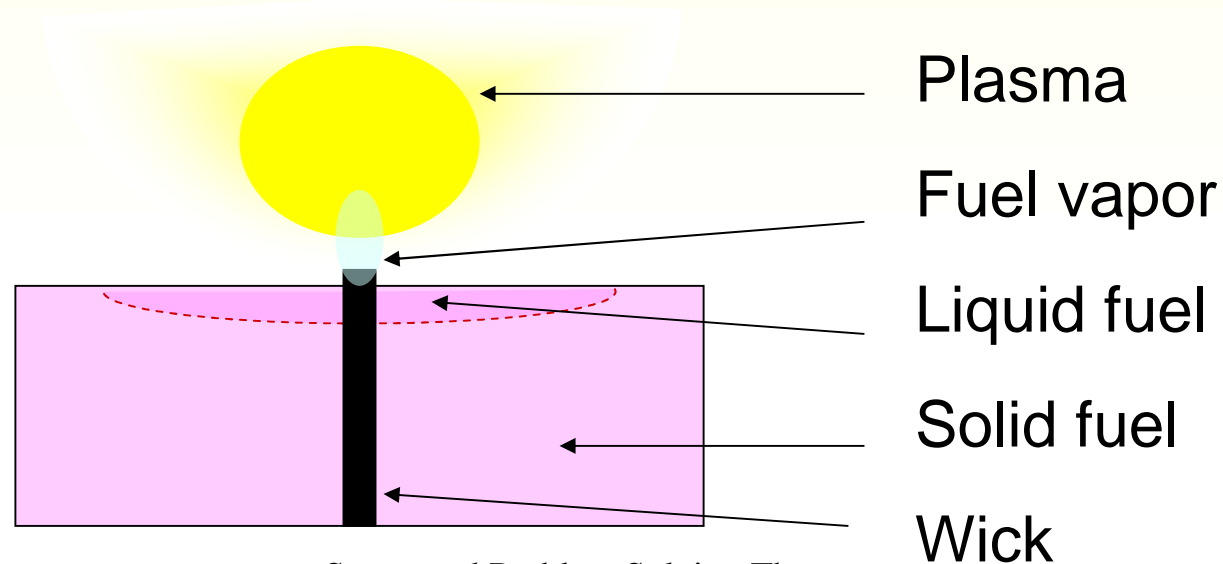
Analyze & modify

Plasma – Temperature

Insufficient light

Fuel – **Rate of combustion**

Attribute raises question of what determines rate?  
Takes us to the next level of insight.



## Solution strategies need to be

- simple,
  - graphic, and
  - metaphorical with

minimum structure,  
expressed generically

## Goal of SOLUTION

Is to resolve an unwanted effect.

There are 3 solution strategies

- Utilization
  - Nullification
    - Elimination

# The 3 Generic Solution Strategies:

## 1. Utilization

$$\begin{array}{c} A \\ \diagdown \\ (U = F) \rightarrow A \\ \diagup \\ A \end{array}$$

U becomes a function, F

(Examine space/time dependence)

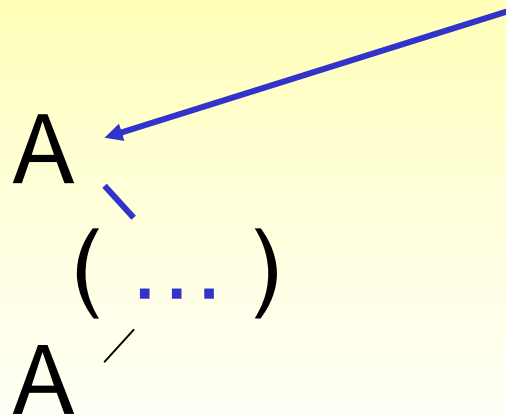


## 2. Nullification

$$\begin{array}{c} A \\ \diagdown \\ U \\ \diagup \\ A \end{array} \rightarrow \underset{|}{A} \leftarrow F - A$$

A new function is introduced, **F**,  
to counteract **U**.

### 3. Elimination



Deactivation of a causal attribute  
(Decouple interaction of objects)

M  
E  
T  
A  
P  
H  
O  
R  
S

Mental attitudes for  
simplifying problem solving  
and encouraging more  
**innovative** solutions by  
engaging RH metaphorical  
resources ...

**M  
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S**

- Recognize that order and logic can encourage LH-logic versus RH-metaphorical thinking.
- Use structure as a heuristic not as a necessity.
- Components not order of structure are important.

M  
E  
T  
A  
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R  
S

- Use simple sketches to engage RH metaphorical thinking.
- Match verbal descriptions with graphic expressions.
- Suspend judgment of ideas in order to encourage intuitive leaps of insight.

**M  
E  
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R  
S**

- Simplify a problem to a single unwanted effect and minimize the number of objects in order to enable a holistic view of a problem.
- Seed the subconscious with verbal metaphors.
- Start with solutions.

# METHODS

- Iterate between **solution**, **analysis**, and **definition** in steps rather than complete one before moving on.
- Search concepts at every step.
- Follow your inspiration.

The goal of a methodology is to spark new concepts from new viewpoints.

By understanding how we think, and by motivating metaphorical participation of both brain hemispheres in problem solving, we can learn, practice, and teach problem solving with innovative effectiveness.



With language we search the depths  
of our rational thinking.

With metaphor we search the depths  
of our imagination.

Together they inspire insight and  
**innovation.**

Ed Sickafus

2006

**M  
E  
T  
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S**

To be creative

U-SIT

and think

Integrate logic and metaphors

Ed Sickafus

2006