GSE101 ANALYTICAL SKILLS

Supporting Resources for Tutors

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Unit I: Thinking Process & Reflection

Introduction

This Unit aims to introduce the concept of thinking process and reflection, mind mapping, metacognition and Thinking paradigms.

Learning Outcomes

By the end of the unit, the learners will be able to:

- Understand thinking process and reflection
- Explain the concept of mind mapping
- Think about the thinking
- Generate, visualize, structure and classify ideas using mind mapping skills
- Understand the thinking paradigms and patterns

Icebreaker (activity):

- Number doesn't Lie
- Free Association

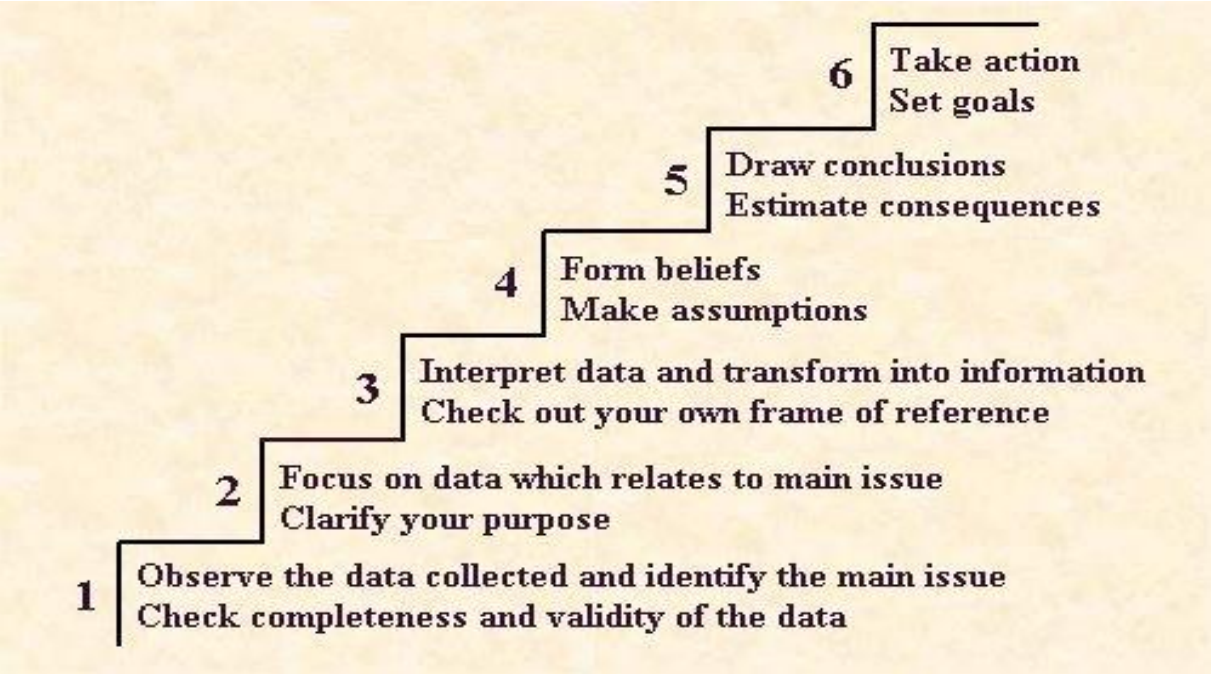
Thinking Process and Reflection

So, what is 'Thinking'?
According to English Oxford Living Dictionary, 'thinking' is simply "the process of considering or reasoning about something".

In fact, thinking is a process of exercising the mind in order to make a decision. It involves remembering or recollecting information to make mental choice between options.

(Source: Prezi Templates)

Thinking Process



- In steps 1 - 3 suspend premature judgment. Use mature, informed judgment in steps 4 - 6.
- As indicated by the curved arrow, starting with beliefs and assumptions, and then skipping to taking action, short circuits the thinking process.
- Share as much of your thinking process as possible with others when you present your ideas and opinions.
- To get the results you want, you do not have to follow each step precisely or even in order. But the more thoroughly you do them, the more you will improve the quality of your decisions.
- Be aware of how the different steps affect each other. For instance, beliefs may lead to new data or new data may lead to new beliefs.

(Based on The Ladder of Inference by Chris Argyris)

Reflection Questions

What? /So What? /Now What?

This structure for reflection questions is perhaps the most widely known and used. It is a basic way to promote discussion that begins with reviewing the details of the experience and moves

toward critical thinking, problem solving, and creating and action plan.

What?
- Descriptive
- Facts, what happened, with whom
- Substance of group interaction

So what?
- Shift from descriptive to interpretive
- Meaning of experience for each participant
- Feelings involved, lessons learned
- Why?

Now what?
- Contextual-- seeing this situation's place in the big picture
- Applying lessons learned/insights gained to new situations
- Setting future goals, creating an action plan

The reflection may be used for (but not limited to):
- Career exploration
- Social change/justice
- Civic responsibility
- Leadership development
- Intellectual pursuit
- Spiritual fulfillment
- Professional development
- Political consciousness

Mind Mapping

What is Mind Mapping?

A mind map is a diagram used to represent words, ideas, tasks, or other items linked to and arranged around a central key word or idea. Mind maps are used to generate, visualize, structure, and classify ideas, and as an aid to studying and organizing information, solving problems, making decisions, and writing.

The elements of mind map are arranged intuitively according to the importance of the concepts, and are classified into groupings, branches, or areas, with the goal of representing semantic or other connections between portions of information. Mind maps may also aid recall of existing memories.

By presenting ideas in a radial, graphical, non-linear manner, mind maps encourage a brainstorming approach to planning and organizational tasks. Though the branches of a mind map represent hierarchical tree structures, their radial arrangement disrupts the prioritizing of concepts typically associated with hierarchies presented with more linear visual cues. This orientation towards brainstorming encourages users to enumerate and connect concepts without a tendency to begin within a particular conceptual framework.[2]

A mind map is a highly effective way of getting information in and out of your brain - it is a creative and logical means of note taking that literally "maps out" your ideas.

All mind maps have some things in common. They have a natural organizational structure

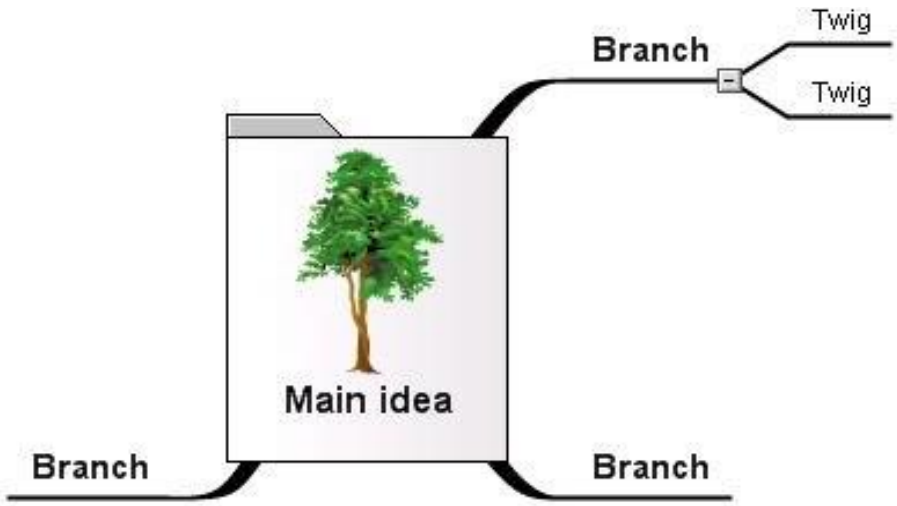
that radiates from the center and use lines, symbols, words, colour and images according to simple, brain-friendly concepts. A mind map converts a long list of monotonous information into a colourful, memorable and highly organized diagram that works in line with your brain's natural way of doing things.

One simple way to understand a mind map is comparing it to a map of a city. The city center represents the main idea; the main roads leading from the center represent the key thoughts in your thinking process; the secondary roads or branches represent your secondary thoughts, and so on. Special images or shapes can represent landmarks of interest or particularly relevant ideas.

A mind map is an external mirror of your own radiant or natural thinking facilitated by a powerful graphic process, which provides the universal key to unlock the dynamic potential of the brain.

The five essential characteristics of a mind map:

- The main idea, subject or focus is crystallized in a central image.
- The main themes radiate from the central image as 'branches'.
- The branches comprise a key image or key word drawn or printed on its associated line.
- Topics of lesser importance are represented as 'twigs' of the relevant branch.
- The branches form a connected nodal structure.



Steps in mind mapping

- Take a sheet of plain paper and turn it sideways (if using flipchart paper you don't need to turn it sideways - it is large enough)
- Using coloured felt pens, draw a small picture (or write a phrase) in the centre of the paper representing the issue you want to solve
- Draw lines out from the main problem (it helps to use different colours for each line)

- Each line should represent a different aspect of your problem or issue
- Write down what each line represents either on top of or on the line
- Add other lines flowing off these main lines
- Write a word or short phrase on the smaller lines indicating what each new line represents (you may find that mind mapping works best for you if you write down the phrases or draw the images first and then connect them with the lines) and
- If you want, add images next to your main line that illustrate what each line means to you (some people think better with pictures, others with words).

Critical Questions to be considered while Mind Mapping

- What is the central word, concept, research question or problem around which to build the map?
- What are the concepts, items, descriptive words or telling questions that you can associate with the concept, topic, research question or problem?

Suggestions

- Use a top down approach, working from general to specific or use a free association approach by brainstorming nodes and then develop links and relationships.
- Use different colours and shapes for nodes & links to identify different types of information.
- Use different coloured nodes to identify prior and new information.
- Use a cloud node to identify a question.
- Gather information to a question in the question node.5

Application of Mind Mapping

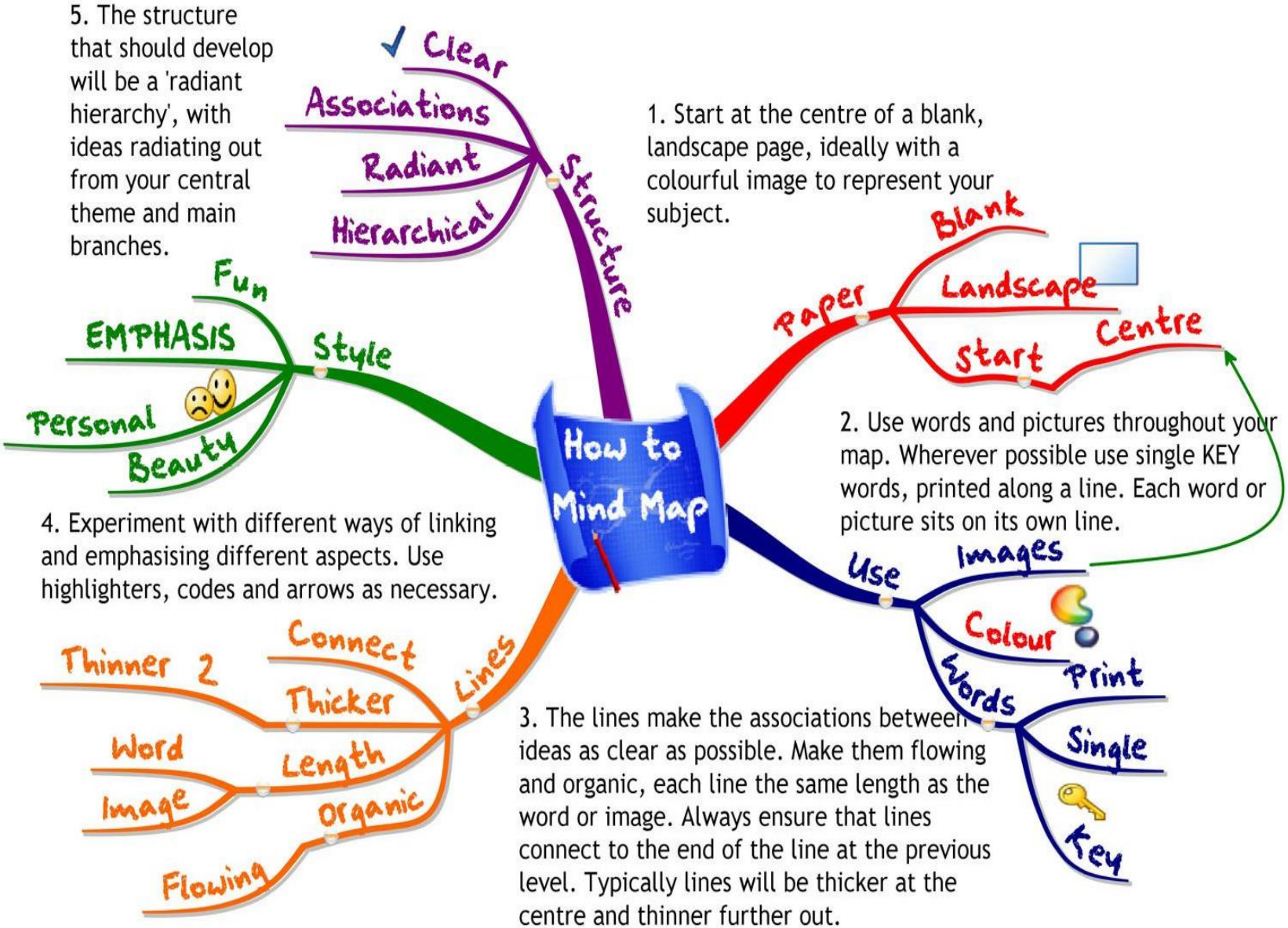
A mind map is often created around a single word or text, placed in the center, to which associated ideas, words and concepts are added.

Mind maps have many applications in personal, family, educational, and business situations, including note taking, brainstorming (wherein ideas are inserted into the map radially around the center node, without the implicit prioritization that comes from hierarchy or sequential arrangements, and wherein grouping and organizing is reserved for later stages), summarizing, revising, and general clarifying of thoughts. One could listen to a lecture, for example, and take down notes using mind maps for the most important points or keywords. One can also use mind maps as a mnemonic technique or to sort out a complicated idea. Mind maps are also promoted as a way to collaborate in colour pen creativity sessions.

Mind maps can be used for:

- Problem solving
- Outline/framework design
- Anonymous collaboration
- Marriage of words and visuals
- Individual expression of creativity
- Condensing material into a concise and memorable format
- Team building or synergy creating activity
- Enhancing work morale

Despite these direct use cases, data retrieved from mind maps can be used to enhance several other applications, for instance expert search systems, search engines and search and tag query recommender. To do so, mind maps can be analyzed with classic methods of information retrieval to classify a mind map's author or documents that are linked from within the mind map. Mind maps can be drawn by hand, either as "rough notes" during a lecture or meeting, for example, or can be more sophisticated in quality. An example of a rough mind map is illustrated. There are also a number of software packages available for producing mind maps.



An example of diagrammatical representation of mind mapping

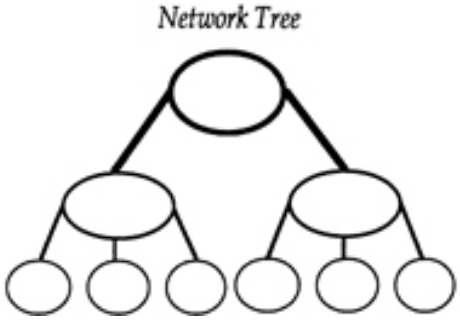
Activity 1. Students will be given any topic of their interest to do mind mapping.

Types of Mind Mapping

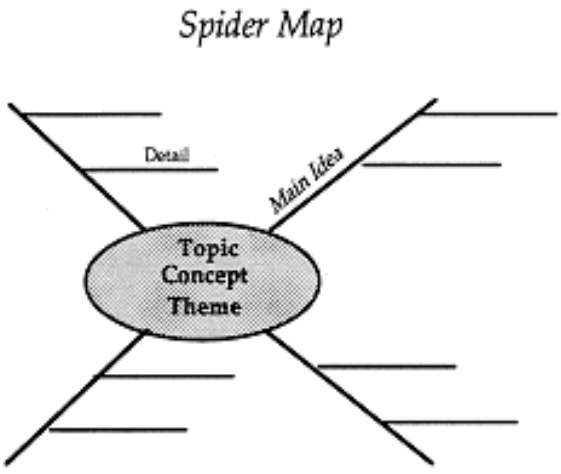
Types of Graphic Organizers

- Graphic organizers come in many different forms, each one best suited to organizing a particular type of information. The following examples are merely a sampling of the different types and uses of graphic organizers.
- A Descriptive or Thematic Map works well for mapping generic information, but particularly well for mapping hierarchical relationships.

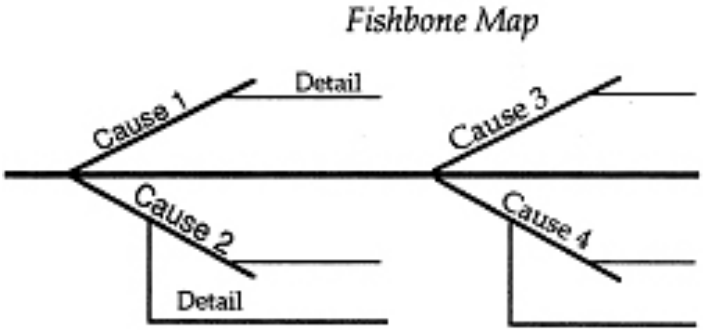
Organizing a hierarchical set of information, reflecting super-ordinate or subordinate elements, is made easier by constructing a Network Tree.



When the information relating to a main idea or theme does not fit into a hierarchy, a Spider Map can help with organization.



When cause-effect relationships are complex and non-redundant a Fishbone Map may be particularly useful.



Metacognition and Thinking about Thinking

Try Thinking about:

- The ability to critically analyze how you think
- Having high self-awareness and control over your thoughts
- Developing appropriate and helpful thinking strategies at each stage of a task

So metacognition:

Refers to one's ability to be aware of what one thinks about and choosing a helpful thought process. It captures one's ability to analyse how one thinks, has high self-awareness and control of their thoughts and choose an appropriate and helpful strategy for the task at hand. Metacognition is, put simply, thinking about one's thinking. More precisely, it refers to the processes used to plan, monitor, and assess one's understanding and performance. Metacognition includes a critical awareness of a) one's thinking and learning and b) oneself as a thinker and learner.

There are different types of metacognition. These include:

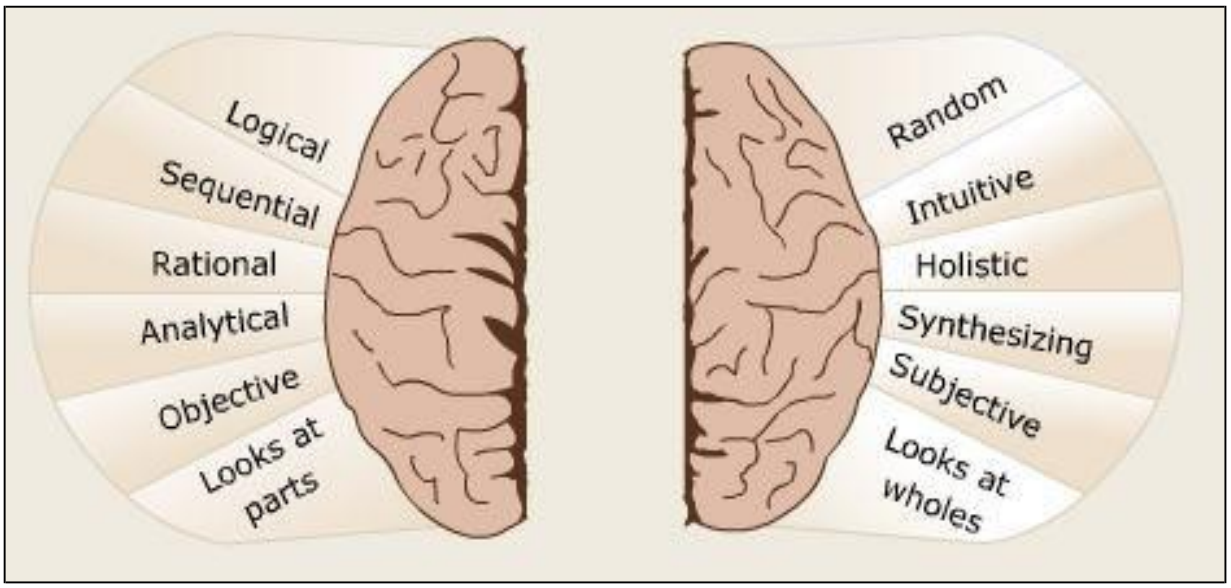
Metacognitive knowledge - this refers to your awareness about what you do or don't know. It is similar to knowing your strengths, weaknesses and any gaps in your knowledge

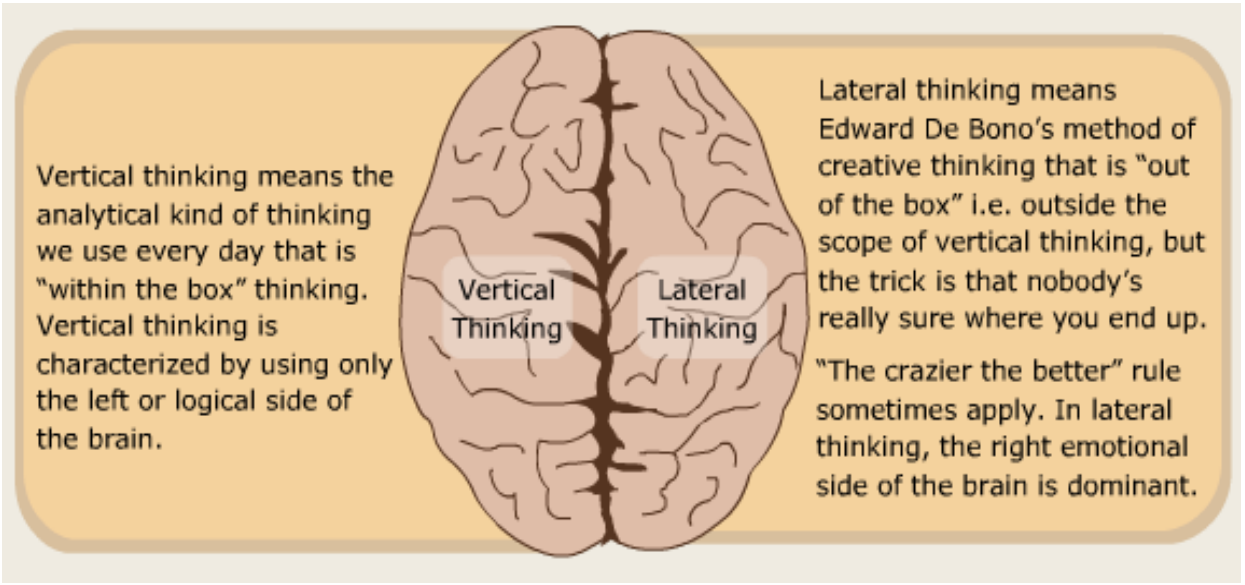
Metacognitive regulation refers to the different strategies students use to manage their thoughts and emotions. This includes how well students plan, monitor and evaluate their performance.

Thinking Paradigms

Lateral and Vertical Thinking

This explains that the two different sides of the brain or hemispheres are responsible for different types of thinking as follows:





Left and Right Brain Coordination Exercise

Step I: Ask for any three students in the class to sign their signature on the white/black board.

Step II: Now ask the same students to sign again with their left leg moving in an anticlockwise direction.

Let the class assess the difference between the first and the second signature. Certainly, the second signature may not be as accurate as the first one. Let the students involved in signing also share their experience of difficulty.

Conclusion: The left-brain tries for accurate signature but the right brain tries to ensure the circular movement of the leg.

Optical Illusion Exercise

OPTICAL ILLUSION VS COLOUR TEST

Look at the chart below and say the **COLOUR** not the Word

BLACK	GREEN	RED
YELLOW	PURPLE	RED
ORANGE	GREEN	YELLOW

Left-Right Conflict

Your Right Brain tries to say the Colour but your Left Brain insists on reading the Word

Difference between the two types of thinking

Vertical Thinking	Lateral Thinking
• Looking for the right approach • Analytical • Sequential • Proceed if there is direction • One must be correct at each step • Use negative to block off certain pathways • Exclude what is irrelevant • Fixed categories or labels • Explore most likely paths • Is a finite process	• Looking for as many approaches as possible • Richness • Proceeds to generate direction • Is provocative • Can make jumps • One doesn't have to be always correct • No negatives • Labels may change • Explore least likely paths • Is probabilistic

Activity 1a: Crossing the Bridge

Instructions:

1. Team Work
2. When you finish the task say Bingo to win the game

Dorji, Yonten, Dema and Tobgay are on an outdoors team-building course. They have to cross a bridge in 17 minutes. The bridge will collapse if there are more than two people on it at the same time. It is dark and it is too dangerous to cross the bridge without a torch. There is only one torch.

Dorji can cross the bridge in 1 minute. The others are wounded or injured to varying degrees which means that it takes:

- Yonten 2 minutes to cross the bridge;
- Dema 5 minutes to cross the bridge;
- Tobgay 10 minutes to cross the bridge.

How did they cross the bridge in 17 minutes?

Activity1b: The Elevator

A man lives on the 15th floor of an apartment block. Each day he leaves his apartment to go to work. He calls the elevator and, once inside, presses the ground floor button. When he returns from work he calls the elevator from the ground floor, enters the elevator and presses the 10th floor button. At the 10th floor he gets out of the elevator and walks the final 5 floors up to his apartment. Can you explain why?

Activity1c: Desert Woman

A woman is dead in the middle of the desert. She has a pack on her back. How did she die?

Activity1d: Blind Beggar

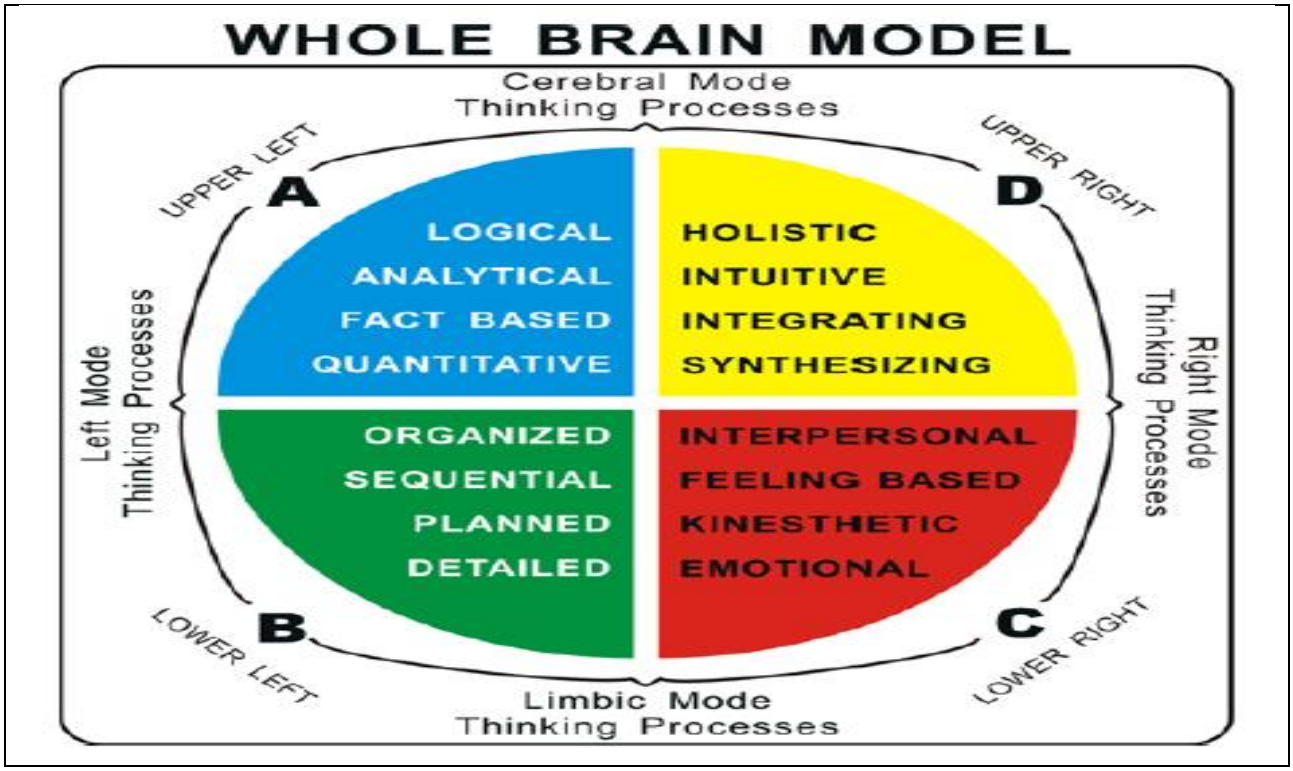
A blind beggar had a brother who died. What relation was the blind beggar to the brother who died?

Whole Brain Thinking

"Whole Brain Thinking is a methodology designed to help thinkers, teams and organizations better benefit from all of the thinking available to them. It acknowledges that while different tasks require different mental processes, and different people prefer different kinds of thinking, organizations will get better results when they can strategically leverage the full spectrum of thinking available." (Herrmann).

Nedd Herrmann developed the Whole Brain Concept in the 1970's whilst a manager at GE (General Electric). He was interested in the source of creativity, initially focused on GE managers and then across many other companies. Over a million people have taken the assessment and it is used in various forms across the world to assist in management, leadership, sales strategy and the individual's self-awareness.

Thinking is split into four key areas. HBDI (Herrmann Brain Dominance Instrument) identifies them as colours to identify analytical thinking (blue), strategic thinking (yellow), people focused thinking (red) and organizational thinking (green).



Human thinking can be divided into two basic types: 1) the fast, unconscious, intuitive, and emotional thinking that is handled by the more primitive parts of our brains, and 2) the slow, conscious, deliberate, and rational thinking that takes place in the parts of our brains that evolved more recently. Daniel Kahneman in *Thinking Fast and Slow* refers to them as System 1 and System 2 thinking. Both types are critical and useful, but they are best suited for different cognitive tasks. Our thinking can be improved if we understand their differences and learn to appropriately match the right type of thinking to the task at hand. Data sense making often requires System 2 thinking, so all data analysts must understand when to use it and how, as well as when, to trust their

intuitions.

System 1 Thinking	System 2 Thinking
• See that an object is at a greater distance than another • Localize the source of a specific sound • Complete the phrase "war and..." • Display disgust when seeing a gruesome image • Solve 2+2=? • Read a text on a billboard • Drive a car on an empty road • Come up with a good chess move (if you're a chess master) • Understand simple sentences • Connect the description 'quiet and structured person with an eye for details' to a specific job	• Brace yourself before the start of a sprint • Point your attention towards the clowns at the circus • Point your attention towards someone at a loud party • Look out for the woman with the grey hair • Dig into your memory to recognize a sound • Sustain a higher than normal walking rate • Determine the appropriateness of a behavior in a social setting • Count the number of A's in a certain text • Give someone your phone number • Park into a tight parking space • Determine the price/quality ratio of two washing machines • Determine the validity of a complex logical reasoning • Solve 17*24

Analytical Thinking & Critical Thinking

Analytical thinking is a critical component of visual thinking that gives one the ability to solve problems quickly and effectively. It involves a methodical step-by-step approach to thinking that allows you to break down complex problems into single and manageable components.

Analytical thinking involves the process of gathering relevant information and identifying key issues related to this information. This type of thinking also requires you to compare sets of data from different sources; identify possible cause and effect patterns, and draw appropriate conclusions from these datasets in order to arrive at appropriate solutions.

Analytical thinking is a thinking process or skill in which an individual has the ability to scrutinize and break down facts and thoughts into their strengths and weaknesses. It involves thinking in thoughtful, discerning ways, in order to solve problems, analyze data, and recall and use information. It involves the following main activities:

- Focusing on facts and evidence

- Analyzing data or information or systems
- Dissecting data/information and the analysis of complex things into simpler constituents
- Reasoning – thinking that is coherent and logical
- Partitioning, breakdown – an analysis into mutually exclusive categories
- Eliminating extraneous data or analysis of a problem into alternative possibilities followed by the systematic rejection of unacceptable alternatives
- Analyzing trends or the analysis of changes over time

Analytical thinking can be broken down into three main steps:

Information Gathering

When it comes to analytical thinking, it's important to develop your ability to recognize underlying issues or problems based on trends, associations and cause-effect relationships between datasets.

Identifying issues and problems

When it comes to analytical thinking, it's important to develop your ability to recognize underlying issues or problems based on trends, associations and cause-effect relationships between datasets.

Organizing information

Once all relevant information has been collected successfully, you must now organize and integrate all the pieces in a way that will provide you with insights and ideas that can be used to draw appropriate conclusions. This in turn will lay down the foundations for potential solutions to the problem or problems you are facing.

Analytical Vs. Critical Thinking

Some people make the assumption that analytical thinking and critical thinking are one in the same. That is not actually true. You want to have the ability to differentiate the two so that you understand when you need to think critically and when you need to think analytically.

When you think critically, you make the decision whether or not an event, an object or situation appears to be right or wrong. Once you are given information, you evaluate the data and determine how it should be best interpreted. You then make conclusions regarding your unique perception of the information. Moreover, you combine your new information with your current knowledge of the world in order to make the most accurate assessment you can make. You start to look into other pieces of data that could be relevant. In addition, critical thinking takes facts and uses them to form an opinion or a belief.

As for analytical thinking, you use it to break down a series of complex bits of information. You think step-by-step to develop an overall conclusion, answer or solution. You look at something through different points of view with the objective to create a cause and an effect. To illustrate, you might try to determine why dogs wag their tails, and then come up with the scientific answer.

Also, with analytical thinking, you use facts to support your conclusion and train of thought. On the other hand, critical thinking is more of an opinion-based style of thinking. Analytical skills lead you to have a more focus and streamlined approach to solution finding where critical thinking skills can go around in circles infinitely. When you have a complex-problem or solution to find, you would use your analytical skills.

Critical thinking involves:

Critical Thinking consists of mental processes of discernment, analysis and evaluation, especially as it relates to what we hear by way of points that are raised or issues which are put forward for discussion. It includes the process of reflecting upon a tangible or intangible item in order to form a sound judgment that reconciles scientific evidence with common sense. Hence, Critical Thinking is most successful when it effectively blends our natural senses or feelings with our logic and intuition, all applied in a systematic manner. It involves the following main activities:

- Deeply evaluating how far information we are given is current, up-to-date and accurate.
- Checking for bias or unsubstantiated assumptions.
- Evaluating how far the evidence or opinions presented genuinely proves the point(s) claimed.
- Weighing up opinions, arguments or solutions against appropriate (usually logical) criteria.
- Making inferences from the data/information and filling in "gaps".
- Taking a clear line of reasoning through to its logical conclusion.

Analytical thinking mainly aims to review the data/information we are presented with (for relevance, patterns, trends etc.) [Lateral thinking aims to put data/information into a new or different context (in order to generate alternative answers or solutions] and Critical thinking aims to make an overall or holistic judgment about the data/information which is as free from false premises or bias as much as possible. Although there is clearly therefore much overlap between all three activities (and they certainly complement one another), each one as a unique focus and where there is time and the needs are significant enough should be deployed in the above order.

Creative Thinking

(Refer Unit III for more details)

Creative thinking means looking at something in a new way. It is "thinking outside the box." Often, creativity in this sense involves what is called lateral thinking, or the ability to perceive patterns that are not obvious.

Some people are naturally more creative than others, but creative thinking can be strengthened with practice. You can practice creative thinking by solving riddles, being aware of (and letting go of) your assumptions, and through play. Play connotes anything unstructured and relaxing such as daydreaming. Creative people have the ability to devise new ways to carry out tasks, solve problems, and meet challenges.

Logical Thinking

Logic is a set of formal principles for reasoning deductively. Deduction begins with one or more premises and ends with conclusions that are consistent with those premises. Logical thinking is a part of critical thinking, but it deserves separate study because it is a long, well-developed, coherent, and distinct set of principles. Every data sense maker should be able to reason logically and construct a valid argument. This topic focuses on the following:

- Logical argument
- Common flaws in logic

Ethical Thinking

Our thinking is not complete without first considering the effects of our knowledge, decisions, and actions on others, including other creatures, and on the larger world. We are engaged in ethical thinking when we consider these effects to pursue justice, fairness, and the wellbeing of others. It involves our values. Most people consider themselves relatively ethical in behavior, but how that translates into action differs considerably, and how we can support the greatest benefits for all in a culturally diverse world is one of our great challenges. Ethical thinking can be improved through study, experience, and practice. The work of data sense makers results in decisions and subsequent actions that should be shaped by ethical thinking. This topic focuses on the following:

- An ethical compass
- Utilitarianism
- Ethics and data

Activity: Read Appendix 4 for the discussion of the topics

Scientific Thinking

Although the roots of scientific thinking extend back to the time of the ancient Greeks and to some extent before then, what we now call science emerged in the 16^{th} and 17^{th} centuries and has led to an exponential increase in our knowledge of the world and the quality of that knowledge. Scientific thinking adheres to a particular method, which includes the following:

1. Knowledge is acquired empirically, through observation and measurement.
2. Knowledge is validated by forming hypotheses about phenomena and then making observations or running experiments to determine if they are false or potentially true
3. Knowledge is always contingent, never certain, and always opens to correction as new observations call existing knowledge into question.
4. Knowledge involves positions that are potentially falsifiable. Effective data sense making benefits greatly from the methods of science, including the formulation and testing of hypotheses and the conducting of experiments. This topic focuses on the following:

   a) Scientific method
   b) Observational vs. experimental studies
   c) Experimental design

Why Scientific Thinking?

Everyone thinks; it is our nature to do so. But much of our thinking, left to itself, is biased, distorted, partial, uninformed, or down-right prejudiced. Yet the quality of our life and that of what we produce, make, or build depends precisely on the quality of our thought. Shoddy thinking is costly, both in money and in quality of life. Excellence in thought, however, must be systematically cultivated.

A Definition:

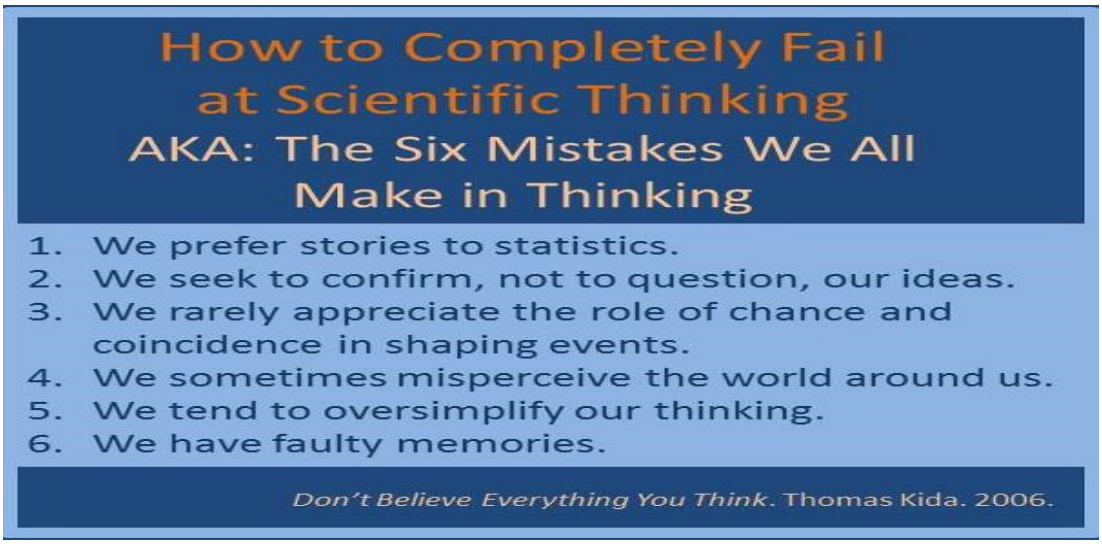
Scientific thinking is that mode of thinking — about any scientific subject, content, or problem in which the thinker improves the quality of his or her thinking by skillfully taking charge of the structures inherent in thinking and imposing intellectual standards upon them.

The Result:

A well cultivated scientific thinker:

- raises vital scientific questions and problems, formulating them clearly and precisely;
- gathers and assesses relevant scientific data and information, using abstract ideas to interpret them effectively;
- comes to well-reasoned scientific conclusions and solutions, testing them against relevant criteria and standards;
- thinks open-mindedly within convergent systems of scientific thought, recognizing and assessing scientific assumptions, implications, and practical consequences; and
- communicates effectively with others in proposing solutions to complex scientific problems.

Scientific thinking is, in short, self-directed, self-disciplined, self-monitored, and self-corrective. It presupposes assent to rigorous standards of excellence and mindful command of their use. It entails effective communication and problem solving abilities as well as a commitment to developing scientific skills, abilities, and dispositions.



Activity: Having discussed the concept of scientific Thinking, a tutor can decide to give any class activity related to scientific thinking

Statistical Thinking

It is well recognized that in order to maintain and improve our competitiveness, we need to continually improve all aspects of our business at an increasing rate. Statistical Thinking provides a common methodology for Continuous Improvement that is applicable to everything we do. Statistical thinking is the use of mathematics to determine the validity and significance of quantitative findings. It is integral to science, data sense making, and even more broadly to many of life's decisions.

Moreover, Statistical Thinking will ensure that we improve efficiently and in a real and lasting manner.

The practice of Statistical Thinking consists of the application of the following elements to all business activities in conjunction with corporate values and objectives. The four element of statistical thinking are:

1. Notion of process
2. Understanding and dealing with variation
3. Understanding and appropriate use of statistical tools
4. Systematic approach to process improvement

Class Activity:

Tutor may assign the class a simple statistical data for interpretation and presentation in the class.

System Thinking

Systems thinking is based on Systems Theory, a relatively new discipline that studies complex systems that initial emerged from cybernetics. It recognizes that with complex systems, which are composed of many interacting parts, the whole is greater than the sum of its parts. We cannot understand complex systems, such as the weather or even something simpler, such as a sales organization, by following the standard scientific approach of focusing on specific things independent of their context. System thinking is in many ways the opposite of analytical thinking: rather than breaking information down into its components parts (analysis), it seeks to understand the whole that is comprised of those parts (synthesis). Systems thinking has much in common with the dialectical thinking that emerged long ago in East Asia, embodied in Confucianism and Taoism, which has dominated those cultures for as long as logical thinking has dominated the West. Systems thinking and eastern dialectical thinking focus on contexts and relationships. Like science, system thinking seeks to understand causation, but it does this differently because effects are illusive when mediated by multiple, dynamical interactions that sometimes separate causes and effects by large gaps in time. It is not difficult to see that data sense making benefits from this holistic perspective. This topic focuses on the following:

- Systems theory
- The importance of considering context and relationships

Visual Thinking

Vision is by far our dominant sense. Our brains have the ability to represent abstract information visually, which makes it possible for us to understand relationships and detect meaningful patterns in data. When words and numbers are not enough, pictures of data are often needed to understand relationships and patterns. This is especially true today because of the many complex problems that we face. In fact, systems thinking, the previous topic in this list can only be examined and understood through the use of visual representations. Data sense makers must understand the potential of visual thinking and know when and how to represent information visually in ways that allow our brains to see, compare, and understand meaningful patterns and relationships. This topic focuses on the following:

- Benefits of visual thinking
- Representing abstract information visually

UNIT II: Overview of Analytical Thinking Skills

Introduction

What are analytical skills, and why are they important in the workplace? Analytical skills refer to the ability to collect and analyze information, problem-solve, and make decisions. These strengths can help solve a company's problems and improve upon its overall productivity and success.

Why Employers Value Analytical Skills*?*

Employers look for employees with the ability to investigate a problem and find a solution in a timely, efficient manner.

To solve problems, employees need strong analytical skills. Hiring managers desire a person who uses clear, logical steps and excellent judgment to understand an issue from all angles before executing an action. Solutions can be reached by clear-cut, methodical approaches or more creative and lateral angles, depending on the objective. Both ways of solving a problem require analytical skills.

Analytical skills might sound technical, but we use these skills in everyday work when detecting patterns, brainstorming, observing, interpreting data, integrating new information, theorizing, and making decisions based on multiple factors and options available.

These essential skills are essential for many different types of jobs in a variety of fields, including business analytics, data architecture, data science, marketing, project management, accounting, business development, programming, law, medicine, and science.

Top Five Analytical Skills

1. **Communication**

Having strong analytical skills means nothing if you cannot share your analysis with others. You need to be an effective communicator who can explain the patterns you see in the data. Sometimes you will have to explain information orally in a meeting or presentation. Other times, you will have to write a report. Thus, you need to have both strong written and oral communication skills.

- Enhancing group productivity
- Interpersonal
- Listening
- Reporting
- Streamlining processes
- Surveying
- Teamwork
- Verbal Communication
- Written Communication

2. Creativity

Often, analyzing requires a creative eye to spot trends in the data that others may not find. Creativity is also important when it comes to problem solving. Employees often must think outside of the box to come up with effective solutions to big problems.

- Budgeting
- Collaborating
- Improving
- Optimization
- Planning
- Predictive modeling
- Problem-solving
- Restructuring
- Strategic planning
- Synthesizing

3. Critical Thinking

Critical thinking is necessary for having strong analytical skills. Critical thinking refers to evaluating information and then making a decision based on your findings. Critical thinking is what helps an employee make decisions that help solve problems for the company.

- Auditing
- Benchmarking
- Business intelligence
- Calculating
- Case analysis
- Causal relationships
- Classifying
- Comparing
- Computing
- Correlation
- Counting
- Decision making
- Diagnosis
- Dissecting
- Evaluating
- Financial management
- Financial recording
- Identifying cost savings
- Interpreting
- Judgment
- Logical thinking
- Prioritization
- Reasoning
- Risk assessment
- Troubleshooting

4. **Data Analysis**

No matter what your career field, being good at analysis means being able to examine a large volume of data and find trends in that data. You have to go beyond just reading and understanding information, to making sense of it, and seeing patterns.

- Business analysis
- Case analysis
- Cost analysis
- Credit analysis
- Critical analysis
- Descriptive analysis
- Financial analysis
- Industry analysis
- PESTLE analysis
- Qualitative analysis
- Policy analysis
- Quantitative analysis
- Return on investment (ROI)
- SWOT analysis
- Technical analysis
- Comparative Analysis

Research

Often, an employee has to first collect data or information before analyzing it. After all, you must learn more about a problem before solving it. Therefore, an important analytical skill is being able to collect data and research a topic.

- Investigating
- Data mining
- Data collection
- Prioritizing
- Recording facts
- Taking inventory
- Checking for accuracy

Analytical thinking talent is important to your business in these situations:

- Strategizing future direction for the business
- Deciphering the impact of market conditions on the business
- Innovating new applications for existing products or services

Obviously, analytical thinking is not new. Humans have had the capacity for analytical thinking for millennia. The problem is that analytical thinking skills are not necessarily intuitive and

these skills may not come easily to many people.

At its essence, analytical thinking involves breaking things down into their component parts quickly and applying judgment to decisions. Analytical thinking is an umbrella that covers 8 natural talents that each of us possess to varying degrees. The more clarity you have in each of these 8 talents, the greater your skill in analytical thinking. Here are the thought processes we expect a person to use when using analytical thinking skills:

- Recognize the underlying issues or problems
- Organize information related to the underlying issues or problems
- Integrate all the pieces
- Draw appropriate conclusions

In order to accomplish these steps, the individual should have strong clarity in these 8 natural talent areas:

- **Balanced decision making**: Make decisions which place equal emphasis on all involved parties or concerns, therefore making decisions which are more likely to satisfy all needs.
- **Conceptual thinking**: Mentally role-plays the execution of the long range projection and makes accurate predictions concerning the possible outcomes.
- **Evaluating what is said**: Objectively evaluate feedback and "hear" the concerns, intentions, or opinions being stated, as opposed to inserting their own feelings or opinions.
- **Intuitive decision making**: Comfortable making decisions on their feet, without having to study a situation or requiring logical data to examine.
- **Problem solving**: Pool together multiple capacities and talents to assess all aspects of a problem from beginning to end, from identification to resolution.
- **Seeing potential problems**: Integrate "now" events into futuristic structures and determine what potential problems might arise. This requires a very flexible perspective.
- **Theoretical problem solving**: Identify future problems and formulate the appropriate steps which would be needed to correct them. They are comfortable enough with their ability to take action on these decisions.

- **Using common sense**: More of a natural reflex than a logical thinking process, this talent uses every day, informal knowledge that has not been formally evaluated and placed in the decision making process.

Benefits of analytical thinking

1. Un-Biased view:

An analyst's role is to listen, observe, understand & imbibe information from all sources and not to place blind faith in any individual, team or system. They are basically the key information provider for senior management and business owners in understanding and defining strategies for current and future market needs.

2. Trust Data/Trend:

Analysts provide conclusions based on historical data, industry trends and other analytical means. Data is crucial and it reflects the health of the industry/domain and solid foundation on which to base future decisions.

3. Defining the flow (Process):

Analysts keep track of data and information so they mostly know the loopholes in the system, market and understand the gap which can be potential growth opportunities. They can bridge this gap by defining the flow which can enhance the efficiency for internal teams and external customers. Their information and analysis can be used to create new products or services hence they can also define and dictate the flow of the market.

4. As solution architect:

Analysts, with their interaction with various team members from different background and understanding of the entire length of the organization, market, system, are in a good position to identify & analyze problems. They can identify the right team/individual to solve or share their experience in fixing particular problems. Due to their knowledge and experience, they may also be able to provide solutions.

5. Benefit to personal life:

Analytical thinking can help us make informed decisions regarding our career choice, career growth opportunities, investment choices, future planning, conflict management, etc.

A phrase you may hear from people all the time would be: “Let’s take a detailed look at this. Let’s analyze what we’re thinking and doing before we make a decision.”

They want to analyze the situation and/or data in an explicit way. This is often driven by their desire to do everything right the first time. Analytical thinkers would rather take extra time and drill down into a topic. That way, when they present the data, information, or decision, they can be sure they’ve nailed it on the first go-round.

Analytical individuals want to gather a lot of facts, and they’re able to keep them organized when working on tasks and challenges. These thinkers bring a number of benefits to the team:

BENEFITS	DRAWBACKS
• They have the ability to look at things in a holistic way. • They base choices on realism and sound processes, with an underpinning of precision, accuracy, and detail. Their decisions have a great deal of validity. • They are “walking dictionaries”! If you have a question, they likely know the answer – or know where to find the answer. • They are strongly oriented towards policy and procedure. • From a leadership perspective, they are highly organized and extremely knowledgeable about their work.	• Analytical thinkers can be sticklers. • They may get bogged down in details. This can be incredibly frustrating to hard blue thinkers, who want to drive quickly towards decisions. • There can always be more analysis! It is possible to suffer analysis paralysis because there is always more data to consider. They want to take another look, and another, to ensure they haven’t missed anything.

ACTIVITY:

Analyzing an Advertisement:

Your students could analyze the intent if an advertisement. If the students believe that the ad argues it will make someone appear more youthful, get them to state that.

Next, ask the students to determine what the ad does to make them think that. For instance, is it the text, the use of colors, etc?

Get them to identify the element that pushes this argument. After they have successfully determined the element, ask them to determine why. If, for instance, they think the ad uses bright colors to make consumers think the product is youthful, get them to say why.

Are bright colors associated with fun and youth? Will it make the viewer think the product is fun and youthful? Why? Get them to push their justification as far as they can-so they can see just how deep analysis can and should go.

Getting students to dig into the reasons why their evidences prove their arguments helps them see the level of analysis they need to fully develop a point. Teachers should explain to students that pointing out their reasons for reaching a conclusion may seem obvious, but it is the step that shows how all the evidence relates-and varies by person because each of us interprets facts differently.

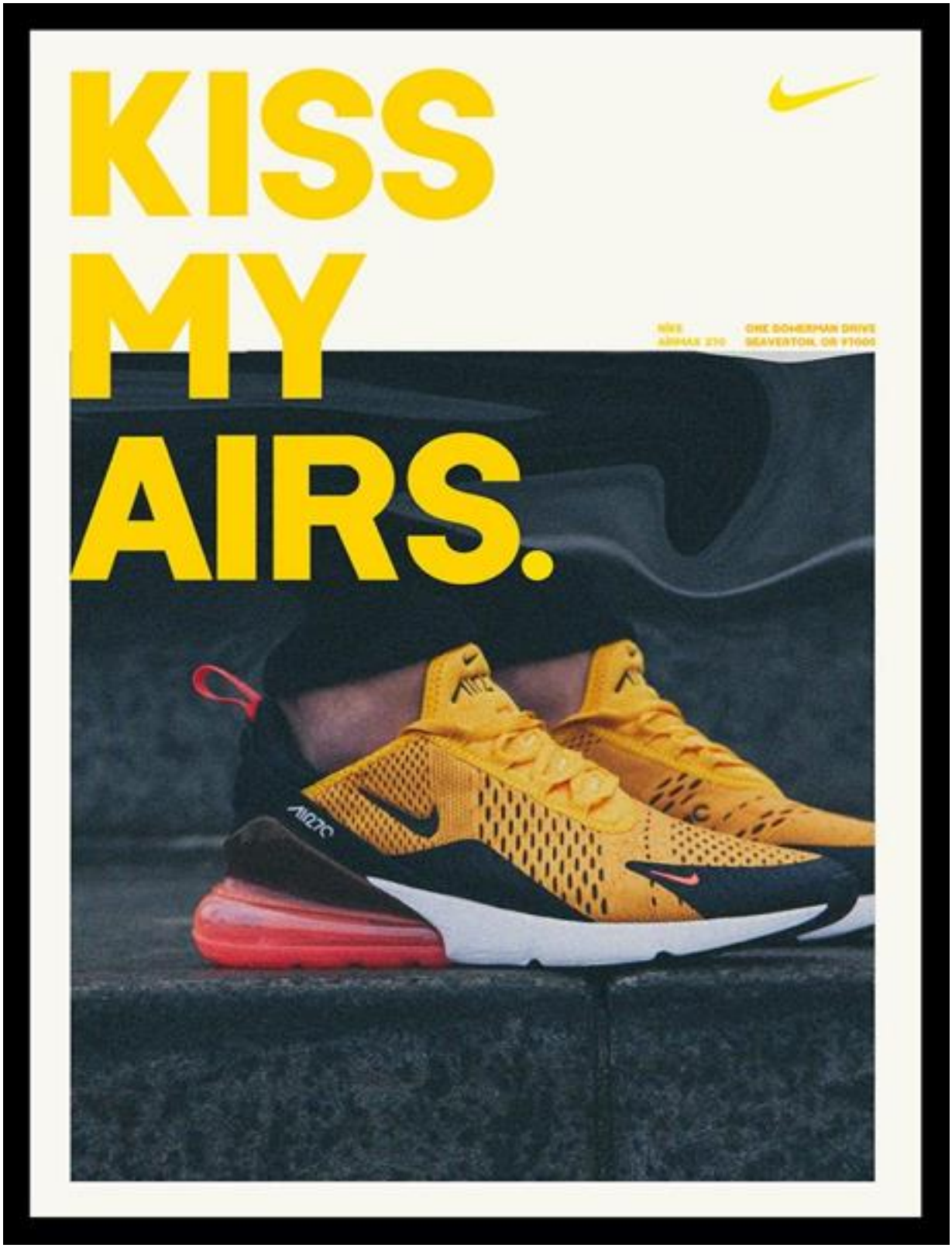
Sample advertisements for reference:

Ad 01

Ad 02


HEALTHY BREAKFAST
BECOMES MORE ENJOYABLE!
NEW
Maggi
GRAIN SHAKTI
OATS NOODLES
FIBRE of 1 BOWL OATS
REAL VEGETABLES
Taste Bhi Health Bhi

Ad03



Analytical thinking is processing information in logical, step-by-step manner to find a solution to a problem. The process begins by gathering information then breaking that information down from a larger system of information into smaller parts. We examine those parts to find connections and relationships between them. This is done by looking for patterns or trends, and by conducting a cause and effect analysis.

After we assess the individual parts, we formulate theories about the problem. We then test the theories to ensure that our assessments of cause and effect are accurate. Finally, we develop and evaluate potential solutions to the problem.

Steps in the Analytical Thinking Process

1. Gather information:

Information gathering helps the individual and the organization to undertake complicated tasks that would otherwise be extremely hard to accomplish if not outrightly impossible without the benefit of gathered information.

In the literal sense, information gathering is a basic human skill necessary for undertaking basic human activities such as eating, sleeping, working etc. For in order to eat, one must know if the food is edible or not; and in order to sleep, one must know if the sleeping place is comfortable or not.

In general practice, information gathering is the collection of data for dealing with the individual's or the organization's current situation. More data means more and better ways of dealing with the current situation. More data broadens the minds of those who will use the data to solve current organizational problems. New ideas come more easily if there are lots of facts to be used as bases.

2. Breaking down the information:

In order to make sense of the information, the analyst has to break down the information into categories and parts so that it becomes easier for the analyst to view each information and data in isolation. This allows the analysts to understand how and why a particular information, data or variable is linked to the others.

3. Find connections and relationships

Understanding these information in isolation helps the analyst understand the dynamics of how each information strand is intertwined with others. Causal relationships can then be determined. Isolating information also gives more clarity when certain information are juxtaposed for comparative analysis.

Essentially, just like we break down exam questions or assignment instructions to get a better understanding of what is expected in the answer, information must be broken down into smaller bits to get better understanding of how processes, events and people interact with each other to achieve individual or communal success.

4. Formulate Theories:

At this step we make inferences from available information and draw logical conclusions. The theories we formulate must be grounded by the available information. After we understand the information, as an analyst, we must try and understand the dynamics of the information.

Based on the patterns and trends in the information, analysts may be able to predict or explain phenomena, events and information to allow us to make better decisions if the theory is able to withstand tests and evaluations.

5. Test theories:

Once a suitable theory has been chosen, an analyst must test it to see whether the assumptions in adopting the particular theory were accurate or not.

This testing is done to determine the causes of the issues and to verify if the theory accurately explains the issue and provides answers for resolving the problem.

6. Develop possible solutions:

After we understand the problem, we will use all available information to draw up as many solutions as possible. Although only a few solutions may be feasible to implement, a wide variety of solutions helps us understand the many approaches to tackle a particular issue.

7. Evaluate Solutions:

We have to evaluate all solutions to identify the best one so that it can be implemented

effectively to address the needs of the individual or organization.

Once the potential solutions are tested and evaluated, we can then select the best possible solution while keeping the other solutions in reserve for contingencies.

ACTIVITY:

Overview:

After exposure to two interesting problems, participants will employ the Force-Field Analysis to focus their thinking on resources that could be tapped in the process of solving a given problem.

Objective:

To develop the use of analytical thinking via a structured format.

Time:

Approximately 25 minutes

Advance Preparation:

Draw the Force Field Analysis on the flipchart but keep it covered until the appropriate time.

Participants/Application:

This exercise works with any size group at any point when a cerebral energizer is needed. The exercise can be used to begin a session if a question like this is posed to the group: "What do you envision as the ideal state of affairs as far as [name topic of course you are facilitating] is concerned?" The analysis required by the Force Field Tool can also be related to various discussions that arise during the course of the day. If used as an end-of-session exercise, the question for the group would be, "Where do we go from here?" This question will lead to the broad division of forces (both restraining and driving) that will help participants achieve an ideal state.

Often, we fail to find the solutions we need because we fail to use the resources we have. We wear blinders, it seems, that prevent us from using what is right in front of us or right inside of

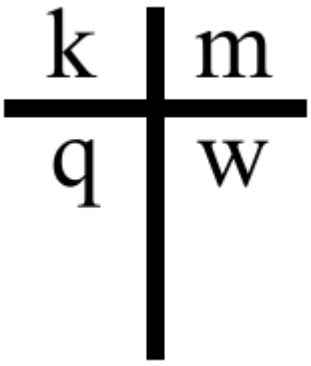
us. Or we impose imaginary limits upon ourselves and assume that we are not allowed to proceed in a particular fashion. In truth, though, there are fewer rules or impediments than we think there are.

A good example of how available resources aren't always used to solve an important problem is this one involving a creative engineering class at M.I.T. The instructor had placed two ping-pong balls at the bottom of a metal cylinder, which was bolted to the floor of the science lab. The cylinder was about seven inches wide and about five feet high. The students had one full hour to remove the ping-pong balls from the cylinder. They could not leave the room but were free to use anything in the room. The professor encouraged them to work together, reminding them that if they found a solution, they would all pass the final exam and if they did not, they would all fail. They all failed. Had you been in that room, how would you have solved the problem?

Procedure:

1. The answer to the M.I.T. problem is "water," which students could have taken from the faucets in order to float the balls to the top. After challenging the class with the M.I.T. problem, ask participants to solve this next problem. [Note: It is important to set up this problem by using a colored magic marker to draw the lines and a different color to draw the letters.

   In the following diagram, which letter does not belong?

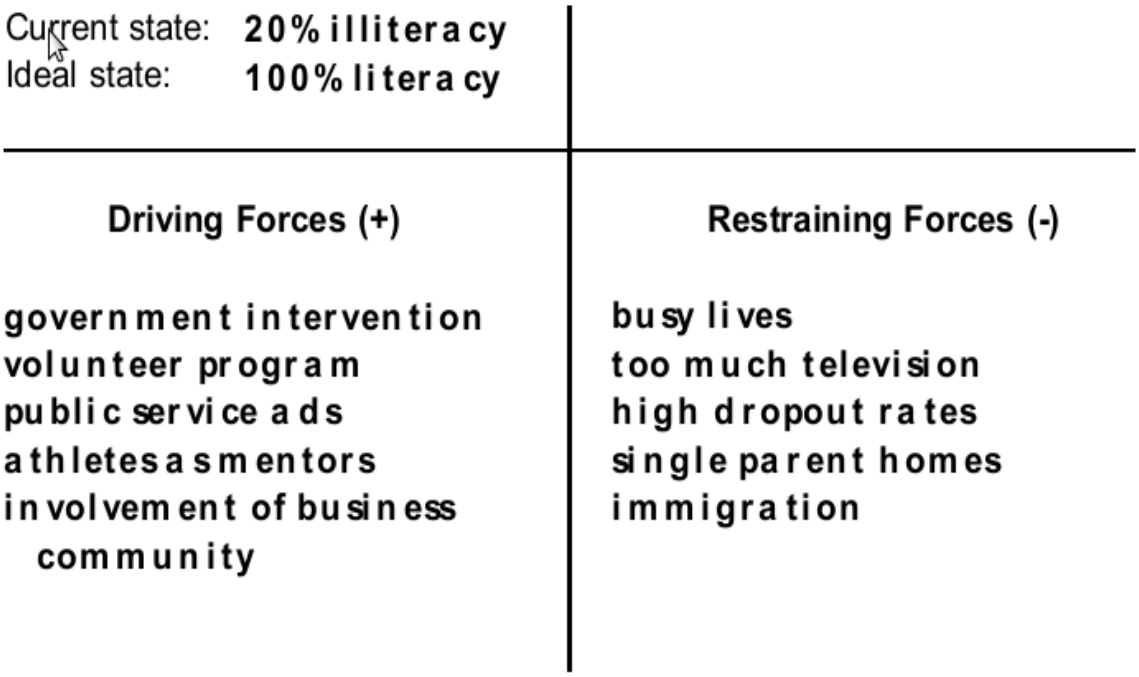


2. Call on few students to explain their answers and then give the correct one: The letter "t," which most people don't even "see," is out of place because it is bigger, thicker, and of a

different color than the other letters.

3. Psychologist Kurt Lewin devised a problem-solving tool that asks us to consider the current state of affairs and to juxtapose it with an ideal state of affairs. Having done that, we now consider what driving forces (indicated by a plus sign) will help us achieve the idealized state by using existing resources. Next, we think about the restraining forces (depicted by a minus sign) that may be preventing us from achieving the desired conditions.

4. Continue with this mini-lecture: The Force Field Analysis is depicted as a large "T," as you can see here. [Show diagram on flipchart.] It's a valuable tool for analyzing a problem, ascertaining its causes, and evaluating the resources available for achieving the desired effect. An example of a problem that might be subject to such analysis is the illiteracy rate in America—1 out of 5 adults is functionally illiterate. That is the current status; ideally, there would be no such thing as illiteracy. The next step involves asking what forces could be used to bring us to the ideal state. Finally, we would consider what forces are causing the rate to be so high or keeping us from reaching the idea. By reviewing the two columns, we can next decide the course of action that should be pursued.



5. Divide the class into small groups of four or five and give each team a sheet of chart paper. Have each group identify a problem at the top of the chart paper and report its current and ideal states. The problem could be one currently facing them as businesspeople or us all as a society.
6. Give each group another group's chart paper and ask members to list both the Driving and the Restraining forces for the problem listed.
7. After about 30 minutes, return the papers to the original groups and ask them to add further driving and Restraining forces and then to select the one force (in either column) that—if they could direct their energies to it—they think could most effect the ideal solution.

8. Call on a spokesperson from each team to report on their selection.

Extending the Activity:

1. Have participants interview one another to learn what special talents/knowledge/abilities they have. Keep a classroom or corporate list of these resources and draw upon various individuals at various times for various projects.
2. Periodically do a brief force field analysis of issues raised by participants that relate to the subject matter of the course.
3. Begin the class with a large force field analysis addressing this issue: "How can we maximize the investment in training, after the training?" The current research is discouraging: Less than half of participants in training programs return to work and effect changes based on the new learning they have acquired. The ideal, of course, would be to have every participant put to use the new skills/concepts they acquired immediately after their return to the workplace.
4. Begin a collection of instances when slavish adherence to rules results in loss to an individual or organization. For example, after transferring to a new school in Seattle, a youngster asked his parents if he could go back to his old school. The reason for his request: The new school did not permit boys to work in the library. The no-boys rule meant considerable intellectual loss for the new school because... the fourth-grader who returned

to View Ridge was none other than Bill Gates!

Analytical Techniques

An **analytical technique** (**analytical method**) is a procedure or a **method for the analysis** of some **problem**, **status** or a **fact**.

There are many tools and techniques available to analyze better but the usage of such tools and techniques depends on the situation and the person selecting the particular tool/technique. A person's experience and knowledge is essential in determining which tool or technique to adopt over other.

Some of these tools and techniques are specialized analytical techniques, which are overwhelmingly based on some mathematical model or which require certain equipment or tools.

Basic and most widely used analytical methods / techniques include:

- BCG matrix
- Brainstorming
- Benchmarking
- Gap Analysis
- Mind Maps (more in Unit I)
- Pareto principle, Pareto principle 80-20 rule (More in Unit V)
- Six Questions
- SWOT Analysis (More in Unit V)

BCG Matrix (Boston matrix)

What is BCG Matrix (Boston matrix)

The BCG Matrix was developed by the Boston Consulting Group (BCG) and is used for the evaluation of the organization's product portfolio in marketing and sales planning. It aims to evaluate each product, i.e. the goods and services of the business in two dimensions.

The **BCG Matrix** (**Growth-share matrix**) is a method that comes from the consulting company **Boston Consulting Group** (**BCG**), thus the name **BCG matrix** or **Boston matrix**. The BCG matrix is used for the evaluation of a organization's **product portfolio** in marketing and sales planning. It aims to evaluate each product, i.e. goods and services of the business in two dimensions:

- Market growth
- Market share

The combination of both dimensions creates a matrix into which the products from the portfolio are placed:

	High market share	Low market share
High market growth	Star	Question mark
Low market growth	Cash cow	Dogs

Each type of products may be seen as:

- **Cash cows** - do not require high investment, these products form the basis of the company's profitability
- **Stars** - have the potential to become cash cows, it is necessary to invest in advertising, incremental innovation, etc.
- **Question marks** - it is necessary to differentiate between them, promising products may become cash cows
- **Dogs** - these dampen production, they should be withdraw from the market

How to use of the BCG matrix in practice?

The **BCG matrix** is used for evaluation of a company´s product portfolio, it can also be used to assess key business units such as divisions or individual companies of a large corporation. Both market share and growth rate are essential in the assessment of a product´s value. A product´s market share and the rate of its growth vary in time. The producer must therefore manage the good´s lifecycle, the provider must manage the service´s lifecycle. BCG matrix analysis results

help the organization to identify the strategic plan of the entire product portfolio so that each of the quadrants contains the products of the organization. The products in the quadrants must be balanced so that products defined as cash cows allow for the funding of other products. However, with the product life cycle, it is necessary to have a future potential in the form of stars and question marks in the portfolio. On the basis of its specific strategy, situation and reasons of the position of the products in the quadrants, the organization must decide on its product strategy. It is appropriate to add to the model a third dimension of profitability of a product or a service which can be either high or low. The square thus becomes a three-dimensional cube. Within the cube, the quadrants which correspond to high profitability are most significant. It is also necessary to consider whether there are reasonable prospects of high profitability of products or services in the future.

BCG matrix is in practice used very often and it is one of the most practical and most comprehensible analytical techniques for an organization. It is crucial for the determination of the correct **product strategy** of every business.

ACTIVITY:

Teaching Notes for this Marketing Activity

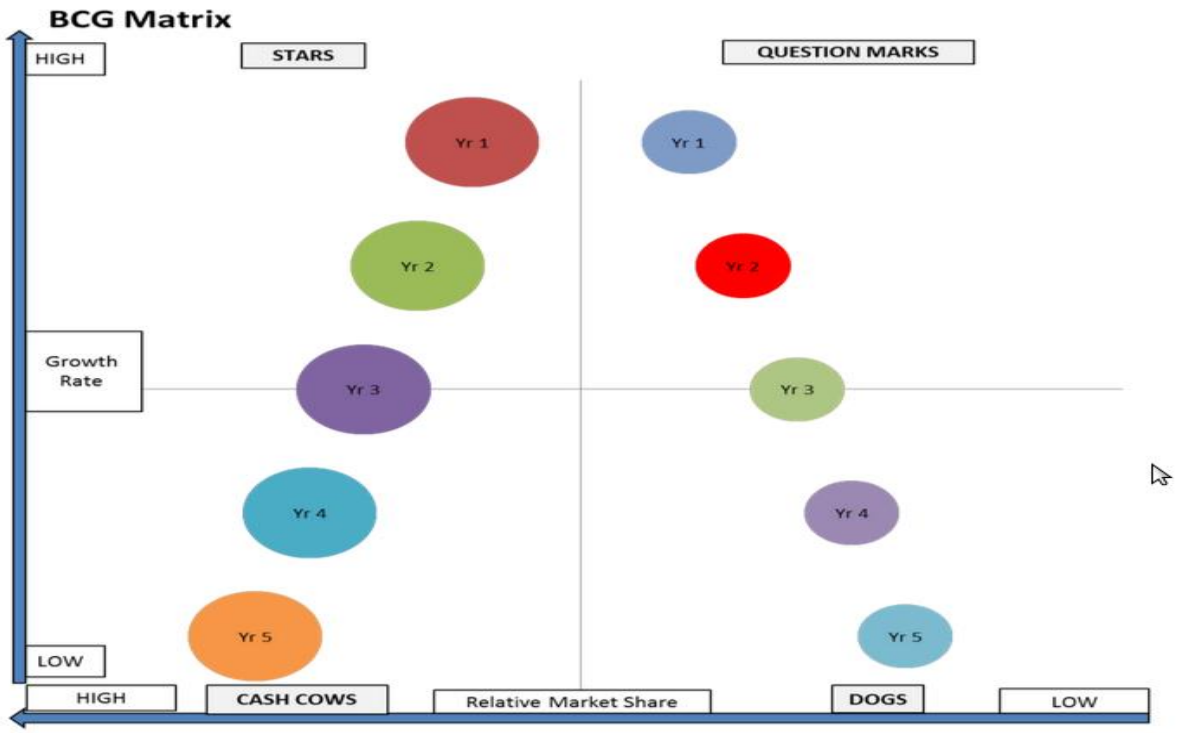
Preferred format: This teaching activity is designed to be completed in small groups of students.

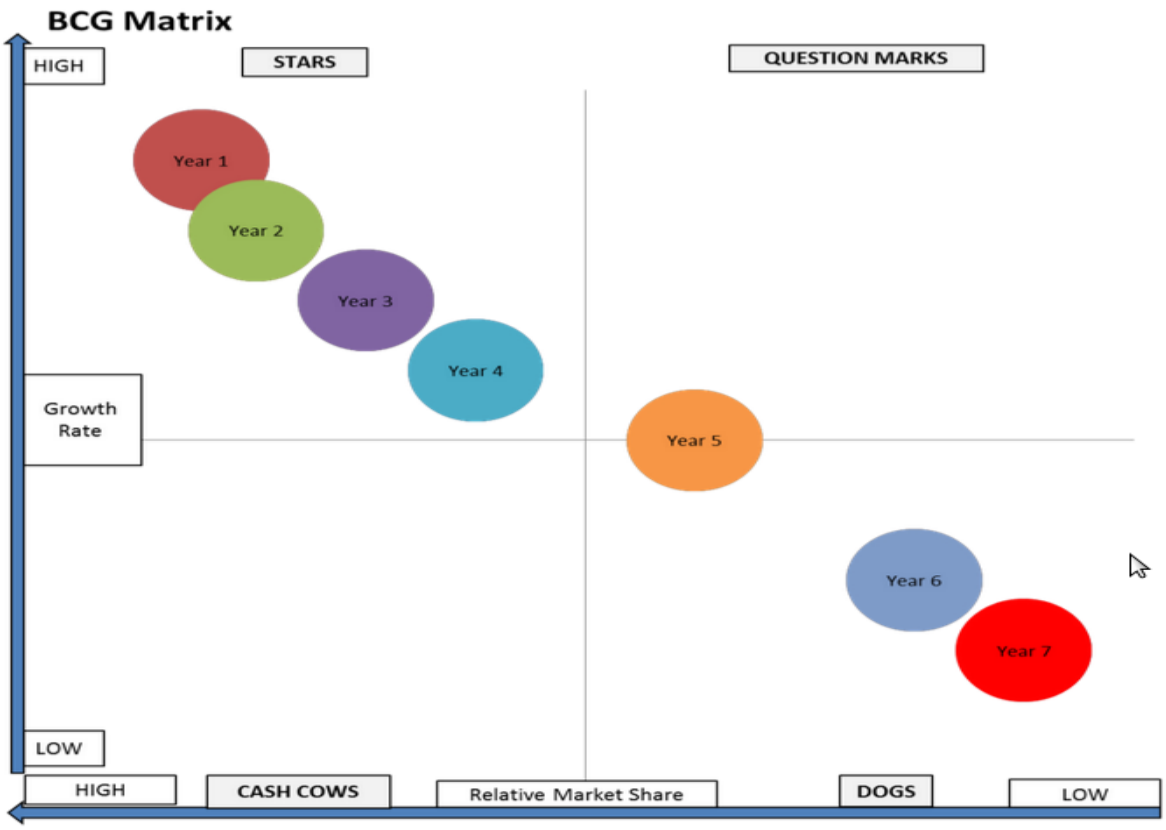
Exercise time: The group discussion time should be around 20 minutes.

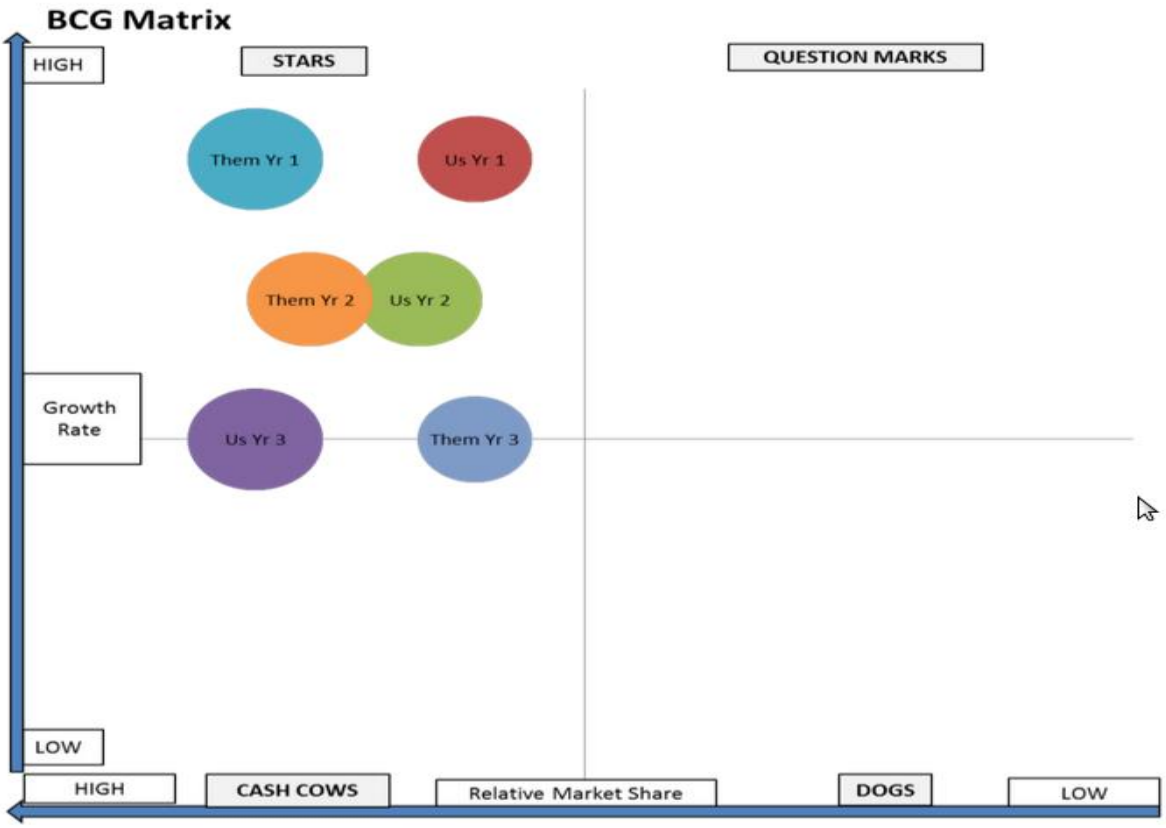
Student Task

Below there are several BCG matrix examples shown. In each case, the portfolio/s has been tracked over time. You have two questions to address for each BCG matrix.

- What is probably happening to make the portfolio move in such a pattern on the BCG matrix?
- What implications are there for the firm managing this portfolio – that is, what guidance is provided by the BCG matrix?


BCG Matrix
HIGH
STARS
QUESTION MARKS
Yr 1
Yr 1
Yr 2
Yr 2
Growth Rate
Yr 3
Yr 3
Yr 4
Yr 4
Yr 5
Yr 5
LOW
HIGH
CASH COWS
Relative Market Share
DOGS
LOW





Brainstorming

Brainstorming is a group creativity technique. The aim is to generate as many ideas on the topic.

It is used in many fields - from problem solving to generating highly creative ideas. It is used in the management, marketing and the scientific activities.

Copywriter Alex Faickney Osborn came first with this idea in 1939 and developed it later in a specific method in his book Applied Imagination (1953).

Five basic principles are generally known. Their goal is to eliminate all restrictions and alternatively stimulate the creation of new ideas:

- **Pleasant atmosphere** - it is important to induce a creative climate and pleasant environment, and properly plan whole meeting
- **We focus on quantity** - the more ideas, the more likely they will contain quality design solutions
- **No criticism** - no restrictions exist, we postpone criticism until later to not hamper the flow of ideas and suggestions
- **Unusual ideas are welcome** - a new way of thinking, we generate ideas regardless of their reality, logic, rationality
- **We combine and improve the already formed ideas** - "1 +1 = 3", ideas are formed by cooperation between the team

ACTIVITY:

Define the problem you want solved clearly, and lay out any criteria to be met. Keep the session focused on the problem. Ensure that no one criticizes or evaluates ideas during the session. Try to get everyone to contribute and develop ideas, including the quietest members of the group. Encourage them to come up with as many ideas as possible, from solidly practical ones to wildly impractical ones. Welcome creativity. Ensure that no train of thought is followed for too long (Max 30 Min) Encourage people to develop other people's ideas, or to use other ideas to create new ones. Appoint one person to note down ideas that come out of the session.

Unit III: Creative Thinking

Introduction

This Unit aims to familiarize the learners with the concept of creativity, characteristics of a creative person, barriers to creativity and methods of creativity for overcoming barriers.

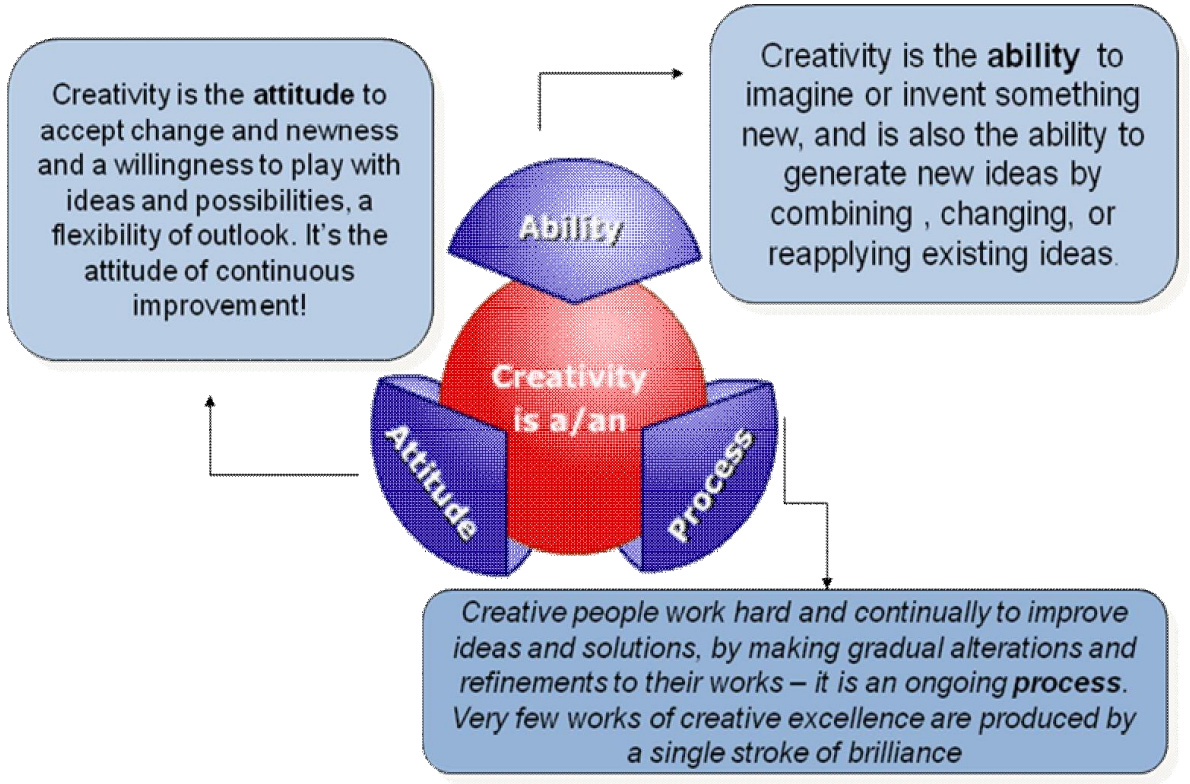
Learning Outcomes

By the end of the unit, the learners will be able to:

- Explain the concept and importance of creativity in life
- Identify characteristics of a creative person
- Assess their creativity using creativity tools
- Apply creativity in real life situations

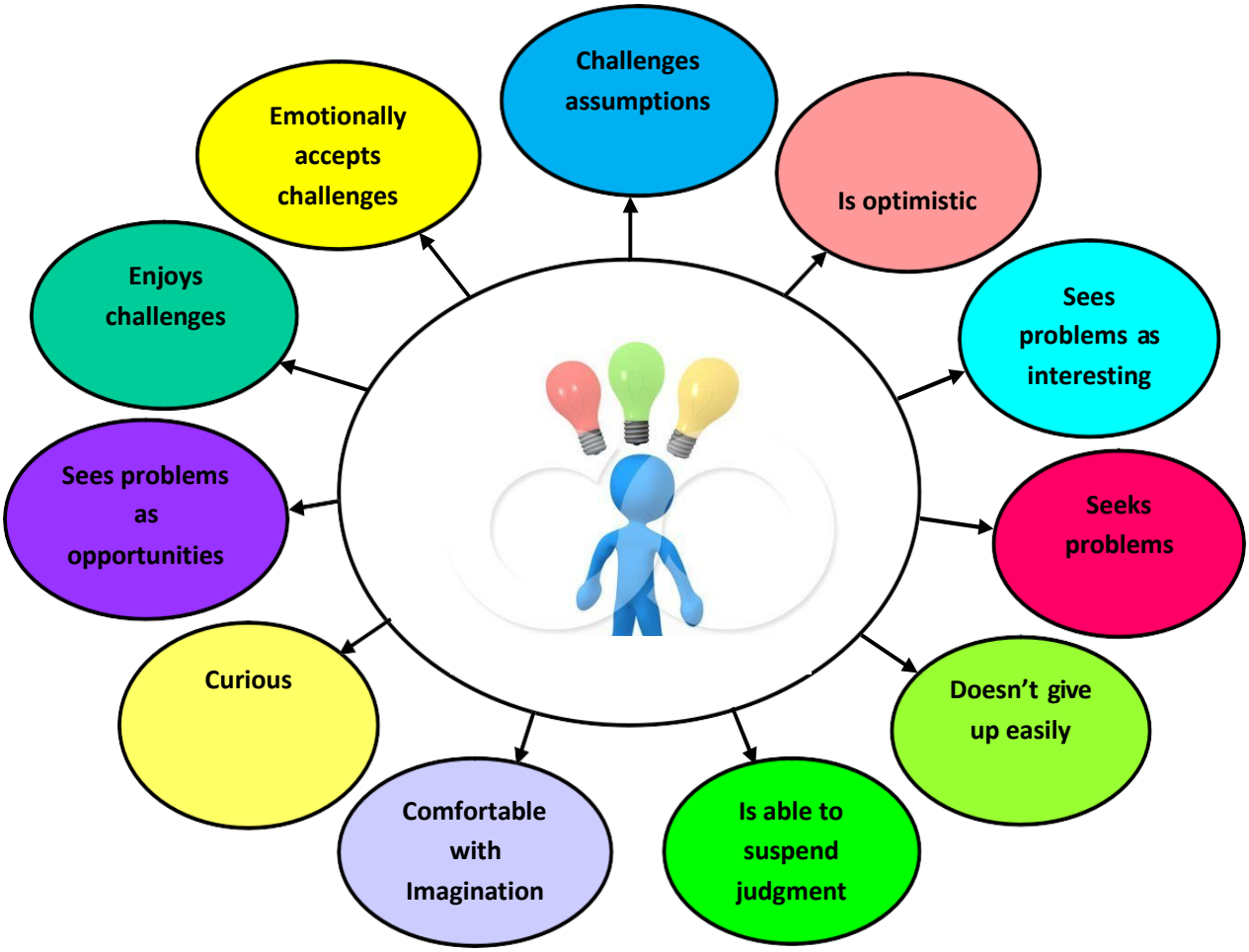
Definition of Creativity

Creativity is defined as the tendency to generate or recognize ideas, alternatives, or possibilities that may be useful in solving problems, communicating with others, and entertaining ourselves and others.



Which are the comments creative people will make?

Characteristics of a Creative Person



Activity 2a:

Divide the class into groups and give them SCAMPER scenario to solve.

1. Conceptual Blocks

Despite the importance of creative thinking to so many facets of our lives, human beings are prone to mental ruts. A number of conceptual blocks can keep us from solving problems creatively.

Constancy: Once we've learned a solution to a problem, we often try to reuse that solution when encountering similar problems. It can be difficult to ignore that solution and consider others. When that solution is ineffective, being fixated on it interferes with our problem solving. Creative problem solving requires being able to define and solve problems multiple ways.

Commitment: Although our minds can process a lot of information, we often get committed to

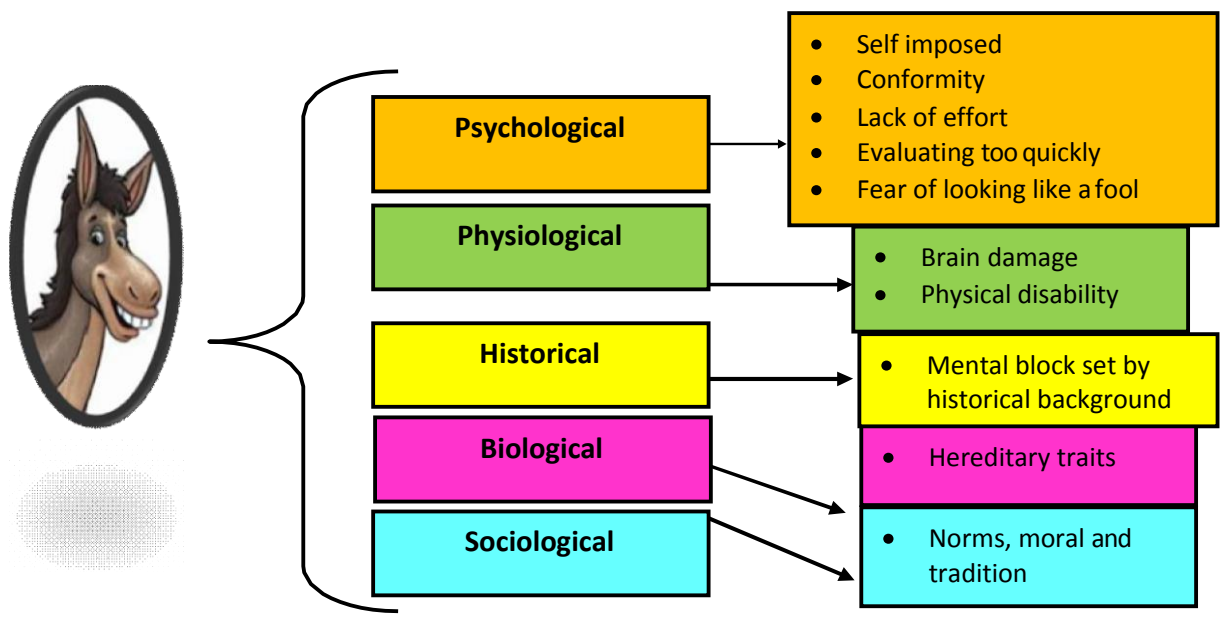
overly simplistic assumptions about things. Creative problem solving requires relaxing our assumptions in order to notice subtle differences and similarities that might help us find solutions.

Compression: To quickly solve a problem, we often artificially limit the information we use in defining the problem and searching for solutions. We overlook important things surrounding the problem or mistakenly assume that some types of solutions are more appropriate than others. Creative problems solving requires looking at the "big picture," considering all relevant information about the problem, and ensuring that a variety of possible solutions are examined.

Complacency: Sometimes we give up too easily when we encounter problems for which we don't immediately see solutions. Creative problem solving often requires extensive study of the problem and time for creative ideas to incubate in our minds.

Our minds tend to be programmed to quickly solve the problems we typically encounter in a day. However, those thought patterns could block our ability to solve problems creatively. To increase our creativity, we need to break our conceptual blocks.

Barriers to Creativity



Overcoming Barriers to Creativity
Activity 2b:
Pictionary or Dumb Charades

Stage 1: Experience

Acquire a repertoire of experiences because their rich backgrounds give more possibilities for new solutions. But there are blocks to obtaining experience:

- Fear of not learning
- Fear of violating standards

Stage 2: Association

Associate experiences into a useful product. What are the blocks to making associations?

- Overvaluing rationality.
- Fear of self-awareness

Stage 3: Expression

Express your idea. What are the obstacles to expression?

- Fear of embarrassment
- Fear of assertion

Stage 4: Evaluation

People who undervalue their ideas tend not to follow through, which is when we must distinguish the creative from the bizarre, the productive from the irrelevant. Here, two related hurdles comprise a false dilemma which can cloud your ability to evaluate an idea and force you to choose between proceeding with an unpromising project and prematurely deep-sixing a promising one:

- Fear of humiliation
- Fear of rejection

Stage 5: Perseverance

Original ideas and products are fun, but unless you persevere, they won't make anybody rich. Perseverance-related blocks include:[12]

- Fear of failure
- Lack of rewards

Activity 2c:

National Institute of Traditional Medicine, Thimphu produces herbal tea *(Tsheringma)* for medicinal purposes. The production unit of the institute manufactures more than one million

packets per year. The production unit carried out stringent quality control and quality assurance procedures to ensure ultimate results and to meet international standards.

One day, in their production unit, they received a complaint that a consumer had bought a packet of *Tsheringma* that was empty. Immediately the institute deploys a team of experts to look into the matter and find out the cause of this incident and put an end to any such future occurrences. You are one of the team of experts hired by the institute to investigate the matter. Your approach must be the most economically viable amongst many. What would your approach be?

Methods of Creativity Evolution

This is the method of incremental improvement. New ideas stem from other ideas, new solutions from previous ones, the new ones slightly improved over the old ones. Many of the very sophisticated things we enjoy today developed through a long period of constant evolution.

For example, look at the history of the automobile or any product of technological progress.

Synthesis

With this method, two or more existing ideas are combined into a third, new idea. Combining the ideas of a magazine and an audio tape gives the idea of a magazine you can listen to, one useful for blind people or freeway commuters. For example: The dinner theater, where people go first to eat and then to see a play or other entertainment.

Revolution

Sometimes the best new idea is a completely different one, a marked change from the previous ones. While an evolutionary improvement philosophy might cause a professor to ask, "How can I make my lectures better and better?" a revolutionary idea might be, "Why not stop lecturing and have the students teach each other, working as teams or presenting reports?"

Reapplication

Look at something old in a new way. Go beyond labels. Unfixate, remove prejudices, expectations and assumptions and discover how something can be reapplied. For example, a paperclip can be used as a tiny screwdriver if filed down; paint can be used as a kind of glue to prevent screws from loosening in machinery.

Changing Direction

Many creative breakthroughs occur when attention is shifted from one angle of a problem to another. This is sometimes called creative insight.

Example, Archimedes's discovery of buoyancy is a good example.

Learning Activities

Mensa Test is used for testing IQ

Activity 2d: Mensa Test

Below you will find a list of short sentences, which have in common that they are all referring to every expressions with numbers in it. The words in these expressions are indicated by its first letter only. You will have to deduct the complete expression by making an association with the numbers provided. A simple example could be: "24 H in a D".

This expression obviously refers to "24 Hours in a Day".

According to MENSA, if you get 23 of these, you are a "genius".

1. 26 L of the A
2. 7 D of the W
3. 7 W of the W
4. 12 S of the Z
5. 52 C in a P (WJs)
6. 13 S in the USF
7. 18 H on a G C
8. 5 T on a F
9. 90 D in a R A
10. B M (S H T R)
11. 32 is the T in D F at which W F
12. 15 P in a R T
13. W on a T
14. 100 C in a R
15. 11 P in a F (S) T
16. 12 M in a Y
17. 13=UFS
18. 8 T on a O
19. 29 D in F in a L Y
20. 365 D in a Y
21. 13 L in a B D
22. 52 W in a Y
23. 9 L of a C
24. 60 M in a H
25. 23 P of C in the H
26. 64 S on a C B
27. 9 P in S A
28. 6 B to an O in C
29. 1000 Y in a M
30. 15 M on a D M C

Activity 2e:

Instruct learners to list down seven lettered words for five minutes. Let them write a story using those words and present to the class.

Unit IV: Problem Solving Process

Understanding Problem Analysis

Problem solving is the act of defining a problem; determining the cause of the problem; identifying, prioritizing and selecting alternatives for a solution; and implementing a solution. This Unit aims to orient the learners to the concept of conventional and creative problem solving skills, brain storming process, questioning techniques and fish bone analysis.

Learning Outcomes

By the end of the unit, the learners will be able to:

- Differentiate conventional and creative problem solving skills
- Apply creative problem solving skills in daily life situations
- Generate new ideas through brain storming exercises
- Demonstrate creative questioning techniques
- Analyze problems using fish bone analysis

Conventional Problem Solving Process

The convention problem solving is a more linear and structured approach to describing and resolving an issue. It takes a set of data and works off of that same data to come up with a solution. This Problem Solving process consists of a sequence of sections that fit together depending on the type of problem to be solved.

Present the Problem

- Try and find the most important parts of the problem
- Keep an open mind about the effects you see and their possible causes
- Be as specific as possible when thinking about the problem
- These steps just help you understand the problem; REMEMBER, don't think of solutions as yet
- AVOID presuming a solution
- AVOID solving a problem before even thinking of it
- AVOID looking at the most obvious options alone
- Once you've identified the problem make a list of things you can do about

Ask the solutions

- Postpone the selection of one solution until several alternatives have been proposed.

- Having a standard with which to compare the characteristics of the final solution is not the same as defining the desired result.
- A standard allows us to evaluate the different intended results offered by alternatives. When you try to build toward desired results, it's very difficult to collect good information about the process.
- Considering multiple alternatives can significantly enhance the value of your final solution.
- Once the team or individual has decided the "what should be" model, this target standard becomes the basis for developing a road map for investigating alternatives.
- Brainstorming and team problem-solving techniques are both useful tools in this stage of problem solving.
- Many alternative solutions should be generated before evaluating any of them.
- A common mistake in problem solving is that alternatives are evaluated as they are proposed, so the first acceptable solution is chosen, even if it's not the best fit.
- If we focus on trying to get the results we want, we miss the potential for learning something new that will allow for real improvement.

Shoot down the ideas

Skilled problem solvers use a series of considerations when selecting the best alternative. They consider the extent to which:

- A particular alternative will solve the problem without causing other unanticipated problems.
- All the individuals involved will accept the alternative.
- Implementation of the alternative is likely.
- The alternative fits within the organizational constraints.

Make consensus

- Come up with alternative solutions to the problem and rank them according to how viable and feasible they appear to be based on your circumstances.
- Choose the best solution that is most viable and feasible and hope your plan comes off without a hitch.

Creative Problem Solving Process

The Problem Solving process consists of a sequence of sections that fit together depending on the type of problem to be solved. These are:

- Problem Definition.
- Problem Analysis.
- Generating possible Solutions.
- Analyzing the Solutions.

- Selecting the best Solution(s).
- Planning the next course of action (Next Steps)

Creative Problem Solving is a proven method for approaching a **problem** or a challenge in an imaginative and innovative way. It's a process that helps you redefine the **problems** and opportunities you face, come up with new, innovative responses and solutions, and then take action. **Creative problem solving** is the mental process of creating a **solution** to a **problem**. It is a special form of **problem solving** in which the **solution** is independently created rather than learned with assistance. **Creative problem solving** requires more than just knowledge and thinking.

Problem definition

The normal process for solving a problem will initially involve defining the problem you want to solve. You need to decide what you want achieve and write it down. Often people keep the problem in their head as a vague idea and can so often get lost in what they are trying to solve that no solution seems to fit. Merely writing down the problem forces you to think about what you are actually trying to solve and how much you want to achieve. The first part of the process not only involves writing down the problem to solve, but also checking that you are answering the right problem. It is a check-step to ensure that you do not answer a side issue or only solve the part of the problem that is most easy to solve. People often use the most immediate solution to the first problem definition that they find without spending time checking the problem is the right one to answer. Identify the problem. State and describe the Problem.

Define the Problem

What prevents you from reaching your goal?

You may need to state the problem in broad terms since the exact problem may not be obvious.

- you may lack information to define it

- you can confuse symptoms with underlying causes

Prepare a statement of the problem and find someone you trust to review it and to talk it over. If the problem is a job situation, review it with your supervisor or the appropriate committee or resource.

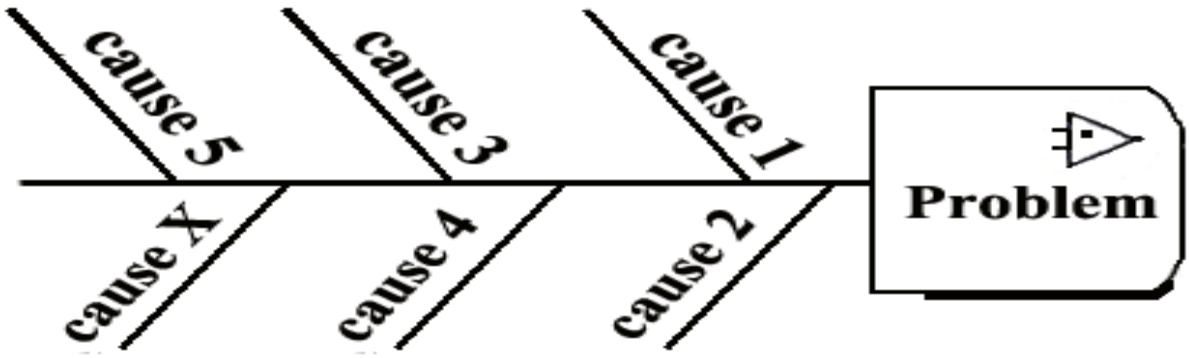
Consider these questions:

- What is the problem?
- Is it my problem?
- Can I solve it? Is it worth solving?
- Is this the real problem, or merely a symptom of a larger one?
- If this is an old problem, what's wrong with the previous solution?
- Does it need an immediate solution, or can it wait?
- Is it likely to go away by itself?
- Can I risk ignoring it?
- Does the problem have ethical dimensions?
- What conditions must the solution satisfy?
- Will the solution affect something that must remain unchanged?

Causes!

When problem solving, identify the causes of the problem in order to solve it.

- Identify causes of your problem
- Look at the current situation, rather than its history
- Do not consider the "trouble" it creates whether now or in the future.
- List and organize the causes of the problem



http://www.studygs.net/problem/problemsolvingv1.htm

Problem analysis

"Problem analysis can be defined as dissecting and thoroughly studying a problem with the objective to understand how the problem emerged and how it grew to its current proportion." – Coert Visser.

A Problem Analysis investigates a situation/problem in order to allow the researcher to understand more fully the problem, in order to recommend practical solutions for solving it. In addition, a Problem Analysis determines the degree of the problem and if the problem is a genuinely related to the specific site under investigated.

The next step in the process is often to check where we are, what the current situation is and what is involved in making it a problem. For example, what are the benefits of the current product/service/process? And why did we decide to make it like that? Understanding where the problem is coming from, how it fits in with current developments and what the current environment is, is crucial when working out whether a solution will actually work or not. Similarly you must have a set of criteria by which to evaluate any new solutions or you will not know whether the idea is workable or not. This section of the problem solving process ensures that time is spent in stepping back and assessing the current situation and what actually needs to be changed.

After this investigation, it is often good to go back one step to reconfirm that your problem definition is still valid. Frequently after the investigation people discover that the problem they really want to answer is very different from their original interpretation of it.

Five steps of problem analysis „

Step1:

- Gain agreement on the problem definition …
- Write a simple and clear definition of the problem description …
- Establish an order of importance for all features of the system …
- Come to an agreement with all stakeholders …
- Resolve conflicts by negotiation

Step 2:

- Identify the root causes of the problem …
- Make sure that the problem identified is the real problem …
- Sometimes, a problem hides other more important problems …
- Addressing the wrong problem leads to failure …

- A problem can have several causes: „
- Some might be eliminated by non-software solutions „
- Some might need contradictory solutions „
- More than one solution might be needed …
- This part of the analysis requires input from extremely knowledgeable, insightful and experienced persons

Step 3:

- Identify stakeholders and users …
- Stakeholder: anyone who could be affected by the new system or has input to provide in the implementation of the new system …
- Complex problems always involve the input of different stakeholders that have different viewpoints on the problem. Users: will use the system „
- Managers: will pay for the system, or will manage the users „
- IT people: will install, manage and maintain the system „
- External regulators: will impose constraints on the system operation „
- System developers: will implement a solution to the problem …
- Forgetting one of these might lead to major rework later on, or even to project failure.

Step 4:

- Define the system boundary …
- Any software system has to interact with its environment …
- System boundary describes an envelope in which the solution is contained. …
- System is divided as: „
- The system itself and its functionalities „
- The things (outside the system) that interacts with the system …
- Actors: „
- Supplies, uses, or modifies the information in the system „
- Someone or something, outside the system, that interacts with the system …
- Later on, this early information will direct how the system interfaces will be defined.

Step 5:

- Identify the constraints on the system …
- Constraint: a restriction on the degree of freedom we have in providing a solution
- They are as important as requirements: they direct what the system should not do, or what the system should not be.

The Creative Problem Solving Process (Step by step):

1. State The Problem
2. Gather Data
3. Restate Problem
4. Identify Alternatives
5. Evaluate Alternatives
6. Implement Decision
7. Evaluate Results

Activity 3b: 'Beauty 4U' Dilemma: Anti-aging Cream

Generating possible solutions

When you have discovered the real problem that you want to solve and have investigated the climate into which the solution must fit, the next stage is to generate a number of possible solutions. At this stage you should concentrate on generating many solutions and should not evaluate them at all. Very often an idea, which would have been discarded immediately, when evaluated properly, can be developed into a superb solution. At this stage, you should not pre-judge any potential solutions but should treat each idea as a new idea in its own right and worthy of consideration.

Brainstorming process and rules

Brainstorming Process

Brainstorming is a group technique for generating new, useful ideas and promoting creative thinking

- Identify need for Brainstorming
- Form Brainstorming Group
- Prepare for Brainstorming session
- Generate Ideas
- Develop, group and prioritize ideas
- Decide next steps

Rules for Brainstorming

- Define the problem you want solved clearly, and lay out any criteria to be met
- Keep the session focused on the problem
- Ensure that no one criticizes or evaluates ideas during the session

- Try to get everyone to contribute and develop ideas, including the quietest members of the group
- Encourage them to come up with as many ideas as possible, from solidly practical ones to wildly impractical ones.
- Welcome creativity
- Ensure that no train of thought is followed for too long (Max 30 Min)
- Encourage people to develop other people's ideas, or to use other ideas to create new ones
- Appoint one person to note down ideas that come out of the session

Fishbone Analysis (Cause and Effect/Ishikawa/Fishbone Diagram)

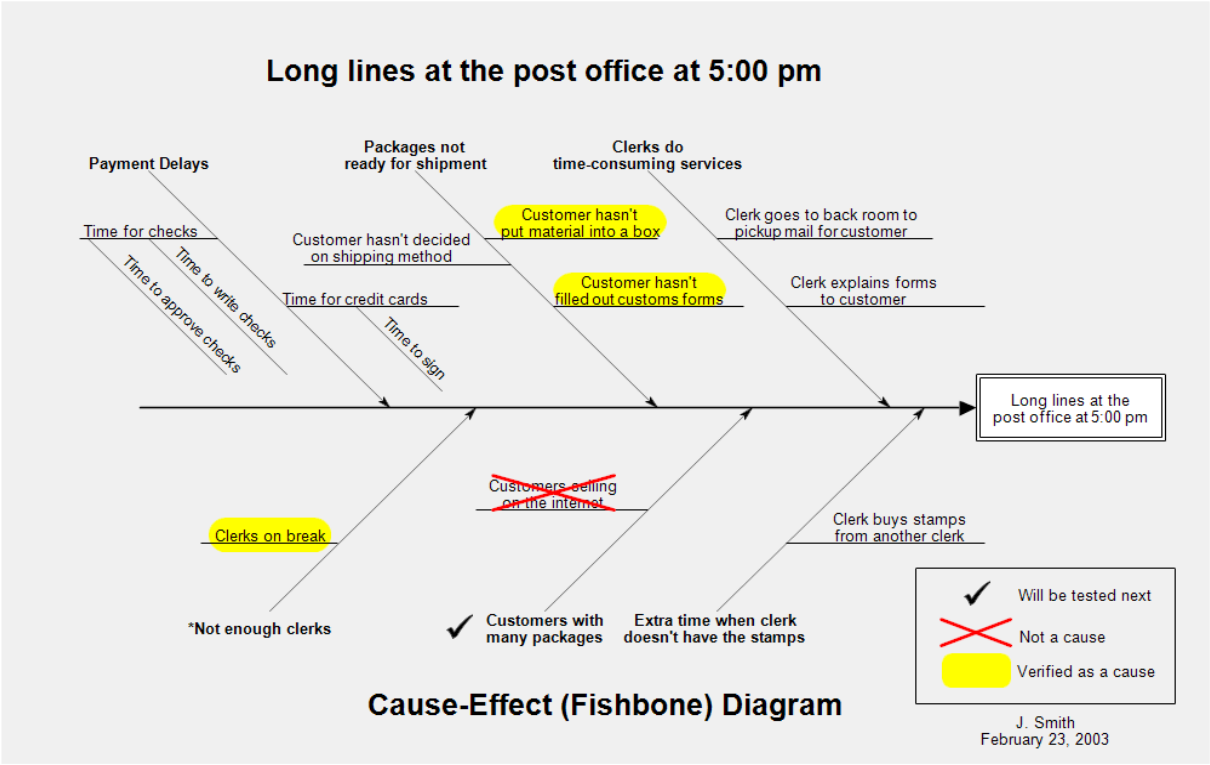
- A systematic method of looking at a problem and its causes
- Developed by Kauro Ishikawa who popularised its use in the Japanese Quality Movement
- Also known as Fishbone Diagram

When should a fishbone diagram be used?

- Need to study a problem/issue to determine the root cause?
- Want to study all the possible reasons why a process is beginning to have difficulties, problems, or breakdowns?
- Need to identify areas for data collection?
- Want to study why a process is not performing properly or producing the desired results?

How is a fishbone diagram constructed?

- Draw the fishbone diagram.
- List the problem/issue to be studied in the "head of the fish".
- Label each ""bone" of the "fish". The major categories typically utilized are:
- The 4 M’s: Methods, Machines, Materials, Manpower
- The 4 P’s: Place, Procedure, People, Policies
- The 4 S’s: Surroundings, Suppliers, Systems, Skills
- Brainstorm potential causes of the problem
- Review each major cause category. Circle the most likely causes on the diagram
- Asking "why" will help get to the root cause of the problem.
- Reach an agreement on the most probable cause (s)


Long lines at the post office at 5:00 pm
Payment Delays
Packages not ready for shipment
Clerks do time-consuming services
Time for checks
Time to write checks
Time to approve checks
Customer hasn't decided on shipping method
Customer hasn't put material into a box
Clerk goes to back room to pickup mail for customer
Time for credit cards
Time to sign
Customer hasn't filled out customs forms
Clerk explains forms to customer
Long lines at the post office at 5:00 pm
Customers selling on the internet
Clerks on break
Clerk buys stamps from another clerk
*Not enough clerks
Customers with many packages
Extra time when clerk doesn't have the stamps
Will be tested next
Not a cause
Verified as a cause
Cause-Effect (Fishbone) Diagram
J. Smith
February 23, 2003

Unit V: Decision Making Process

Introduction

This Unit aims to provide learners the skills of effective decision making using six thinking hats, decision tree analysis, Pareto Chart and What-If Analysis.

Learning Outcomes

By the end of the unit, the learners will be able to:

- Apply the six thinking hats in decision making
- Use SWOT analysis to make decisions
- Use the Decision Tree Analysis to derive cause and effect relationship to find solutions to problems
- Analyze cause-effect relationship of a situation applying Pareto principle
- Generate alternative decisions using What-If Analysis

Decision-making involves purposeful selection of an action from among a set of alternatives in the light of a given objective. Decision making is so important that one single decision taken at one point of time can change the whole course of a person's life or turn the course of an organisation or a society.

In the following section, a discussion of Edward De Bono's Six Thinking Hats, Decision and Tree Analysis are presented.

Six Thinking Hats

Six Thinking Hats is a good technique for looking at the effects of a decision from a number of different points of view. It allows necessary emotion and skepticism to be brought into what would otherwise be purely rational decisions. It opens up the opportunity for creativity within decision-making. The technique also helps, for example, persistently pessimistic people to be positive and creative.[14]

Activity 4a: Matching hats with their definitions.

Activity 4b: Matching hats with comments.

Different Ways to Think!

Yellow Thinking Hat = advantages, benefits, positives, savings. (Why it can be done. Why there are benefits. Why it is a good thing to do.)

Red Thinking Hat = emotions, feelings, hunches, intuition. (How do I feel about this matter right now? How might others feel? How will I feel in a few months/years from now?)

Blue Thinking Hat = Thinking about the process of thinking. (Is it a good idea for me to be thinking about the process? How much should I think about the views of others?)

Black Thinking Hat = Caution, truth, judgment. (Does it fit the facts? Will it work? Can it be done?)

White Thinking Hat = Facts, figures, information. (What information do we have? What information do we need to get? Who has information we need?)

Green Thinking Hat = Exploration, proposals, suggestions. (What can we do? Are there some different ideas? Who is included and who is not included?)

Activity 4c: If you are not familiar with the Six Thinking Hats method - it is just a way to "try on" different viewpoints. This can be very useful as an educational planning activity. Below is an outline that explains how to incorporate a critical thinking activity into the planning process.

Thinking Hats – How It Works

The different hats represent different types of thinking. If actual hats (although it can make the activity fun) are too difficult to find you can use hats cut out of different coloured paper Each hat is a different colour and represents a different type of thinking. The key is to have a visual that represents the different types of thinking.

Activity 4d: Arrange learners into groups of six. Provide each group with six different thinking hats. (Each thinking hat should be placed on each group's table as a reference).

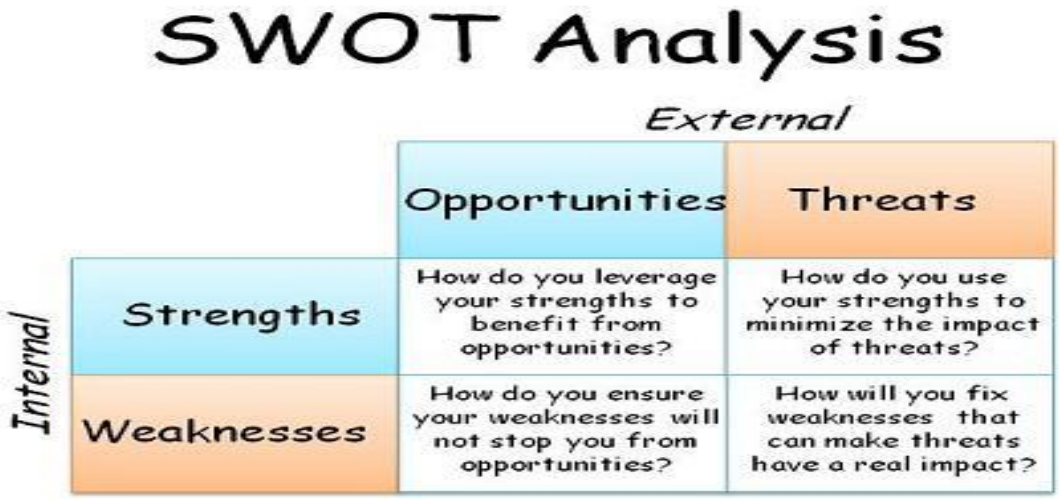
Ask each group to take a minute to familiarize themselves with each type of thinking.

Have each person in your group select a hat or type of thinking. Once they have their hat on (either literally or figuratively) ask them to try to discuss on the given problem from the thinking viewpoint of the hat they are wearing. *(Created By: Pardy & Associates 2005)*

SWOT analysis

SWOT stands for 'Strengths, Weaknesses, Opportunities and Threats'. This is a method of analysis of the environment and the company's standing in it.

SWOT is made of two parts: the strengths and weaknesses refer to the internals of a company while the opportunities and threats are external to the company and exist in the environment.



- Use a SWOT analysis to distinguish between where you are now and where you wish to be,
- Be realistic about your strengths and weaknesses,
- Be specific — only include key points and issues,
- Relate strengths and weaknesses to critical success factors,
- Always aim to state strengths and weaknesses in competitive terms,
- Rank points in order of importance, and
- Finally, keep it brief — never more than a page.

Activity: (Tutor may choose to have other SWOT analysis task)

Task

Define the goal and measurable outcomes – i.e. to have more than 90% of students attending Morning Assembly in a semester

- Consider the current activities the college have in place to encourage students in coming up for assembly
- Complete a SWOT analysis, identifying current strengths and realistically appraising the current weaknesses. This can only be done involving teachers, student leaders and students.
- From the current analysis identify factors which could be improved
- Identify opportunities that could be created
- Put a plan and set of measures in place.

Decision Tree analysis

What is decision tree analysis?

A decision tree is a decision support tool that uses a tree-like graph or model of decisions and their possible consequences, including chance event outcomes, resource costs, and utility. It is one way to display an algorithm. Decision trees are commonly used in operations research, specifically in decision analysis, to help identify a strategy most likely to reach a goal. Another use of decision trees is as a descriptive means for calculating conditional probabilities. When the decisions or consequences are modelled by computational verb, then we call the decision tree a computational verb decision tree.

A decision Tree consists of 3 types of nodes:-

- Decision nodes - commonly represented by squares
- Chance nodes - represented by circles
- End nodes - represented by triangles15

A decision tree is one of the most systematic tools of decision-making theory and practice. Such trees are particularly helpful in situations of complex multistage decision problems. For example, when you need to plan and organize a sequence of decisions and take into account how the choices made at earlier stages and the outcomes of possible external events determine the types of decisions and events at later stages of that sequence.

A decision making tree is essentially a diagram that represents, in a specially organized way, the decisions, the main external or other events that introduce uncertainty, as well as possible outcomes of all those decisions and events.

Different types of tree-diagrams are used in determining the optimum course of action, in situations having several possible alternatives with uncertain outcomes. The resulting chart or diagram (which looks like a cluster of tree branches) displays the structure of a particular decision, and the interrelationships and interplay between different alternatives, decisions, and possible outcomes.[16]

Activity 4e: Decision tree practice

Making the Tree

- Write the decisions you need to make on a piece of paper.
- Draw a box around this decision.
- Draw lines to possible solutions to the left of the decision.
- Draw a square at the end of the decision and draw new lines with further decisions.
- If you do not know the outcome of a decision, draw a circle instead.
- Complete all possible decision paths.

Evaluate the Decision

Assign a score to each possible outcome. Try making all the possibilities of the outcomes add up to 100 so you will have a reasonable percentage. For example, if you have nine possible outcomes, you may have eight outcomes worth 10 points and one outcome worth 20 points.

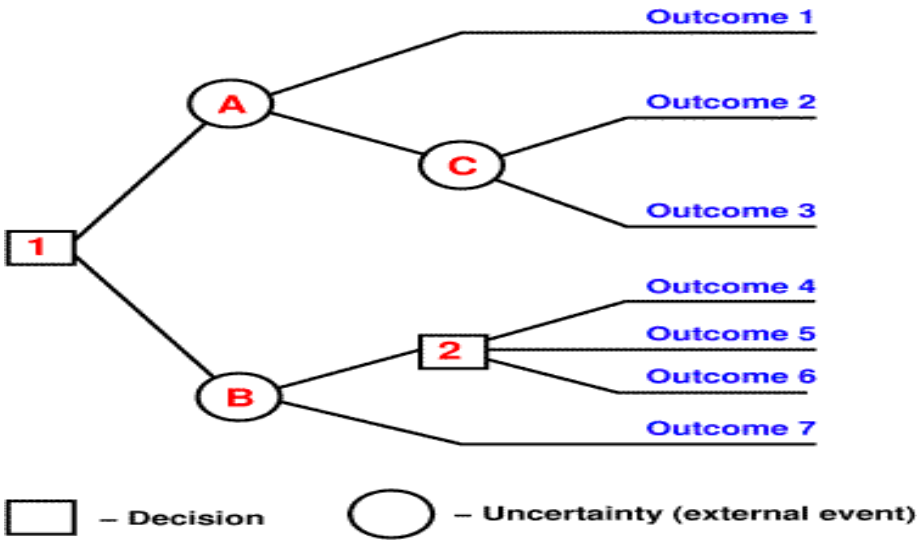
The 20-point outcome would be twice as positive as each 10-point outcome, but only 20 percent as likely an outcome compared to all other possible outcomes.

Add a probability to each decision for the uncertainty. Then multiply this probability by the points score. If you gave your 20 point outcome a probability of 0.2 then the score would be 4.

Other Considerations

Within the business of finance decisions, you must take cost into account for each decision and decision node. For personal decisions, you must take more abstract things into account such as personal happiness and uncertainty. Because of this, decision trees tend to work better for concrete business decisions.

Here is a schematic example that illustrates the basic elements of decision trees.



Squares represent decisions you can make. The lines that come out of each square on its right show all the available distinct options that can be selected at that decision analysis point.

Circles show various circumstances that have uncertain outcomes (For example, some types of events that may affect you on a given path). The lines that come out of each circle denote possible outcomes of that uncontrollable circumstance. Write down above each such line in the decision tree your best guesses for probabilities (for example, “80%” or “0.8”) of those different outcomes.

Each path that can be followed along the decision tree, from left to right, leads to some specific

outcome. You need to describe those end results in terms of your main criteria for judging the results of your decisions. Ideally, you will assign each end outcome a quantitative measure of the overall total benefit you will receive from that outcome (you can express it as a perceived monetary value).

Now you have a complete decision making tree with specific numbers for both the probabilities of the uncertain events and the benefit measures (desirability) of each end result. At this stage the tree can give you more specific recommendation on what would be your best choices.

In particular, for each choice that you control (at the decision points shown by squares), you can calculate the overall desirability of that choice. Just sum the benefit measures of all the end outcomes that can be traced back to that choice (via one path or another), weighted by the probabilities of the corresponding paths. This will show you the preferred choice (the one with the highest overall desirability).

If you have more than one decision point, you need to do that calculation for the decisions that are at the latest stages first. Identify the choice that gives the highest overall desirability and leave only that branch (removing the decision point). Do the same with the remaining squares, working your way to the left (to the first decision point in the sequence).[18]

Uses

Decision Trees are excellent tools for helping you to choose between several courses of action. They provide a highly effective structure within which you can lay out options and investigate the possible outcomes of choosing those options. They also help you to form a balanced picture of the risks and rewards associated with each possible course of action.

Decisions trees provide a method of accessing several different courses of action. These techniques help you understand the possibilities and possible pros and cons of different decisions. Decisions trees can be used for both personal and business decisions and are popular in the health care industry.[19]

Activity 4f:

You are a university graduate looking for a job. You have three career options:

- Private Organization
- Corporation

- Civil Service

Design a Decision Tree to choose a suitable career option that best suits you.[20]

Pareto Chart

What is a Pareto Chart?

A Pareto Chart is "a series of bars whose heights reflect the frequency or impact of problems. The bars are arranged in descending order of height from left to right. This means the categories represented by the tall bars on the left are relatively more significant than those on the right." The chart gets its name from the Pareto principle, which postulates that eighty percent of the trouble comes from twenty percent of the problems.

Why use Pareto Charts?

The use of Pareto Charts serves a number of purposes. "A Pareto Chart breaks a big problem into smaller pieces (and) identifies the biggest contributors (It can) help us get the most improvement with the resources available by showing where to focus efforts in order to maximize achievements. The Pareto Principle states that a small number of causes accounts for most of the problems. Focusing efforts on the 'vital few' causes is usually a better use of valuable resources."

When is a Pareto Chart used?

A Pareto Chart is a good tool to use when the process you are investigating produces data that are broken down into categories and you can count the number of times each category occurs.

No matter where you are in your process improvement efforts, Pareto Charts can be helpful, early on to identify which problem should be studied, later to narrow down which causes of the problem to address first. Since they draw everyone's attention to the 'vital few' important factors where the payback is likely to be greatest, (they) can be used to build consensus. In general, the biggest problems – those with the highest bars on the Pareto Chart should be given the first attention.

Making problem-solving decisions isn't the only use of the Pareto Principle. Since Pareto Charts convey information in a way that enables to see clearly the choices that should be made, they can be used to set priorities for many practical applications. Some examples are:

- Process improvement efforts for increased unit readiness

- Skills that an agency or an individual wants to develop
- Customer needs
- Suppliers
- Investment opportunities

How is a Pareto Chart constructed?

A meaningful set of data is the key requirement for constructing a Pareto Chart. This data has to be collected and categorized based on the conditions or factors one wishes to study. The steps shown below are the most common procedures followed in constructing a Pareto Chart:

Step 1: Record the raw data. List each category and its associated data count.

Step 2: Order the data. Prepare an analysis sheet, putting the categories in order and placing the one with the largest count first.

Step 3: Label the left hand and vertical axis. Make sure the labels are spaced in equal intervals from 0 to a round number equal to or just larger than the total of all counts. Provide a caption to describe the unit of measurement being used.

Step 4: Label the horizontal axis. Make the widths of all the bars the same and label the categories from largest to smallest. An "other" category can be used last to capture several smaller sets of data. Provide a caption to describe them. If the contributor names are long, label the axis A, B, C, etc. and provide a key.

Step 5: Plot a bar for each category. The height of each bar should equal the count for that category. The widths of the bars should be identical.

Step 6: Find the cumulative counts. Each category's cumulative count is the count for that category added to the counts for all larger categories.

Step 7: Add a cumulative line. This is optional. Label the right axis from 0 to 100% and line up the 100% with the grand total on the left axis. For each category, put a dot as high as the cumulative total and in line with the right edge of that category's bar. Connect all the dots with straight lines.

Activity 4g: Alcohol abuse by youths has become a serious issue in the Bhutanese society over the recent years. Use the Pareto principle to present recommendations to curb this problem.

Activity 4h: You are a team investigating the delay associated with processing credit card

applications. Group the data into following categories: no signature, no valid residential address, non-legible handwriting, already a customer and other category.

Category	**Frequency**
No address	9
Illegal	22
Current customer	15
No signature	40
Other	8

Using the example data, construct a Pareto Chart (referring to the 7-step procedure given in the resource pack)

Activity 4i: For example, the issue of why there is a low qualifying rate for students proceeding to tertiary education in Bhutan.

Using the example data, students follow the steps to construct a Pareto Chart

Category	**Frequency**
Financial background	55
Distraction	50
Lack of Resources	40
Passive Individuals	65
Study Environment	20
Less Tertiary Institutes	30

Review results of group work and answer any questions learners may have.

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APPENDICES

Appendix 1

turns in time and doesn't hit him.	
A man marries twenty women in his village but isn't charged with polygamy.	Clue: He only marries them... Answer: He's a priest; he is marrying them to other people, not to himself.
A landlord is threatening to evict a father and his beautiful young daughter, unless she agrees to marry him. There are a lot of witnesses and in a false gesture of sincerity; he offers her an opportunity to remain in the house without marrying him. He has a silk bag in which he says he has placed a white and a black stone from the footpath on which they're standing. If she picks the white stone from the bag, then she wins; if she picks the black, she loses. However, the young girl saw him place two black stones in the bag. She can't accuse him of cheating, because he would say that his good question was called into question and storm off without showing the bag. How does the clever girl win?	Clue: The landlord will not want to be embarrassed. Answer: She withdraws a stone and instantly drops it into those on the ground and is lost. To know what colour it was they must look at the stones remaining in the bag...
A man is alone on an island with no food and no water, yet he does not fear for his life.	Clue: There are many types of island Answer: He is a policeman on a traffic island

Appendix 2

Answer for Unit I, Activity-1

Dorji (1 min) and Yonten (2 min) cross the bridge (2minutes)

Dorji(1 min) takes the torch back to the other side (1minute).

Dema (5 min) and Tobgay (10 min) cross the bridge (10 minutes).

Yonten (2 min) takes the torch back to the other side (2 minutes).

Dorji (1 min) and Yonten (2 min) cross the bridge (2 minutes).

Appendix 3

1. 26 L of the A 26 LETTERS OF THE ALPHABET
2. 7 D of the W 7 DAYS OF THE WEEK
3. 7 W of the W 7 WONDERS OF THE WORLD
4. 12 S of the Z 12 SIGNS OF THE ZODIAC
5. 52 C in a P (WJs) 52 CARDS IN A PACK (WITHOUT JOKERS)
6. 13 S in the USF 13 STRIPES IN THE UNITED STATES FLAG
7. 18 H on a G C 18 HOLES ON A GOLF COURSE
8. T on a F 5 TOES ON A FOOT
9. 90 D in a R A 90 DEGREES IN A RIGHT ANGLE
10. 3 B M (S H T R) 3 BLIND MICE (SEE HOW THEY RUN)
11. 32 is the T in D F at which W F 32 IS THE TEMPERATURE IN DEGREES FAHRENHEIT AT WHICH WATER FREEZES
12. 15 P in a R T 15 PLAYERS IN A RUGBY TEAM
13. 3 W on a T 3 WHEELS ON A TRICYCLE
14. 100 C in a R 100 CENTS IN A RAND
15. 11 P in a F (S) T 11 PLAYERS IN A FOOTBALL (SOCCER) TEAM
16. 12 M in a Y 12 MONTHS IN A YEAR
17. 13=UFS 13 IS UNLUCKY FOR SOME
18. 8 T on a O 8 TENTACLES ON A OCTOPUS

19. 29 D in F in a L Y 29 DAYS IN FEBRUARY IN A LEAP YEAR

20. 365 D in a Y 365 DAYS IN A YEAR

21. 13 L in a B D 13 LOAVES IN A BAKERS DOZEN

22. 52 W in a Y 52 WEEKS IN A YEAR

23. 9 L of a C 9 LIVES OF A CAT

24. 60 M in a H 60 MINUTES IN A HOUR

25. 23 P of C in the H B 23 PAIRS OF CHROMOSOMES IN THE HUMAN BODY
26. 64 S on a C B 64 SQUARES ON A CHESS BOARD
27. 9 P in S A 9 PROVINCES IN SOUTH AFRICA
28. B to an O in C 6 BALLS TO AN OVER IN CRICKET
29. 1000 Y in a M 1000 YEARS IN A MILLENIUM
30. 15 M on a D M C 15 MEN ON A DEAD MANS CHEST

Appendix 4

Doing Ethics: Rational and Creative Thinking

Richard Garlikov

One of the characteristics of many, perhaps even most, math and logic problems -- often called "word problems" -- where the calculation or formula is not simply given to you, is that answers are much easier to verify (or disconfirm) than they are to discover in the first place. Sometimes the same is true of mechanical and scientific problems, where a solution is difficult to discover, but one can tell fairly readily whether a proposed solution works or not, at least as far as the problem is defined. (It is not always possible to test for or to immediately recognize unknown or unanticipated harmful side-effects of any solution, but one can tell whether the proposed solution will have the sought effect.) The same sort of phenomenon often occurs in trying to solve ethical dilemmas or problems in real life. It is often far easier to recognize a proposed solution to a particular problem as being satisfactory or not (apart from, at the time unrecognized, side-effects) than it is to discover or invent a likely solution. Having ethical principles does not mean one can automatically or mechanically generate solutions to ethical problems, even when those principles can be applied fairly easily to see whether a proposed solution is satisfactory or not.

Suppose, for example, that one has an ethical principle which, in a particular conflict between two people, implies that if there is an act which would accommodate the interests of both in this particular case, it would be morally more preferable than any act which only accommodates one person at the expense of the other. It might be extremely difficult to think of an act that would accommodate both parties' interests or needs, but if a possible candidate arises, it is usually fairly easy to see whether it will, at least theoretically, serve that purpose. Rational thinking and creative thinking are not necessarily the same thing. The purpose of developing rational principles in ethics is to help one seek answers in the right places, and to recognize them when they are found. But rational ethical principles may not necessarily be helpful for logically, mechanically, or automatically inventing or discovering feasible solutions in the first place. Consider the following case, for example.

In a (fictional?) case study, reprinted in Donaldson, Werhane, and Cording's *Ethical Issues in Business: A Philosophical Approach* (seventh edition), Hans Wolf describes a situation in which a pharmaceutical company CEO, under pressure to increase profits, must decide, from among numerous other options open to him, whether or not (also) to sell a treatment for serious viral infections to the Philippine government, primarily for treatment of serious measles cases. The dilemma is that the U.S. FDA has rejected the drug for the U.S. market because, though it passed the old standard, it does not pass a brand new standard the FDA uses. It is not clear whether the batch available is therefore in some way dangerous or not. It was not previously considered dangerous. Currently the Philippine government uses the old standard. Moreover last year, half the children in the Philippines who got measles died from them. There is no batch of the drug available to sell to the Philippines that would meet the FDA's new standards, because the drug is difficult to make and is in short supply.

The vice president in charge of exports for the pharmaceutical company has told the CEO "It's not our job to over-protect other countries. The health authorities in the Philippines know what they're doing. Our FDA always takes an extreme position. Measles is a serious illness. Last year over half the kids in the Philippines who had measles died. It's not only good business but good ethics to send them the only batch ... we have available."

Should the CEO sell the batch of this drug to the Philippine government or not, is the implied question.

It seems to me there is only one thing that makes this seem like a difficult decision for the CEO (or the company) to have to make, something that is left out of the above facts. Once that consideration is entered into the equation there is no ethical dilemma for the company at all. There seems to be the implicit assumption above not to tell the Philippine government about the new FDA test and their subsequent rejection of this drug. The dilemma seems to be whether not to sell the drug to the Philippines or to sell it under some sort of false pretenses in order to deceive or "pull a fast one" on the Philippines. This is a false dichotomy because there is another option -- telling the Philippine government the whole situation about the new test and the rejection by the U.S. government and then letting them decide for themselves whether to buy the drug or not.

From the information given about the need in the Philippines for some sort of effective

treatment, it seems to me quite clear that the government would want the drug anyway. They should have the opportunity to accept or reject the sale, as long as they have the honest information from the company. I think it would be wrong to sell the drug by trying to act as though nothing happened to make the drug unmarketable in the U.S. and just rely on the health officials in the Philippines to know about it on their own. But there is every reason to believe, from the above, that whatever the risk might be to Philippino children, the risk of not using the drug seems far greater. I see selling them the drug with full disclosure as being no different from a scratch and dent sale or a discontinued model clearance sale that has full disclosure.

Selling them the drug without full disclosure would be dishonest even if legal. It would be like marketing a drug with side-effects that only the company knew about and were able to sneak past the FDA. Theoretically, FDA testing should be about catching problems a company does not detect or know about, not about catching problems a company knows about and is trying to hide. Morality is not some sort of game where subterfuge or cheating others is okay if one does not get caught ahead of time.

Finally, it may be that the vice president in charge of exports, quoted above, meant that full disclosure was unnecessary because the Philippine health authorities know about the new FDA tests and will not care, given their needs for the treatment. But the way the statement reads, it is more likely that, regardless of what he meant, the CEO would take his statement as implying or saying it is ok to keep the medical authorities in the Philippines in the dark about the existence of the new test and the failure of the company's drug to pass it because they ought to be competent enough to know about the test, whether they do know or not -- that it ought to be their responsibility to know. Had the vice president said more clearly that the pharmaceutical company should inform the Philippine officials of the test and the drug's failure of it and then let them decide whether the need justifies the risk because they are competent to make that decision, I think there would have been no moral dilemma for the CEO about this particular issue. I think the apparent moral dilemma only shows up if the vice president's comments are meant to advise or condone deceit or lack of any kind of disclosure about the new FDA test and its results.