

Thinking and Problem solving – UNIT 2

UNIT 2: Topics to be Covered

Thinking	
• Components of Thinking	
• Nature of Thinking	
• Thinking and Reasoning	
Problem Solving process	
Problem Solving - skills and Strategies	
Creative Thinking	
Model of creative Thinking	

What is Thinking: There are various ways to define thinking

Thinking is the mental process of manipulating information to form **concepts, solve problems, reason, and make decisions**. It involves the use of **cognitive functions** such as **perception, memory, and judgement to process and analyze information**

Or

Thinking is perhaps one aspect of our mental activity which continues even when we are asleep. The difference between what is thinking and what is not thinking is just our awareness about the particular thinking process. Hence thinking is a complex mental process which involves manipulation of information. Such information is collected through our senses (such as vision, hearing, smelling etc) from the environment, as well as the information which is stored in our memory because of our encounter with many events and situations in the past.

Thinking is a constructive process in the sense that it helps us to form a new representation of any object or event by transforming available information. It involves a number of mental activities, such as inferring, abstracting, reasoning, imagining, judging, problem solving, and creative thinking. Such activities take place in our mind and can be inferred from our behaviours. Thinking is usually initiated by a problem and goes through a sequence of steps such as judging, abstracting, inferring, reasoning, imagining, and remembering. These steps are often directed towards solution of the problem. The example given below will help you to understand this in a better way.

In order to reach your new school on time suppose you are trying to find out the shortest route from your home to your new school. Your choice will be guided by many factors such as condition of the road, the density of traffic during your school time, safety while walking on the road etc. Finally you take a decision about the best possible shortest route after considering all these factors. Thus, a simple problem like this also requires thinking. The solution to this problem emerges after processing information that is available to us from the environment and our past experience. Thinking relies on a variety of mental structures such as concepts and reasoning.

We will briefly learn about these mental structures.

Concepts: Concepts are one of the key elements of thinking. Concepts represent objects, activities, ideas, or living organisms. They also represent properties (such as “sour” or “brave”), abstractions (such as “anger” or “fear”), and relations (such as “smaller than” or “more intelligent than”). Concepts are mental structures which allow us to organize knowledge in systematic ways. We cannot observe them directly, but we can infer them from behaviour. We as human beings have the capacity to abstract the essential characteristics of objects, events or whatever we perceive. For example, when we see a Potato we categorize it as ‘vegetable’, and when we see a towel we categorize it as ‘cloth’. Whenever we encounter a new stimulus we tend to treat it as a member of a familiar or remembered category and take the same action toward it and give it the same label.

Reasoning: Reasoning is also one of the key aspects of thinking. It is a process that involves inference. Reasoning is used in logical thinking and problem solving. It is goal directed, and the conclusions or judgments are drawn from a set of facts. In reasoning, information from the environment and the stored information in the mind are used following certain rules. There are two types of reasoning: deductive and inductive. In deductive reasoning we try to deduce or draw conclusion from a set of initial assertions or premises; where as in inductive reasoning we start from available evidence to generate a conclusion about the likelihood of something. Most cases of scientific reasoning are inductive in nature. Scientists and even lay people consider a number of instances and try to determine what general rule covers them all.

Thinking and Reasoning

Reasoning is a specific type of thinking that involves drawing conclusions from premises or evidence. It can be divided into two main types:

Deductive Reasoning: Starting from a general principle and reaching a specific conclusion. For example, “All humans are mortal. Socrates is a human. Therefore, Socrates is mortal.”

Inductive Reasoning: Making generalizations based on specific observations. For example, “The sun has risen in the east every day so far. Therefore, the sun will rise in the east tomorrow.”

Examples

Abstract Thinking: A scientist theorizing about the existence of black holes based on mathematical models.

Creative Thinking: An artist creating a unique piece of artwork by combining different styles.

Critical Thinking: A student evaluating the credibility of sources for a research paper.

Reflective Thinking: A teacher reflecting on their teaching methods to improve student engagement.

Nature of Thinking

The nature of thinking encompasses several key aspects:

1. **Abstract Thinking:** This involves processing ideas that are not physically present. For example, imagining a future event or solving a mathematical problem.
2. **Creative Thinking:** Generating new ideas or concepts, or finding new associations between existing ideas. For instance, coming up with a novel solution to a problem.
3. **Critical Thinking:** Analyzing and evaluating information to form a judgment. This includes questioning assumptions and assessing the validity of arguments.
4. **Reflective Thinking:** Deliberately thinking about one's own thinking processes. This can involve self-assessment and considering how to improve one's cognitive strategies.

Problem solving

Everyone has problem and ability to solve problems (animals/ humans/ insects)

What Is A Problem?

A Problem Is Any Situation Where There Is A Gap Between The Current State And A Desired State, With Obstacles In The Way.

- What is problem solving: The Process Of Finding A Solution To A Difficult Or Complex Issue.
- Involves Logical Reasoning, Creativity, And Critical Thinking.

Types Of Problems:

Well-defined: Clear Goals And Solution Paths (Example: Mathematical Problems).

Ill-defined: Unclear Goals And Multiple Possible Solutions (Example: Real-world Challenges).

Importance of Problem solving:

It is an Essential Skill In Academic And Real-world Scenarios which Helps In Decision-making, Innovation, And Overcoming Challenges, also helps in crucial skill For Academic Success And Career Development. Enhances Decision-making And Innovation.

Problem Solving Process:

- **Identify/ understand The Problem**
- **Clarify The Issue:** Understand What The Problem Is And Why It Needs To Be Solved.
- **Gather Information:** Collect Relevant Data And Insights To Understand The Problem's Context.
- **Define The Problem:** Articulate The Problem Clearly, Ensuring Everyone Involved Has A Common Understanding.

Define the Problem:

- Defining The Problem Is The Hardest Part.
- We Usually Tend To Worry About The Problem Before Trying To Identify What The Problem Actually Is.
- We Perceive A Problem, Which Might Not Actually Be The Problem And Start Worrying About It. Instead, Try To Define The Problem

Barriers to Problem Solving:

1. Problems Are Barriers Themselves
2. Irrelevant Information,
3. Bias Towards Confirmation,
4. Baseless Constraints,
5. Mindset And Fixedness To One Method Of Solving Problems.

Problem solving skills and strategies: The Steps

1. Understanding Problem:

- **1. Clearly define the problem before seeking solutions.**
- Start by articulating the problem in precise terms. A well-defined problem is easier to solve because it sets clear boundaries and objectives.
- **2. Gather all relevant information and data.**
- Collect as much relevant information as possible from various sources. This might include historical data, expert opinions, or case studies, helping to form a comprehensive understanding.
- **3. Identify the root cause, not just the symptoms.**
- Use techniques like the “5 Whys” to drill down to the root cause. Solving surface-level symptoms often leads to temporary fixes, while addressing the root cause results in lasting solutions.
- **4. Ask critical questions to uncover hidden issues.**
- Challenge assumptions and ask probing questions to uncover underlying issues that might not be immediately apparent. This can reveal complexities that need to be addressed.
- **5. Develop a complete understanding to guide effective solutions.**
- Synthesize all gathered information to form a clear, complete picture of the problem. This understanding will guide you in creating targeted and effective solutions.

2. Creative Thinking

- **1. Think outside the box; explore unconventional ideas.**
- Encourage creativity by considering non-traditional approaches. This might involve looking at how similar problems are solved in other industries or disciplines.
- **2. Brainstorm multiple solutions without judging them initially.**
- During brainstorming sessions, suspend judgment to allow all ideas, even the wild ones, to surface. This often leads to breakthroughs when unexpected connections are made.
- **3. Use lateral thinking techniques to unlock new possibilities.**
- Employ lateral thinking, a method developed by Edward de Bono, to approach problems from different angles. Techniques like random word association can spark new ideas.
- **4. Encourage diverse perspectives to enrich creativity.**
- Involve people from different backgrounds and disciplines. Their unique perspectives can lead to more innovative and varied solutions.
- **5. Combine different ideas to create innovative solutions.**
- Sometimes, the best solution is a combination of several ideas. Look for ways to integrate and adapt multiple concepts to create a more robust solution

III) Analytical Tool

1. Apply SWOT analysis to assess strengths and weaknesses.

SWOT (Strengths, Weaknesses, Opportunities, Threats) analysis helps in understanding the internal and external factors affecting the problem. This structured approach aids in strategic decision-making.

2. Use logical reasoning to evaluate potential solutions.

Apply logical reasoning to assess the feasibility of each solution. This involves considering the cause-and-effect relationships and ensuring that the solution addresses the problem effectively.

3. Consider both qualitative and quantitative data in analysis.

Balance numerical data (quantitative) with descriptive insights (qualitative) to get a full picture of the situation. Both types of data are crucial for a well-rounded analysis.

4. Weigh the pros and cons of each option systematically.

Create a pros and cons list for each solution. This helps in visualizing the trade-offs and making a more informed decision.

5. Select the solution with the most favorable outcomes.

Choose the solution that maximizes benefits while minimizing risks. This selection should be backed by data and thorough analysis.

IV) Decision Making

1. Make decisions based on thorough analysis and evidence.

Base your decisions on data and evidence rather than gut feeling alone. A data-driven approach reduces bias and increases the likelihood of success.

2. Consider short-term and long-term impacts of each option.

Evaluate how each decision will affect the short-term and long-term. Some solutions might offer quick fixes but could create problems in the future.

3. Use decision-making models to guide your choice.

Employ models like the Decision Matrix or Cost-Benefit Analysis to structure your decision-making process. These tools help in objectively comparing different options.

4. Be decisive, but remain flexible to adapt if needed.

Once a decision is made, commit to it. However, stay flexible and ready to pivot if new information or challenges arise.

5. Communicate decisions clearly to all stakeholders.

Ensure that everyone involved understands the decision and the rationale behind it. Clear communication helps in aligning efforts and reducing misunderstandings

V) Implementing Solutions

- **1. Develop a clear plan with specific steps and timelines.**
- Create a detailed action plan that outlines the steps needed to implement the solution, along with deadlines and milestones to track progress.
- **2. Allocate necessary resources and assign responsibilities.**
- Ensure that all resources, including time, money, and personnel, are allocated effectively. Assign tasks to specific individuals or teams with clear responsibilities.
- **3. Monitor the implementation process closely for success.**
- Keep a close eye on the implementation to ensure everything is on track. Use regular check-ins and progress reports to stay informed.
- **4. Be prepared to make adjustments as challenges arise.**
- Remain agile and ready to adapt the plan if new challenges or opportunities emerge. Flexibility in execution often leads to better outcomes.
- **5. Ensure effective communication throughout the process.**
- Maintain open lines of communication with all stakeholders. Regular updates and transparency are key to keeping everyone aligned and engaged.

VI) Reflecting and learning

- **Evaluate the outcome of the implemented solution.**
After implementation, assess whether the solution achieved the desired results. Compare the outcomes with the initial goals to determine success.
- **Reflect on what worked well and what didn't.**
Take time to analyze both the successes and failures. Understanding what worked well can reinforce good practices, while learning from failures prevents repeating mistakes.
- **Document lessons learned for future reference.**
Keep a record of the lessons learned during the problem-solving process. This documentation can be a valuable resource for future problem-solving efforts.
- **Continuously improve problem-solving techniques.**
Use the insights gained to refine and enhance your problem-solving skills. Continuous improvement is key to becoming a more effective problem solver.
- **Use feedback to refine and develop better strategies.**
Gather feedback from all involved parties and use it to fine-tune your approach. Constructive criticism can lead to better strategies and improved outcomes.

VII) Collaboration and Communication

Engage team members in collaborative problem-solving.

Involve your team in the problem-solving process to harness collective intelligence. Collaboration often leads to more innovative and effective solutions.

Foster open communication to share ideas and feedback.

Encourage an environment where everyone feels comfortable sharing their ideas and feedback. Open communication leads to better decision-making and stronger team dynamics.

Leverage diverse skills and expertise within the group.

Make use of the varied skills and knowledge of team members. Diversity in experience and thinking can lead to more comprehensive solutions.

Build consensus through active listening and discussion.

Engage in active listening and open discussion to build consensus around solutions. Ensuring everyone's voice is heard increases buy-in and commitment.

Maintain clear communication channels throughout the process.

Keep communication channels open and clear throughout the problem-solving process. This ensures that everyone is on the same page and that there are no misunderstandings.

Common fields where problem solving is practiced

- Psychology: Problem Solving Is Used In Psychology To Try And Obtain Solutions To Problems Dealing With Mental Health

- Computer Science And Algorithms: Every Software Company That Develops New Software Has To Troubleshoot And Solve Problems That The New Software Might Have. In The Field Of Computer Science And Artificial Intelligence Where Algorithms Are The Methods Through Which The Programs Are Designed, Problem Solving Is A Hero!
- Engineering: Problem Solving In Engineering Is Used To Overcome Product Or Process Failures. It Is Usually Done To Rectify The Problem And Also To Ensure That The Problem Does Not Occur Again
- Medicine Science and Health: Research Studies / Public Health.

RCT: Root Cause Analysis

It is a systematic process of discovering the origin of problems or the root cause of the problem in order to determine appropriate solutions. It is the fundamental aspect of problem solving in any field.

- Identify the underlying cause or causes of a problem rather than addressing the immediate symptoms. It ensure that same problem does not occur.
- Step1: Problem must be clearly and understood [By gathering all data, documenting the data, understanding its impact on the process or system)
- Step 2: Asking series of Why Questions – A method known as 5 Whys. The goal of asking this 5 Whys is to peel the symptoms and find out the root cause.
- Step 3: One the root cause is been identified solutions can be addressed
- Step 4: Develop solutions
- Step 5: Implement and Monitor the Solutions

Root Cause Analysis is not only just fixing problem but about

Learning Opportunity

Document Valuable Insights.

How systems works and how it can be improved.

Culture of Learning and Improvement

Various Tools to identify the underlying problem:

1. 5 Whys: Keep asking "Why?" until the root cause is identified.
2. Fishbone Diagram (Ishikawa): Visualizes the cause-and-effect relationship of problems.
3. SWOT Analysis
4. Brainstorming
5. Flowcharting
6. Pareto Analysis
7. Stakeholder Analysis
8. Gap Analysis

9. Failure Mode and Effects Analysis (FMEA)
10. Six Sigma Tools (DMAIC)
11. Survey and Feedback Analysis

Toyota & 5 Whys Tool:

This method was initially developed by Sakichi Toyoda; the founder of Toyota industries and till time is being used in Toyota Motor Corporation. This is considering as the basic tools for Toyota's scientific approach.

Along with Toyota this tool has widespread application in many other industries including food safety to rectify root cause of customer complaints and other non-conformances underlying in product and processing.

Example:

Perform a **root cause analysis** for the issue of **reducing password sharing** using the **5 Whys Technique**. This method helps us uncover the underlying reasons behind a problem by repeatedly asking "why" until we reach the fundamental cause.

Define the Problem: The problem is **password sharing**, which compromises security and violates access controls.

1. Ask "Why?" (First Iteration):

- **Why do users share passwords?**
 - Because they find it convenient to share credentials with colleagues or friends.

2. Ask "Why?" (Second Iteration):

- **Why do users find it convenient to share passwords?**
 - Because they face challenges in remembering multiple complex passwords for different accounts.

3. Ask "Why?" (Third Iteration):

- **Why do users struggle with remembering passwords?**
 - Because password policies often require frequent changes, leading to confusion and forgetfulness.

4. Ask "Why?" (Fourth Iteration):

- **Why do password policies mandate frequent changes?**
 - Because organizations prioritize security, but this practice unintentionally encourages users to write down or share passwords.

5. Ask "Why?" (Fifth Iteration - Root Cause):

- **Why does the security policy inadvertently promote password sharing?**
 - Because it lacks a balance between security and usability, leading users to take shortcuts.

Root Cause: The overly strict password policy creates usability challenges, pushing users to share passwords for convenience.

Solution Recommendations:

- **Usability-Driven Policies:** Revise password policies to strike a balance between security and user experience.
- **Multi-Factor Authentication (MFA):** Implement MFA to enhance security without burdening users with frequent password changes.

SWOT Analysis:

SWOT (also known as SWOT matrix, SWOT analysis, and SWOT method) is a framework for identifying and analyzing a business's internal factors, namely strengths and weaknesses, and external factors, namely opportunities and threats. The framework helps differentiate and establish unique opportunities for companies within a broader market to determine their strategic business directions.

The History of SWOT Analysis

The history of SWOT analysis dates back to the 1960s. A management consultant from Stanford Research Institute, [Albert Humphrey](#), and his team invented a framework to help businesses with more sustainable strategic planning.

The framework was initially introduced as SOFT Analysis (Satisfactory, Opportunity, Fault, and Threat). After a decade of work, Albert and his team eventually proposed a SWOT analysis that assesses criteria such as products, processes, customers, distributions, finances, and administration.

The Actual Meaning of SWOT

SWOT stands for Strengths, Weaknesses, Opportunities, and Threats. Strengths and weaknesses are internal factors within a company that can typically be controlled or changed. In contrast, opportunities and threats are external factors that companies cannot influence directly but can respond to strategically.

- **Strengths** describe what a business is good at, setting it apart from competitors.
- **Weaknesses** are barriers that hinder a company from performing at its best.
- **Opportunities** are external factors that could provide competitive advantages.
- **Threats** are potential elements that could harm the company.

Since its introduction in the 1960s, the SWOT framework has been widely used in business practices, but its application is not limited to business planning. It is also used for assessing products, places, industries, and individuals.

What is Personal SWOT Analysis?

A personal SWOT analysis is a method of individual assessment. It can be done at any stage in life to determine self-improvement, educational choices, career paths, or career growth opportunities. You can use a personal SWOT for self-assessment or social comparison.

Why is Personal SWOT Analysis Important?

When it comes to significant changes in your life, it involves gathering information, thinking, and analyzing. Conducting a personal SWOT analysis can help you avoid unforeseen mistakes because it requires you to address your strengths, weaknesses, opportunities, and threats.

You can understand well the following aspects:

- **Strengths:** Recognizing your advantages over your competitors/peers and positioning yourself to achieve your goals.
- **Weaknesses:** Identifying weaknesses allows you to develop a plan to bridge your gaps.
- **Opportunities:** Identifying opportunities helps you determine chances that guide you toward your goals.
- **Threats:** Recognizing threats enables you to build a defensive plan against potential obstacles and unexpected challenges.

Being aware of your weaknesses could be your biggest strength – Gordon Hester said.

Personal SWOT Analysis Matrix.

The personal SWOT analysis is presented as four quadrants:

Strengths	Weakness
Opportunities	Threats

Strengths and weaknesses are always internal factors. Opportunities and threats are always external factors.

To analyze these factors, ask yourself a series of questions related to your goal.

1. **List All Your Answers:** Be honest with yourself. The more detailed your points, the better you can determine future improvements.
2. **Gather Your Answers:** Write down everything to prevent missing points. You can always eliminate unimportant issues later.

3. **Determine Your Solutions:** Identify solutions that can help you achieve your goal. Ensure your answers are realistic and achievable.