

Module 2

21st Century Skills: Creativity, Critical thinking, Collaboration, Problem Solving, Decision Making- Lateral Thinking- Critical Thinking Vs Creative Thinking

Problem Solving Techniques: Six Thinking Hats- Mind Mapping- Forced Connections- Scientific Temperament and Logical Thinking with case studies.



21st century skills

International organizations have defined a set of skills to be developed by students so that they can succeed in today's transformed workplace.

1. Learning skills

- Critical Thinking
- Creative thinking
- Collaborating
- Communicating



2. Literacy skills

- Information Literacy
- Technology Literacy
- Media Literacy

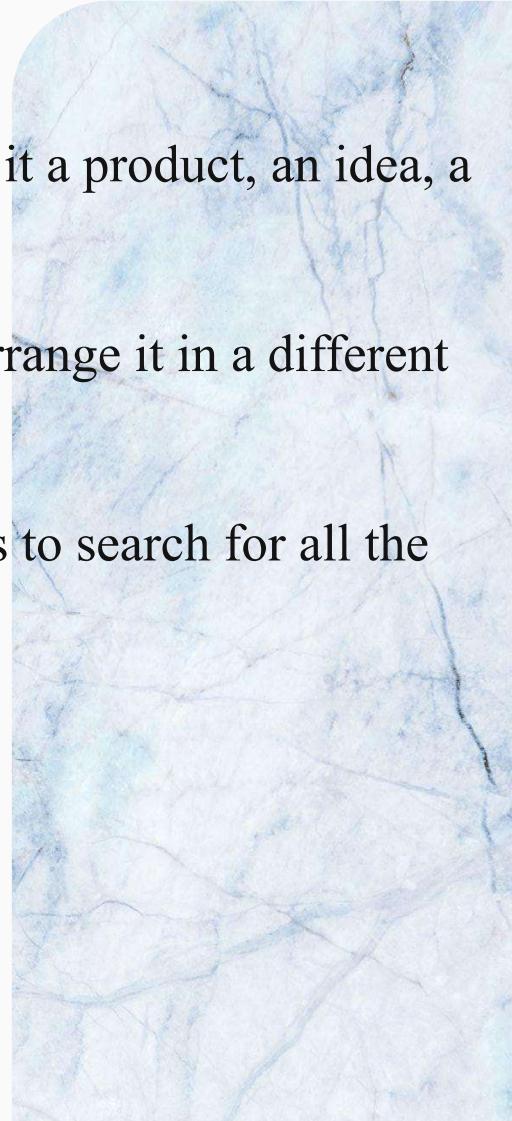
3. Life skills

- Flexibility
- Initiative
- Social skills
- Productivity
- Leadership



Creativity

- Creativity is the skill of producing something new and valuable; be it a product, an idea, a concept, a process or a solution to a problem.
- It involves the ability to acquire knowledge, break it down and rearrange it in a different manner to generate something new and valuable.
- A creative person is able to use the existing knowledge in new ways to search for all the possible solutions to the problems he confronts with.
- Creative feelings cannot always be expressed in words.



In short, creativity is

- A basic capability of the human brain.
- A skill which can be learned and improved.
- The product of disciplined thinking.
- The result of being open to experiences and thinking about them.
- A process that involves trial and error.
- Creative people learn from experiences

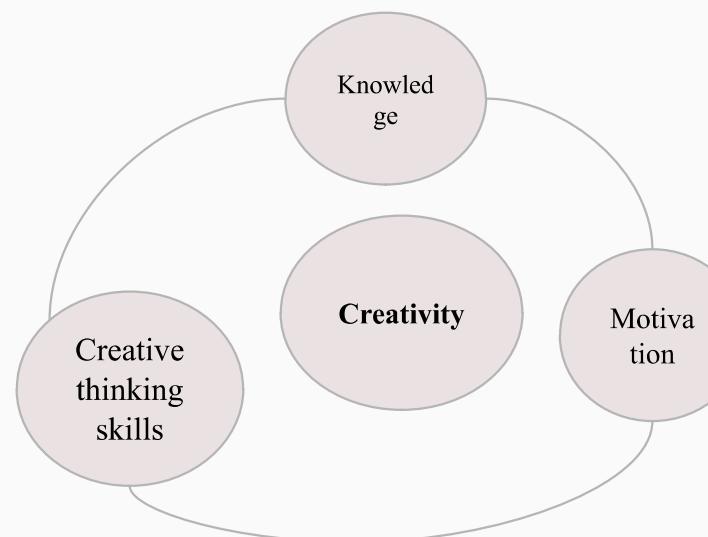


Sources of creativity

Knowledge → creative person should have a wide range of interests that allow him to come in contact with new elements

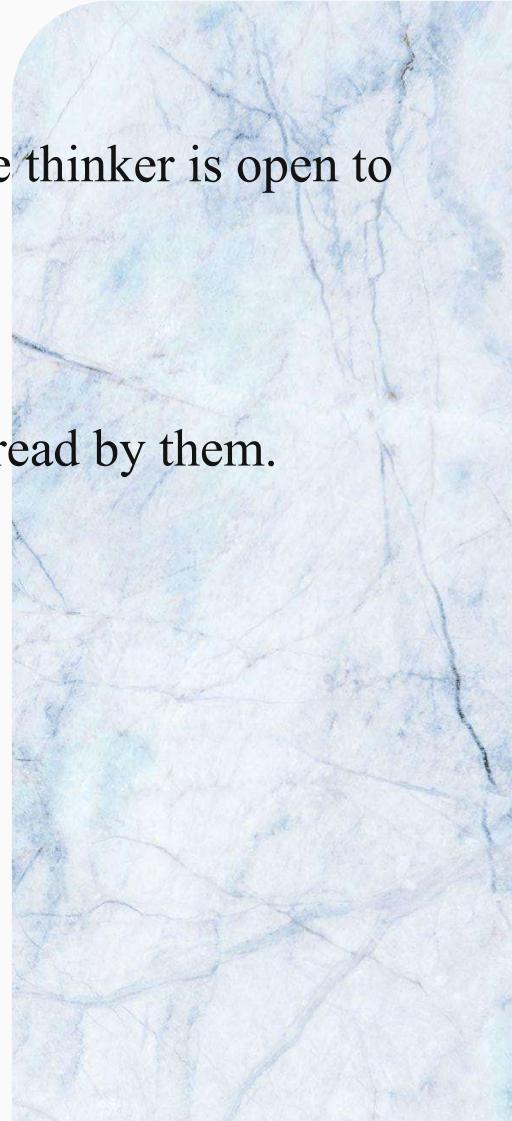
Creative thinking skills → better thinking skills make us more creative

Motivation → experts see motivation as the most important component of creativity.



Critical thinking

- Critical thinking is clear, rational and disciplined thinking where the thinker is open to recognize and raise the efficiency of thought process.
- It is a tool to improve one's thinking capacity.
- Critical thinkers analyze, unify and evaluate what is heard, seen or read by them.



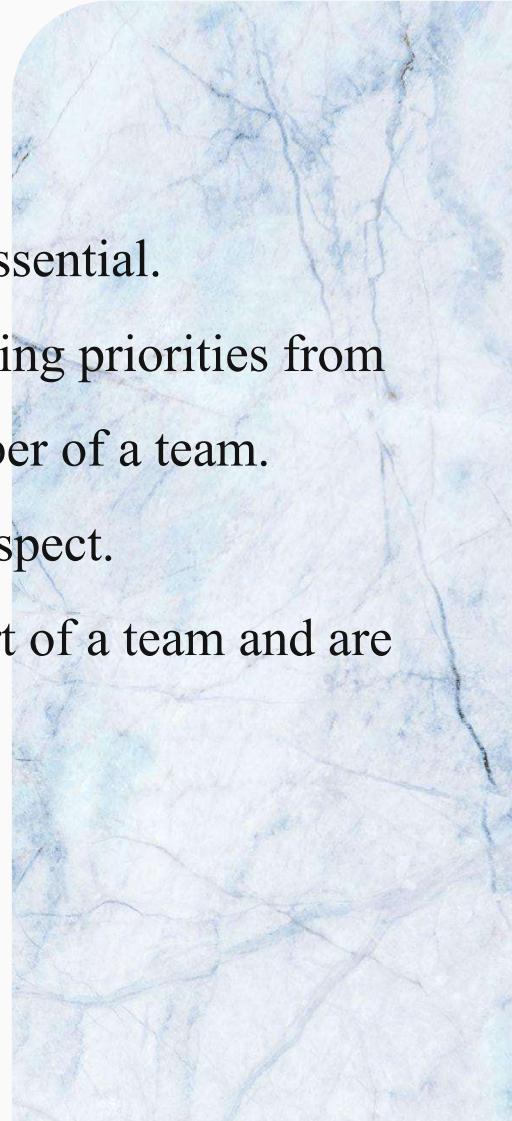
Essential Critical thinking skills

1. Distinguish between verifiable facts and claims of value
2. Distinguishing relevant data from irrelevant information
3. Determining whether a statement is factually correct
4. Identifying whether a source is credible
5. Spotting ambiguous claims or arguments
6. Identifying logical inconsistencies
7. Recognizing errors in the line of reasoning
8. Assessing the strength of an argument or claim



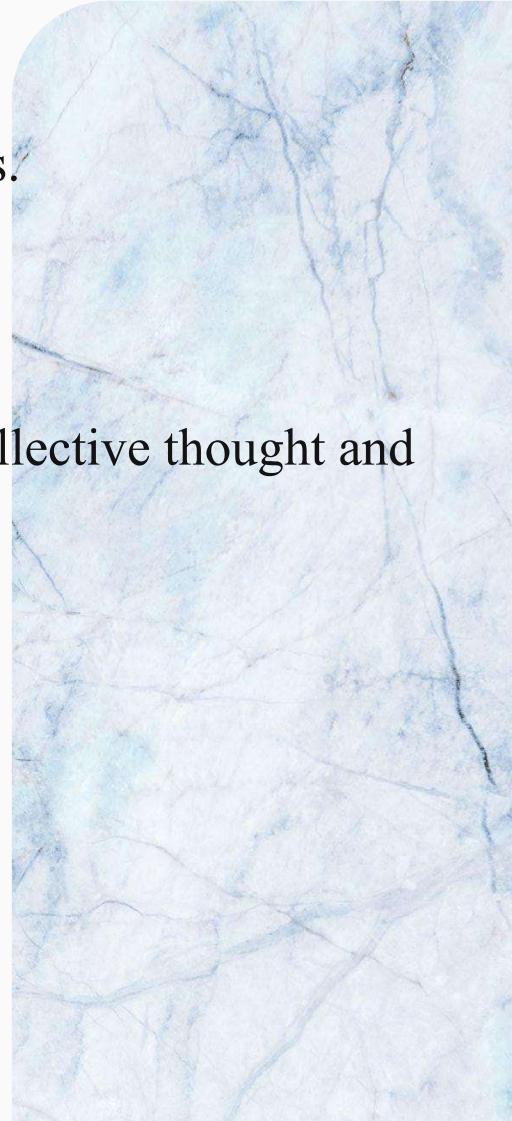
Collaboration

- Collaboration skills are what enable you to work well with others.
- Most work environments require collaboration, so these skills are essential.
- These skills include understanding a variety of perspectives, managing priorities from everyone in the group, and meeting expectations as a reliable member of a team.
- Successful collaboration requires a cooperative spirit and mutual respect.
- Employers typically seek employees that function effectively as part of a team and are willing to balance personal achievement with group goals



Problem Solving

- Problems are obstacles thrown in front of us to hamper our progress.
- These problems must be solved and overcome.
- Problems can arise in personal, professional and social contexts.
- Some problems can be solved using mind alone, some can be by collective thought and some by using external aids.
- Types of problems :
 1. Based on type of unknowns
 2. Based on level of difficulty
 3. Based on open-endedness



- Complex problems → cannot be solved through simple logical processes.
- There is a problem solving cycle which has been identified by Bransford and Stein and is known as the IDEAL model.

1. ***Identification of Problems and Opportunities*** → This is the first step which involves actively looking to the problems and not just responding to them.

The problems must be stated clearly so that the subsequent steps are easier.

2. ***Definition of Goals*** → Defining the goals of the solution is important to decide the direction of the problem solving process.

There must be clear understanding of what the requirement is.

The constraints, various interests, etc must be taken for consideration in this step

3. *Exploration of Possible Strategies* → This stage needs a considerable amount of iteration.

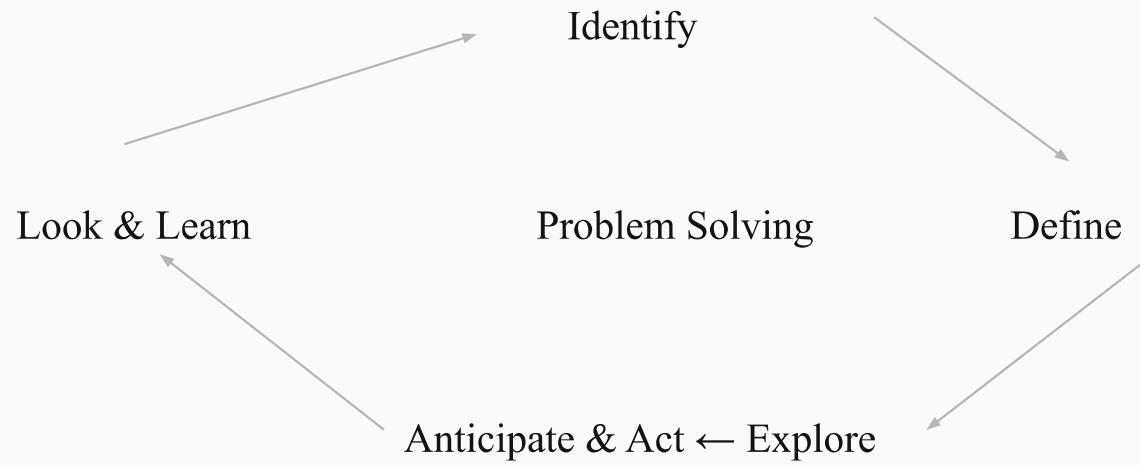
- There are several methods like formal and informal for the generation of alternatives.
- The goals, constraints and interests must be constantly re analysed with respect to the strategy we adopt for problem solving.
- Every possible strategy must be tried before we take a decision.

4. *Anticipation of Outcomes and Action* → Every possible outcome must be analysed after deciding a strategy.

- The already fixed strategy may have to be modified or even discarded.
- Inappropriate assumptions which were made earlier can be rectified in this stage.

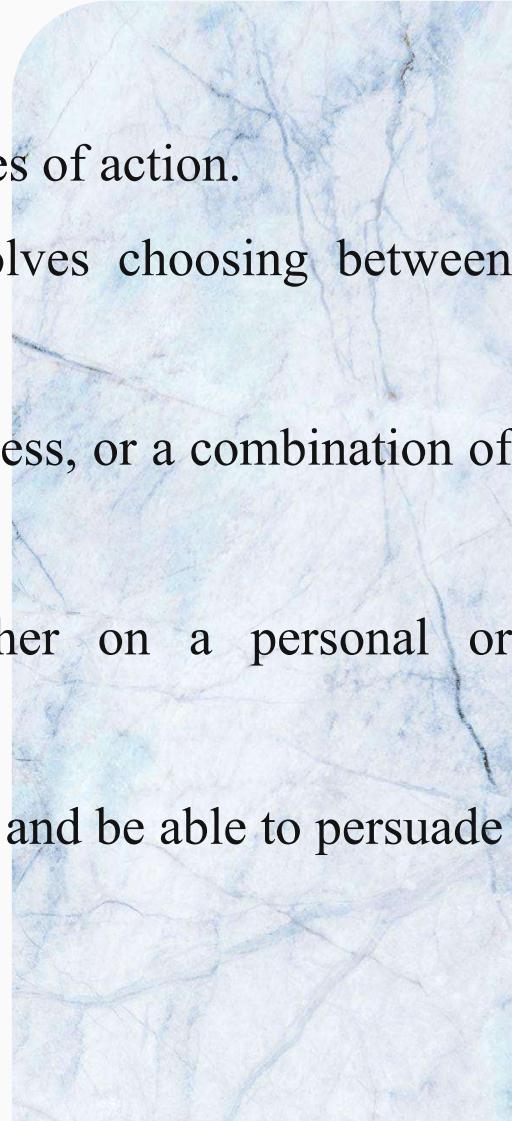
5. Learning through Retrospection → This is the key for all the possible and further progress. It helps to understand the mistake we made and learn from the past experiences.

- This helps in adopting the most suitable strategy in future.



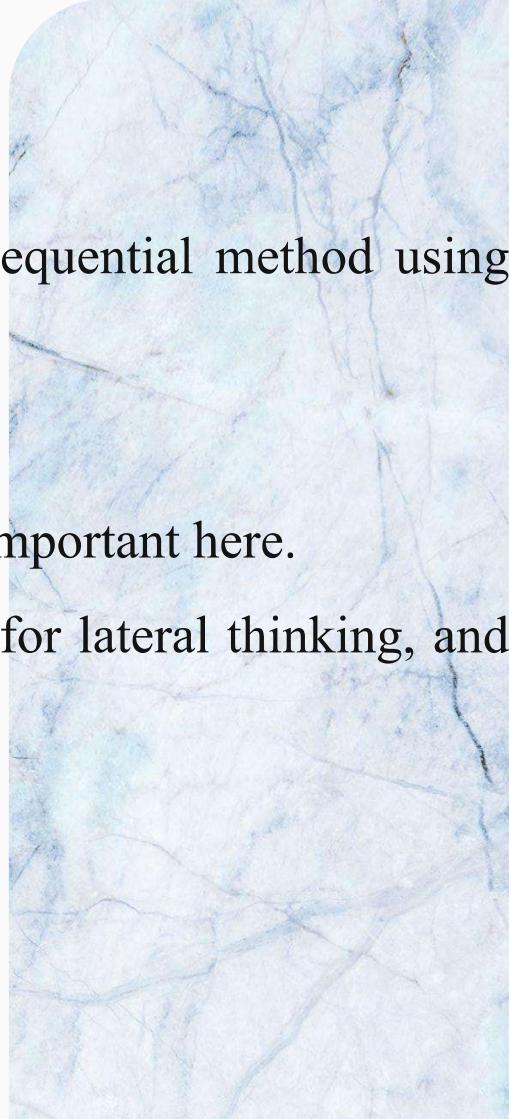
Decision Making

- Decision-making is the act of choosing between two or more courses of action.
- In the wider process of problem-solving, decision-making involves choosing between possible solutions to a problem.
- Decisions can be made through either an intuitive or reasoned process, or a combination of the two.
- Decisions need to be capable of being implemented, whether on a personal or organizational level.
- You do, therefore, need to be committed to the decision personally, and be able to persuade others of its merits



Lateral Thinking

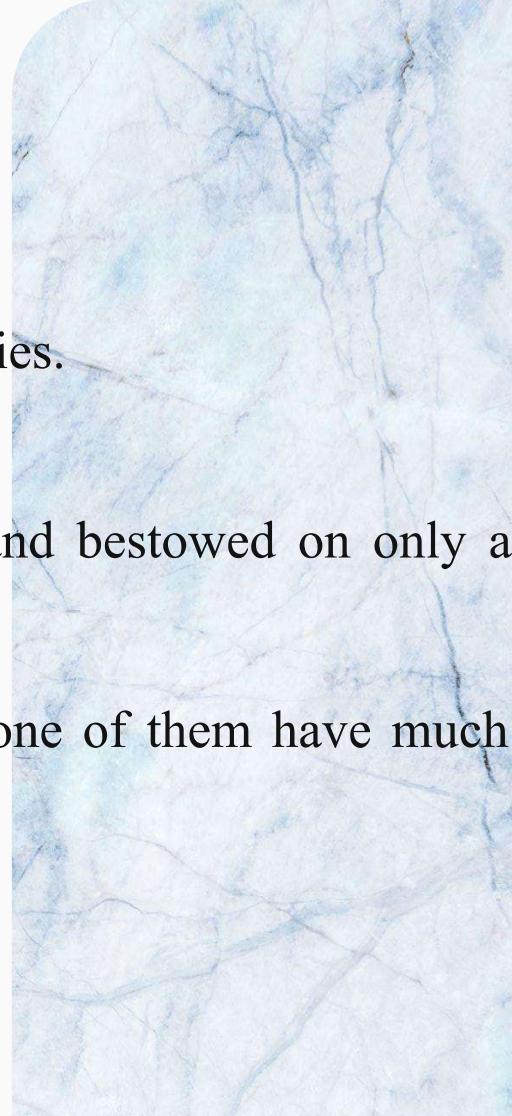
- Lateral thinking is a term coined by Edward de Bono.
- It represents a way of problem solving by an indirect and non sequential method using reasoning.
- It is a process that starts with the generation of new ideas.
- The logical continuity of steps to reach and solve a problem is not important here.
- According to Edward de Bono, 4 types of thinking tools are used for lateral thinking, and are,



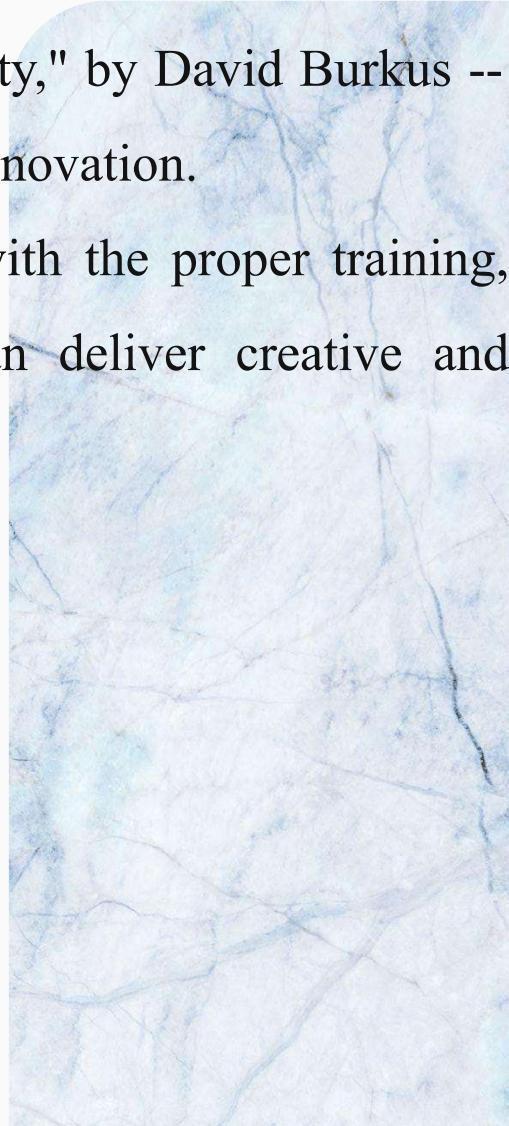
1. Idea generating tools to break routine thinking patterns.
2. Focus tools to identify new focus areas or ideas.
3. Harvest tools to create more value from the ideas generated.
4. Treatment tools to consider real world constraints and opportunities.

Myths of Creativity

- Most people think creativity is divinely-inspired, unpredictable and bestowed on only a lucky few.
- There are a lot of popular myths about business creativity, yet none of them have much scientific evidence.



- A new study based on the latest research-- "The Myths of Creativity," by David Burkus -- helps demystify what's behind the forces and processes that drive innovation.
- Burkus' research supports what I have always believed -- that with the proper training, anyone with a common sense mindset grounded in reality can deliver creative and innovative new ideas, projects, processes, and programs.
- The first step is to not limit your thinking.



Ten long-standing myths about creative thinking

1. Eureka myth.
2. Breed myth.
3. Originality myth.
4. Expert myth.
5. Incentive myth.
6. Lone Creator myth.
7. Brainstorming myth.
8. Cohesive myth.
9. Constraints myth.
10. Mousetrap myth.

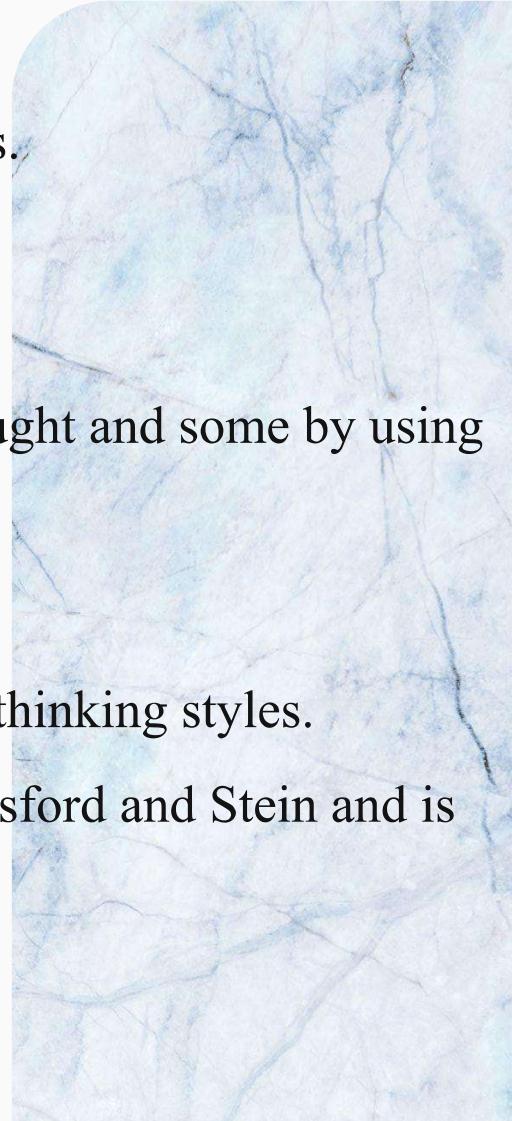


Critical Thinking v/s Creative Thinking

CRITICAL THINKING	CREATIVE THINKING
Mostly linear	Often non linear
Selective (works by elimination)	Generative (generates new possibilities)
Converges towards single answer	Moves away from a single answer
Looks for correct answer	Looks for possibilities
Remains objective and logical	Suspends judgments

Problem Solving Techniques:

- Problems are obstacles thrown in front of us to hamper our progress.
- These problems must be solved and overcome.
- Problems can arise in personal, professional and social contexts.
- Some problems can be solved alone, some can be by collective thought and some by using external aids.
- Problem solving requires a number of different thinking styles.
- Some problems require critical thinking while others need creative thinking styles.
- There is a problem solving cycle which has been identified by Bransford and Stein and is known as the IDEAL model.



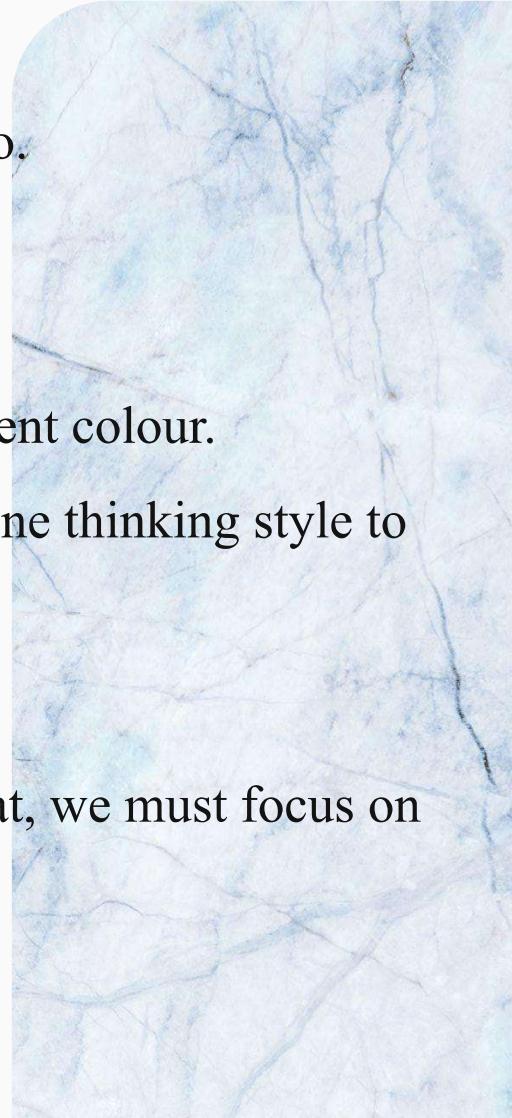
Six Thinking Hats

- The Six Thinking Hats method was put forward by Edward de Bono.
- This method helps us analyze and structure our thought process.
- According to de Bono, we are capable of different thinking styles.
- These styles are represented by imaginary hats, each hat with different colour.
- By mentally wearing and switching hats, it is easier to move from one thinking style to another.

1. *The White Hat*

It is the hat of facts and data. When wearing a mental white hat, we must focus on analysing the available data and infer the information from them.

E.g. There are hundred varieties of animals in this zoo.



2. The Red Hat

It is the hat of feelings and emotions.

When wearing a red mental hat, we are free to focus on insights, anxieties, feelings, etc. E.g. I feel worried about their safety.

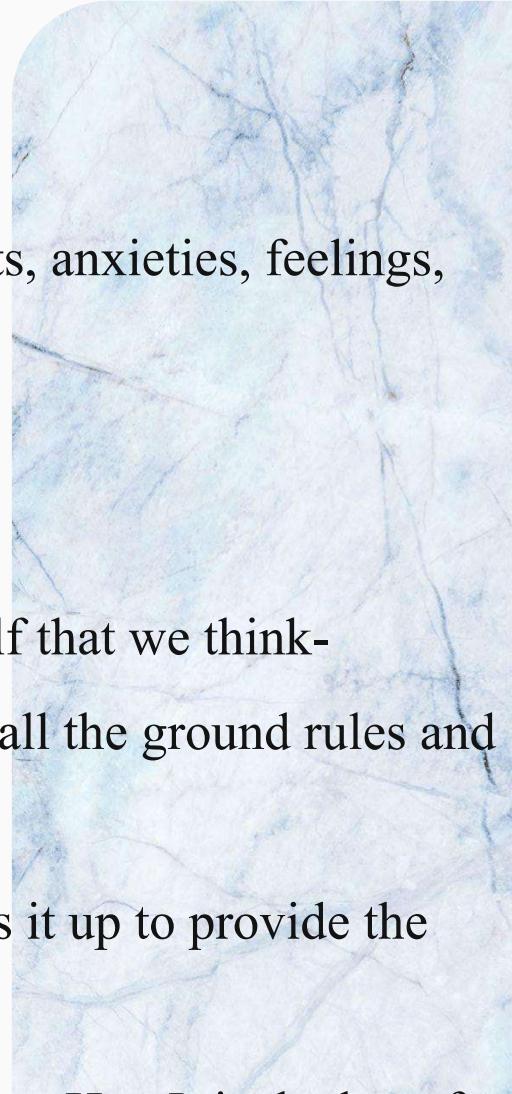
3. The Blue Hat

It is the hat of process control.

When wearing the blue hat, it is about the thought process itself that we think-whether are we approaching the problem in the right way, what are all the ground rules and whether the current thinking is productive.

The blue hat initiates the discussion, controls its flow and sums it up to provide the bigger picture.

E.g. How are we planning to market this product? 4. The Yellow Hat It is the hat of



E.g. How are we planning to market this product?

4. The Yellow Hat

It is the hat of optimism and positivity.

We take a logically optimistic view of the problem when we wear a yellow hat.

The benefits, feasibility, positive assets, etc are evaluated in this.

E.g. Such low product cost will raise profit.

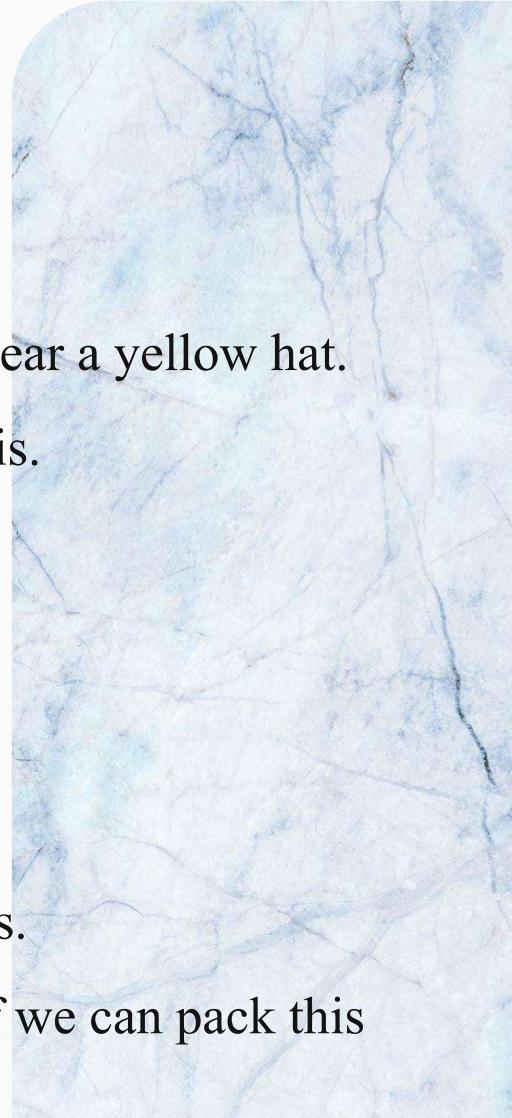
5. The Green Hat

It is the hat of creativity.

We can think and act creatively.

We are encouraged to go beyond the limits we set for ourselves.

Out of the box solutions come from green hat thinking. E.g. If we can pack this product as a new budget option. we can attract more customers.



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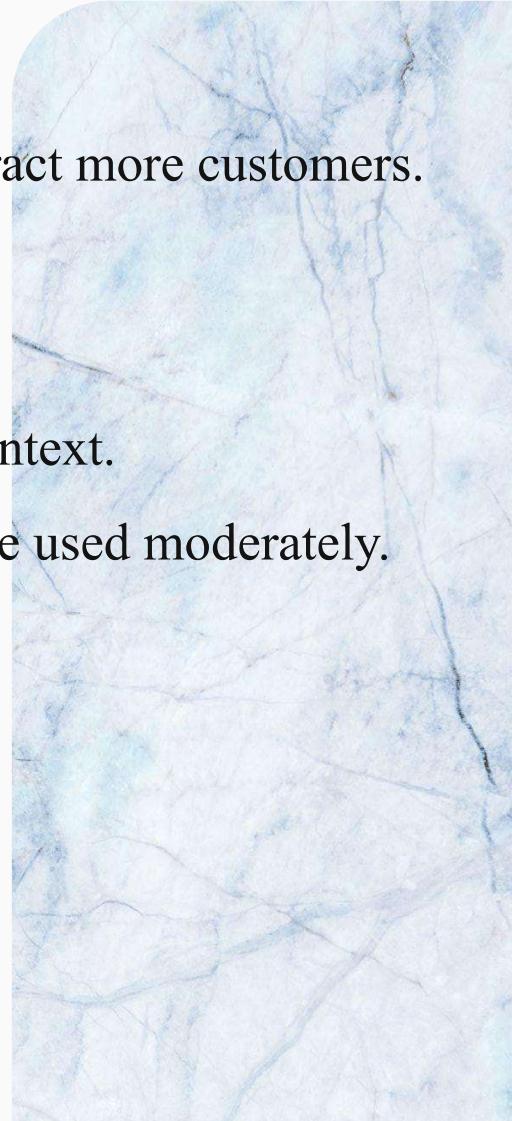
6. *The Black Hat*

It is the hat of caution and critical thinking.

We can reflect on how an idea wouldn't work in the current context.

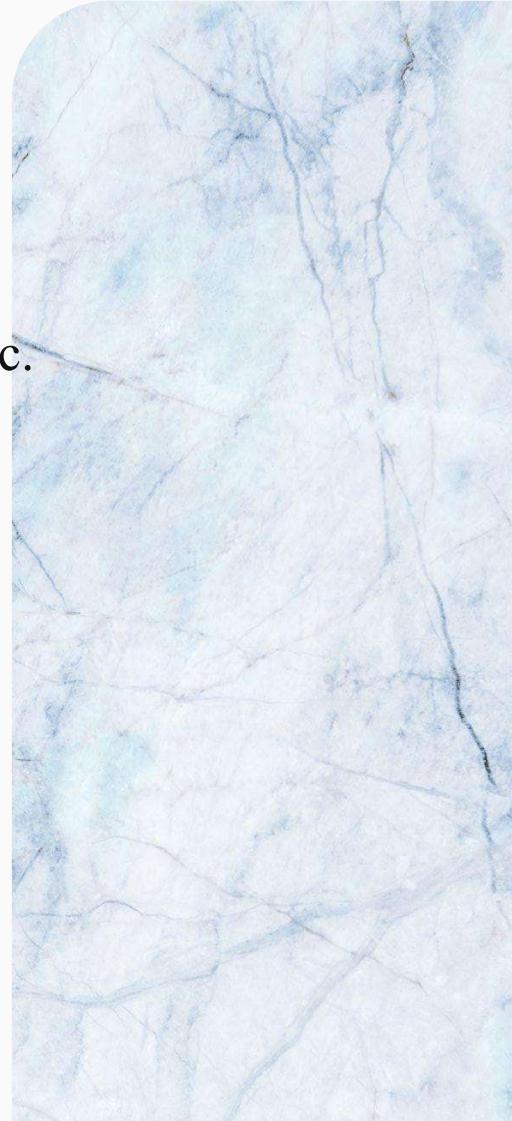
The black hat is important for decision making, but it should be used moderately.

E.g. With such low price, we cannot assure quality.



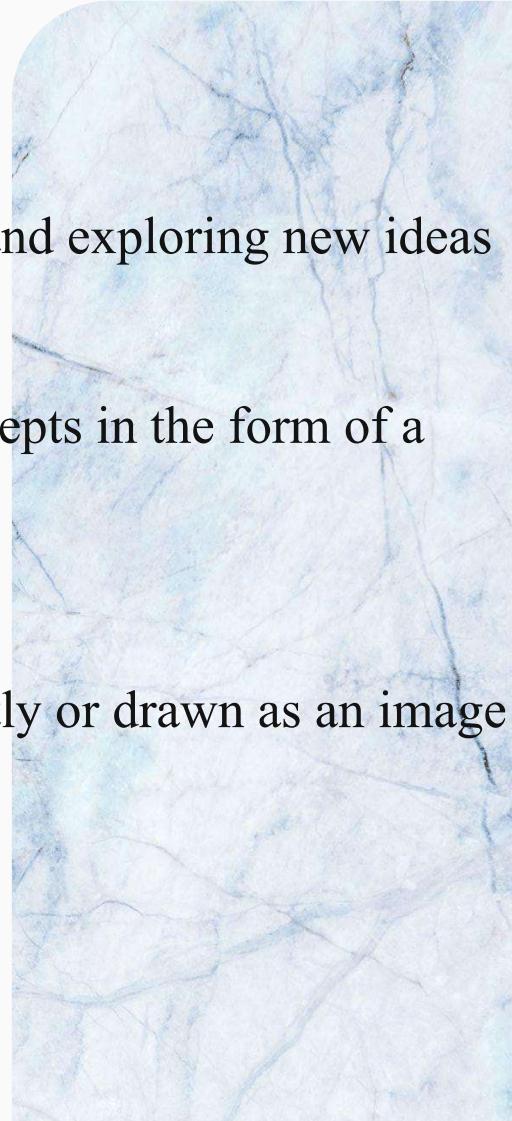
Advantages of Six Thinking Hats

1. Saves time in meetings
2. Eliminates personality conflicts in meetings
3. Helps to separate each aspect of problems, i.e. emotions, facts, etc.
4. Improves performance of individuals and teams
5. Helps in preparing for changes
6. Improves clarity and conciseness in communication.
7. Parallel thought is encouraged

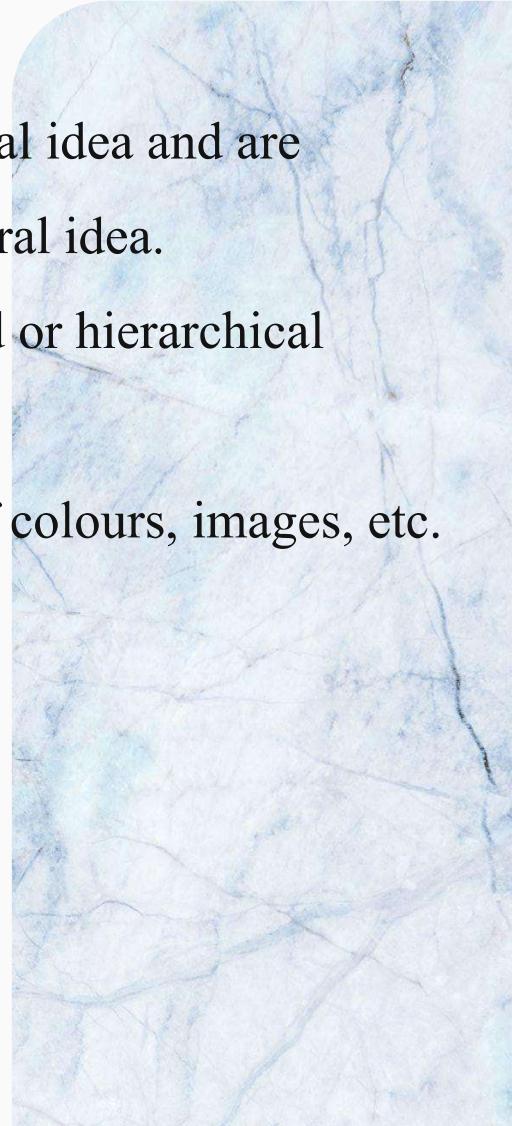


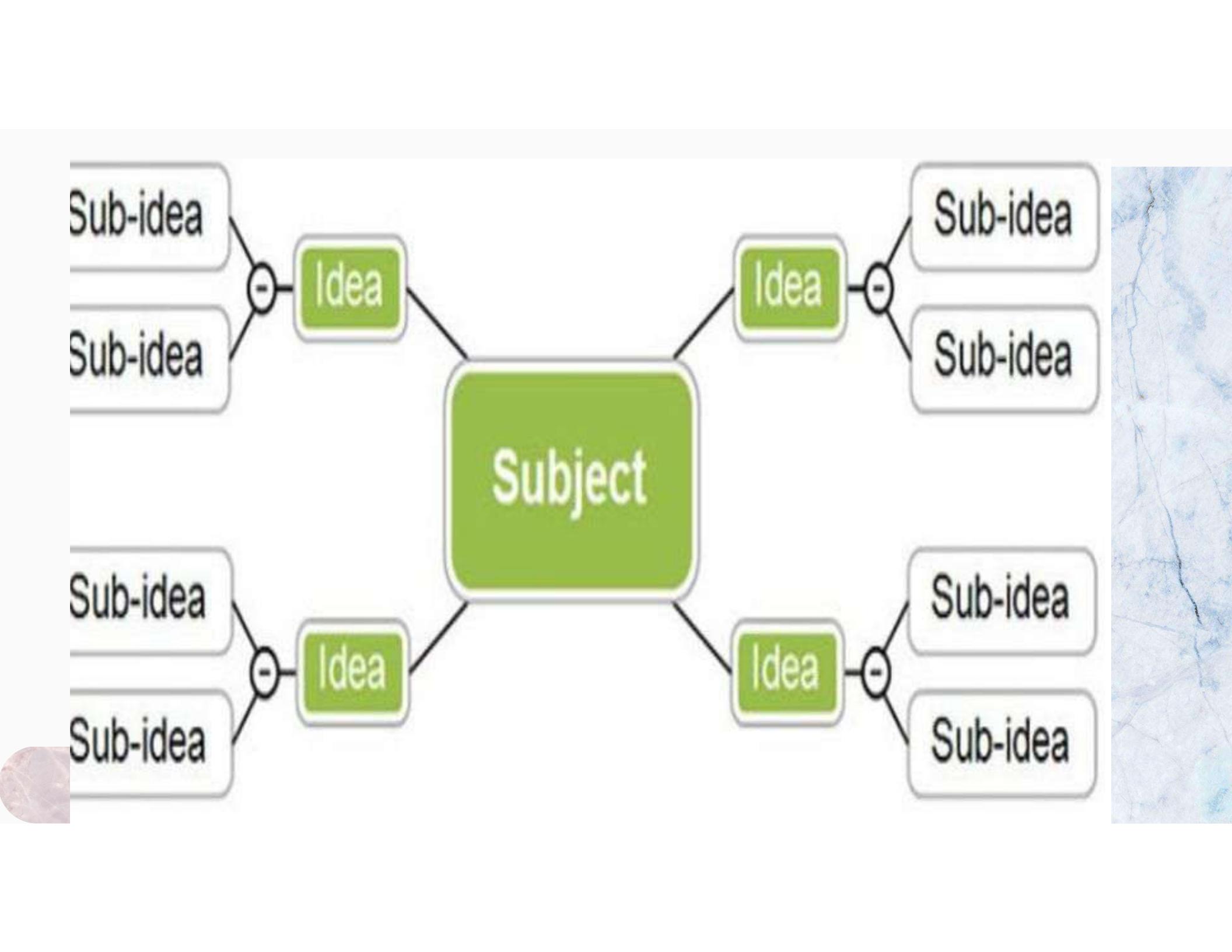
Mind Mapping

- The term “mind map” was coined by Tony Buzan in 1970s.
- Mind mapping is a method of pictorially representing information and exploring new ideas and concepts.
- It represents the hierarchy/ interrelationships of new ideas and concepts in the form of a picture or network.
- It is a spider diagram which “maps” information.
- A mind map usually has a central theme which is written prominently or drawn as an image at the centre of a blank page.



- Major ideas related to the central theme are placed around the central idea and are represented by words, phrases or pictures and connected to the central idea.
- Each major idea has smaller ideas, and those are placed in branched or hierarchical structures.
- Connections among these can be had with lines, arrows, etc. Use of colours, images, etc. adds effectiveness.



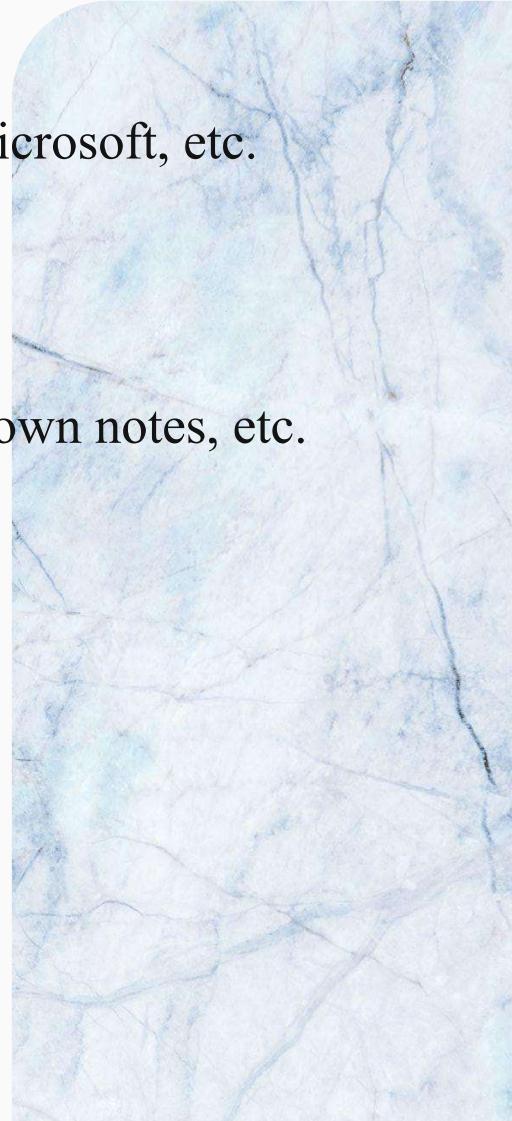


My favourite pastimes



Uses of mind mapping

- Mind maps are used by many companies like IBM, Walt Disney, Microsoft, etc.
- Mind maps are used for business presentations.
- It promotes creative and critical thinking processes.
- It can be used for educational purposes like taking classes, taking down notes, etc.
- It can be used for training purposes.



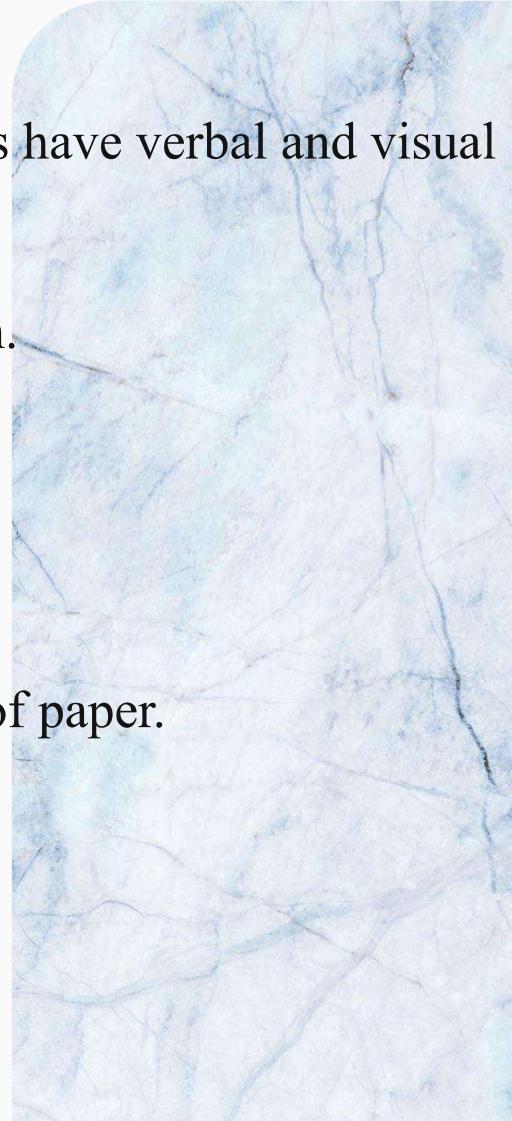
Rules for mind mapping

- Start at the centre of a blank page and place the central idea there.
- Use a picture to represent the central idea, if possible.
- Use colours.
- Make the branches curved rather than using straight lines.
- There should be only one keyword per line.
- Images can be used.
- Develop your own style of mind mapping, if needed.



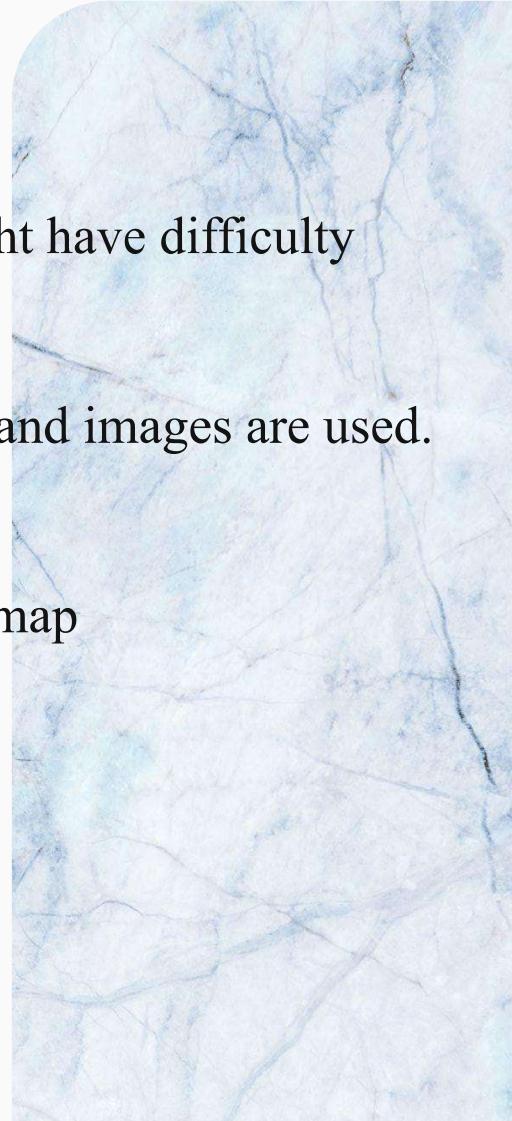
Advantages of mind mapping

- Both hemispheres of brain become active participants as mind maps have verbal and visual components.
- The storage and retrieval of information become easier for the brain.
- New information can be added easily into the mind map.
- Promotes creative thinking.
- Helps in concentrating on single and central idea.
- Helps in condensing large amount of information into single sheet of paper.



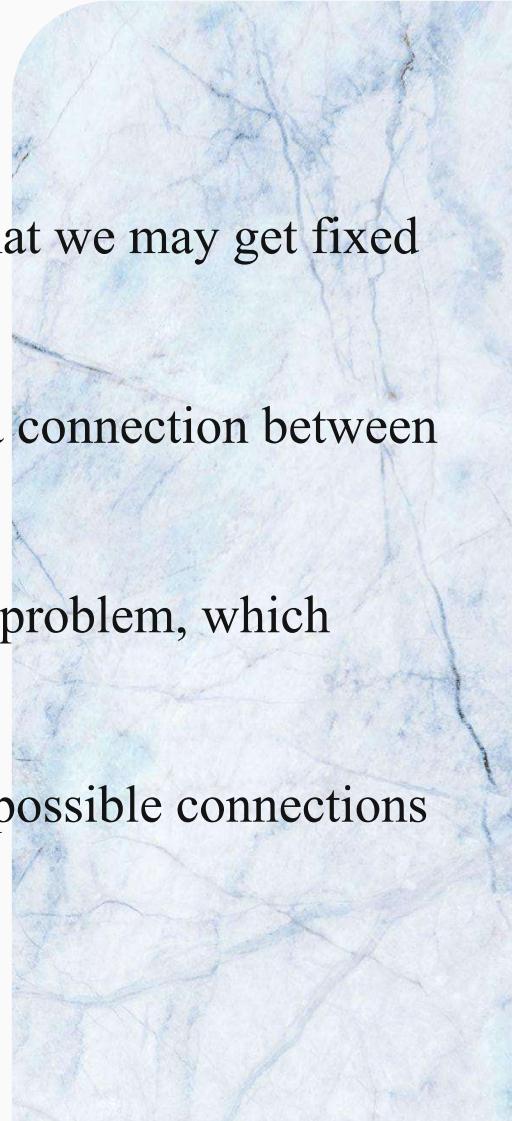
Disadvantages of mind mapping

- Can accommodate only a very limited amount of text.
- Mind maps are often quite personalized and so, another person might have difficulty understanding it.
- Preparation is often quite time consuming - especially when colors and images are used.
- Highly logical people may not find mind mapping easy
- Active participation is necessary to retrieve information from mindmap



Forced Connections

- An entertaining and radical way of generating new ideas.
- This help individuals and groups to breakout the thought patterns that we may get fixed with.
- In this method, the group members are expected to derive or force a connection between the problem at hand and a random object or picture.
- The members can connect any attribute of the object/ picture to the problem, which promotes divergent thinking.
- When the brain considers two different items, it will try to find the possible connections between them.
- This is the basis of forced connection method



Scientific Temperament and Logical Thinking with case studies.

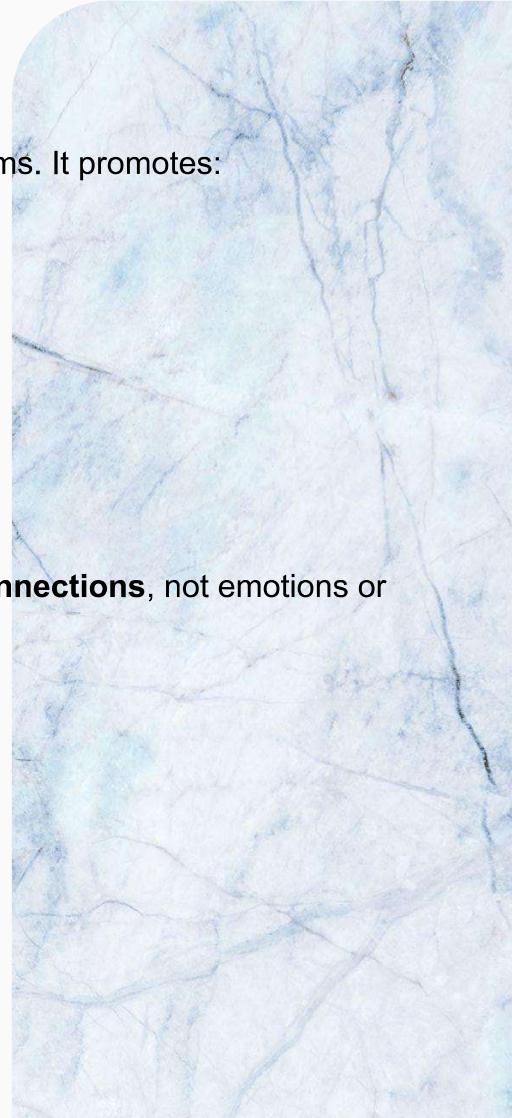
Scientific temperament is an attitude of **logical and rational thinking**, especially when approaching problems. It promotes:

- Observation and questioning
- Testing and verifying facts
- Rejecting superstition or bias
- Accepting conclusions only after evidence

Logical thinking is the **ability to reason** clearly and make decisions **based on facts, data, and rational connections**, not emotions or assumptions.

Importance in Engineering (Life Skills Context)

- Encourages **innovation and problem-solving**
- Prevents blind belief or assumptions in design/testing
- Enhances **decision-making and ethical reasoning**
- Promotes teamwork through objective discussions



Case Study 1: Engineering Ethics – The Challenger Disaster

Situation:

In 1986, NASA's Challenger shuttle exploded shortly after launch. Engineers had warned of issues with **O-ring failure** at low temperatures, but their logical concerns were ignored due to **organizational pressure and emotional decisions**.

Failure in Scientific Temperament:

- Data was ignored in favor of political deadlines
- Logical reasoning by engineers wasn't respected

Life Skills Learning:

- Always prioritize evidence over pressure
- Logical concerns should never be dismissed in technical decisions



Case Study 2: Superstition vs Logic – Electricity Failure in a Hostel

Situation:

In a college hostel, frequent electricity issues were blamed on “bad luck” or ghosts by some students. One engineering student used multimeters and checked load patterns. He found out that a faulty stabilizer was shorting the system.

Failure in Scientific Temperament:

- Superstition overpowered basic technical checks

Life Skills Learning:

- Use scientific tools and logic first before jumping to conclusions
- A small rational step can solve a large emotional problem



Case Study 3: COVID-19 and Mask Usage

Situation:

During early COVID days, rumors circulated that masks were not helpful. Logical thinkers and scientific minds reviewed WHO data, understood droplet transmission, and began promoting masks early, saving many lives.

Application of Scientific Temperament:

- Verified facts before believing mass messages
- Logical evaluation of risk and behavior

Life Skills Learning:

- In crises, scientific thinking saves lives
- Avoid herd mentality; verify before acting



Case Study 4: Mobile App Development Based on User Feedback

Situation:

A student team developed a mental health support app. Instead of assuming what students needed, they conducted surveys, interviews, and A/B testing. The logical and scientific design resulted in high user adoption.

Scientific Approach:

- Hypothesis → Test → Revise
- Evidence-based decision making

Life Skills Learning:

- In design, science helps meet real needs
- Logical thinking ensures inclusive solutions

