Integrating Critical Thinking into Educational Settings

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‘Thoughts on Thinking’ at psychologytoday.com
Things that cause cancer...
according to the Daily Mail:

- Being a man
- Being a woman
- Sunscreen
- Babies
- Baby food
- Crayons
- Flip-flops
- Bras
- Having a big head
- Intercourse with sparrows
Know your Enemy

• Fallacious Thinking:
  • Faulty reasoning in which a fallacy is presented within one’s argument or solution; either by mistake or purposefully, with the intent of persuasion or deception.
  • Whereas fallacious thinking refers to a flaw in one’s reasoning, the flaw is generally limited to that particular solution or argument.

• Cognitive Biases:
  • ‘Systematic errors’ in the thinking process, in which the systematic nature of the thought process reflects more of a tendency towards a particular error.

• Both fallacious thinking and cognitive biases can stem from erroneous logic, emotion and heuristic-based thinking.
Know your Enemy

• Heuristic
  • Experience-based protocol for problem-solving and decision-making, which acts as a mental shortcut
  • A procedure that helps find the adequate, though often imperfect, answers to difficult questions

• For example:
  • Availability
  • Representativeness
  • Anchoring & Adjusting
  • Affect
The Availability Heuristic

• Consider the letter “R” in the English language. Do you think this letter occurs more often:

a) as the first letter of words
   or
b) as the third letter of words?
Schwarz et al (1991) asked participants to identify and describe either 6 or 12 occasions in which they were either assertive or unassertive. After the recall period, participants were asked to rate their own assertiveness. Given that it is easier to recall 6 events than 12 events, those who were asked to recall six occasions of assertiveness rated themselves as more assertive than those who were asked to describe 12 occasions, as were those who were asked to describe 12 occasions of unassertiveness relative to those asked to describe six occasions of unassertive behaviour.
A panel of psychologists have interviewed and administered personality tests to 30 engineers and 70 lawyers, all successful in their respective fields.
Thumbnail descriptions for each have been written.
The following description was chosen at random from the full set of descriptions.
• Please identify whether the person described is more likely to be an engineer or a lawyer.
Jack is a 45-year old man. He is married and has four children. He is generally conservative, careful and ambitious. He shows no interest in political and social issues and spends most of his free time on his many hobbies which include home carpentry, sailing and mathematical puzzles.
The Representativeness Heuristic

• Suppose you flipped a fair coin 6 times. Which sequence is more likely to occur?

  • A) HTTHTH
  • B) HHHHHTTT
Anchoring & Adjustment Heuristic

So what? Who cares?
The Affect Heuristic

• Strack, Martin and Schwarz (1988) asked individuals to:

  Think about their lives and rate their general happiness with it.

• Participants were also asked:

  How frequently they went out on dates.

• When the general happiness question was asked first there was no correlation between responses. However, when the dating question was asked first, responses on the two questions were significantly correlated. Why?
The New Knowledge Economy

- 500,000 times the volume of information contained in the U.S. Library of Congress print collection was created in 2002 alone.

- From the years 1999 to 2002, the amount of new information created equalled the amount of information previously developed throughout the history of the world (Varian & Lyman, 2003).

- It is further estimated that the creation of new information is doubling every two years (Jukes & McCain, 2002).

- Due to the ‘internet explosion’, it’s hard to be sure of exactly how much is now out there.

- But, it is currently estimated that 5 exabytes of data are created each day (i.e. 5 billion pick-up trucks full of A4-paper based information).

- Education is no longer solely about attaining knowledge; rather, a large focus now rests on being able to ADAPT our thinking to the constant development of new information and new knowledge.
“Lack of Critical Thinking in schools and society a concern – Higgins”

(Irish Times, Nov. 16, 2017)

“It is so important that all of our citizens be encouraged to think critically rather than merely reproduce the information pushed towards them by proliferating media sources... I believe that those virtues of reflection, of critical reasoning and of ethical enquiry are ones that have gained renewed urgency in the present moment, as humanity is faced with unprecedented challenges of a global kind - from climate change to mass migration.”
So, we have to teach Critical thinking.

Again, how?
General Tips for Presenting Critical Thinking Instruction

- Be Personable – Be Funny
- Utilise Active Learning
- Know your Audience Size
- Be Intellectually Honest with yourself and your students – You cannot always be PC if you want to think critically
- Mode of Delivery – Traditional, e-Learning, Blended Learning
- Utilise Argument Mapping
- To teach critical thinking, you must think critically
5 Tips for Critical Thinking

1. Save your critical thinking for things that matter
2. Do it in the morning
3. Take a step back
4. Play Devil’s Advocate
5. Leave emotion at the door
Know you outcomes: How do I assess Critical Thinking?

- Continuously
  - Reflective judgment requires engagement opportunities to development. Give students those opportunities!

- Through what means?
  - Well, let’s first consider traditional means of assessment.
  - Standardised CT assessment.
Standardised CT Assessment

• Dispositions
  • California Critical Thinking Dispositions Inventory (CCTDI)
  • Need for Cognition Scale (NCS)
  • Motivated Strategies towards Learning Questionnaire (MSLQ)

• Skills
  • California Critical Thinking Skills Test (CCTST)
  • Cornell Critical Thinking Test (CCTT)
  • Watson-Glaser Critical Thinking Assessment (WGCTA)
  • Ennis-Weir Critical Thinking Essay Test (EWCTET)
  • Halpern Critical Thinking Assessment (HCTA)
4 Instructional Typologies for Delivering Critical Thinking (Ennis, 1989)

1. General Approach:
   Actual CT skills and dispositions “are learning objectives, without specific subject matter content” (Abrami et al., 2008, p. 1105).

2. Infusion Approach:
   Requires specific subject matter content upon which CT skills are practiced. In the infusion approach, the objective of teaching CT within the course content is made explicit.

3. Immersion Approach:
   Like the infusion approach, specific course content upon which critical thinking skills are practiced is required. However, CT objectives in the immersed approach are not made explicit.

4. Mixed Approach:
   Critical thinking is taught independently of the specific subject matter content of the course.
4 Instructional Typologies for Delivering Critical Thinking (Abrami et al., 2011)

1. **General Approach:**
   Medium effect

2. **Infusion Approach:**
   Medium to Large Effect

3. **Immersion Approach:**
   Very small effect

4. **Mixed Approach:**
   LARGE effect

NB: The immersion approach is the only approach that does not make CT objectives explicit to students
So, what do I make explicit to students?
Critical Thinking: What is it?

• Well?

• Though 92% of academics surveyed indicated that it was important for students to be able to think and learn in a manner that stimulates a change in their perspectives, 54% of students surveyed indicated that they felt as though “they have not yet been provided the opportunity to do so” (UWA, 2007).

• According to one university lecturer interviewed in Lloyd and Bahr’s (2010, p. 13) qualitative research, ‘we expect students to do it [think critically], but now you are questioning me on my understanding of it, I wonder if I actually understand it myself’.

• Lloyd and Bahr’s research further revealed that while 37% of academics instructing or assessing CT in university courses at least acknowledge the dispositional and self-regulatory aspects of CT, only 47% described CT in terms of involving processes or skills.
Critical Thinking: What is it?

Critical thinking is a metacognitive process, consisting of a number of skills and dispositions, that, through purposeful, self-regulatory, reflective judgment, increases the chances of producing a logical solution to a problem or a valid conclusion to an argument.
Critical Thinking: What is it?

- Dispositions
- Skills
- Reflective Judgment
- Applications
Disposition towards Critical Thinking

- ...the extent to which an individual is disposed, inclined or willing to perform a given thinking skill

- A person with strong disposition towards critical thinking has the consistent internal motivation to engage problems and make decisions by using critical thinking, meaning:
  - the person consistently values critical thinking
  - believes that using critical thinking skills offers the greatest promise for reaching good judgments, and
  - intends to approach problems and decisions by applying critical thinking skills as best as he/she can.
Disposition

Those with a strong disposition toward critical thinking tend to possess positive habits when thinking critically.

Critical Thinking Dispositions

**Reflection**
An inclination to reflect on one's behavior, attitudes, opinions, as well as the motivations behind these; to distinguish what is known and what is not, as well as limited knowledge or uncertainty; to approach decision-making with a sense that some problems are necessarily illustrated, some situations permit more than one plausible conclusion or solution and judgments must often be made based on analysis and evaluation, as well as feasibility, standards, contexts and evidence that precede certainty.

**Truth-Seeking**
To have a desire for knowledge; to seek and offer both reasons and objections in an effort to inform and to be well-informed; a willingness to challenge popular beliefs and social norms by asking questions of oneself and others; to be honest and objective about pursuing the truth even if the findings do not support one's self-interest or pre-conceived beliefs or opinions; and to change your mind about an idea as a result of the desire for truth.

**Inquisitiveness**
An inclination to be curious, desire to fully understand something, discover the answer to a problem and accept that the full answer may not yet be known; to make sure to understand a task and its associated requirements, available options and limits.

**Organisation**
An inclination to be orderly, systematic and diligent with information, resources and time when determining and maintaining focus on the task, conclusion, problem or question, whilst simultaneously considering the total situation and being able to present the resulting information in a fashion, likewise, for purposes of achieving some desired end.

**Self-Efficacy**
The tendency to be confident and trust in one's own reasoned judgments; to acknowledge one's sense of self while considering problems and arguments (i.e. life experiences, knowledge, heuristics, biases, culture and environment); to be confident and believe in one's ability to receive and internalise resulting feedback positively and constructively; to be self-efficacious in leading others in the rational resolution of problems; and recognise that good reasoning is the key to living a rational life and to creating a more just world.

**Clarity**
To seek intelligibility, transparency, lucidity and precision from others and to be clear, with respect to the intended meaning of what is communicated.

**Open-Mindedness**
An inclination to be cognitively flexible and avoid rigidity in thinking; to tolerate divergent or conflicting views and treat all viewpoints alike, prior to subsequent analysis and evaluation; to detach from one's own beliefs and consider, seriously, points of view other to one's own without bias or self-interest; to be open to feedback by accepting positive feedback and to not reject criticism or constructive feedback without thoughtful consideration; and an existing knowledge in light of new ideas and experiences; and to explore such new, alternative or ‘unusual’ ideas.

**Perseverance**
To be resilient and to be motivated to persist at working through complex tasks and the associated frustration and difficulty inherent in such tasks, without giving up; motivation to get the job done correctly; a desire to progress.

**Attentiveness**
Willingness to focus and concentrate; to be aware of surroundings, context, consequences and potential obstacles; to have the full picture.

**Intrinsic Goal Orientation**
Inclined to be positive, competitive and enthusiastic towards a goal task, topic of focus and, if not the topic itself, enthusiasm for the process of learning new things; to search for answers as a result of internal motivation, rather than an external, intrinsic reward system.

**Scepticism**
Inclination to challenge ideas; to withhold judgment before engaging all the evidence or when the evidence and reasons are insufficient; to take a position and be able to change position when the evidence and reasons are sufficient; and to look at findings from various perspectives.

**Creativity**
A tendency to visualise and generate ideas; and to ‘think outside the box’ (i.e. think differently than usual)

**Resourcefulness**
The willingness to utilise existing internal resources to resolve problems; search for additional external resources in order to apply analogies and resolve problems; to switch between solution processes and/or knowledge to seek new ways/information to solve a problem; to make the best of the resources available, to adapt and/or improve if something goes wrong; and to think about how and why it went wrong.
Dispositions & Skills
Skills

1. Analysis
2. Evaluation
3. Inference
Why do we think?

If we genuinely care about our decisions, consideration of what to do and what to believe tend to activate the careful, logical, reasonable part of our mind – a part of our mind that is important for critical thinking.
1) We think in order to decide what to do

• Not only scientists think carefully and logically. We all do this whenever we care about our decisions.
• Consider an important decision: “I should buy a dog”
  • Because I’ve always had dogs and I love them
  • Because dogs are peoples’ best friend
  • Because I can go out walking every evening, keep fit and meet other people with dogs
  • But walking my dog every evening will mean I cannot pursue my new hobby
  • But I’ll feel guilty if I’m forced to leave my dog alone in the house all day
  • But a new dog would be expensive and I’m really short of money right now.

How do we arrive at our final decision in this context?
2) We think in order to decide what to believe

• But our ultimate decision about what to do very often hinges upon our decision about *what we believe*. For example, what would make you believe the statement: Dogs are peoples’ best friend?

• Consider a list of reasons
What to believe?

Dogs are peoples' best friend.

- Dogs are loyal.
- Dogs aid people's mental wellbeing.
- Dogs have evolved to have strong hierarchical social instincts -- they respect the leader of the pack.
- My dogs have always been faithful.
- Dogs decrease their owners' cholesterol levels.

OBJECTIONS???

How do we ultimately decide what to believe in this context?
Questioning our beliefs: Adding but to because.

• When deciding what to believe, we need to be careful not to focus only on reasons for accepting our beliefs (confirmation bias).

• We need to question our beliefs and the reasons we provide as a basis for our beliefs - we need to be sceptical.

• Are dogs really peoples’ best friend. What would make you disbelieve?
Questioning our beliefs: adding **but** to **because**.

Dogs are peoples' best friend.

- **because**
  - Dogs are loyal.
  - **but**
    - Without sufficient training, dogs can wander off and fail to obey their owners. In this sense, they are not always loyal.

- **because**
  - Dogs aid people's mental wellbeing.
  - **but**
    - There is limited research to support this claim and the design of the research studies in this area is of poor quality.

- **but**
  - Some dogs are quite vicious
  - **because**
    - Dogs sometimes attack people
Consider a different belief: Try adding **but** to **because**.
Arguments are hierarchical structures. We can continue to add more levels if we like. For example, we can offer a rebuttal to a but and construct a 4-level propositional structure.

- People are happy when drunk
  - because
  - Alcohol releases our inhibitions
    - but
      - Releasing your inhibitions does not mean you are necessary happy.
      - But
        - Releasing your inhibitions might lead you to do foolish things that result in unhappiness
      - however
        - One can also do spontaneous, foolish things that ultimately help you discover your inner child, a true source of everlasting happiness.
Analysis

• Since asking you the reasons for why think, we have been conducting the skill of analysis.

• Simply, when we analyse information, we are identifying claims, their reasons and their objections, as well as rebuttals.

• Successful analysis yields the structure of an argument, problem and/or solution.
Unpacking a Person's Belief: Analysis

• People don’t always tell you the basis of their beliefs. You often have to ask people why they believe what they believe.

• But whenever they do provide an explanation you can unpack (analyse) the basis of their belief.

• How?
Consider the following dialogue:

A: “I think emotions make thinking irrational”
B: “Why?”
A: “Because in order to be rational one needs to be neutral (and not swayed by emotion). The problem with positive emotions is that they make one too agreeable and inclined to making risky decisions. The problem with negative emotions is that they make one too sceptical and inclined to reject all forms of evidence”.
B: “But is not scepticism a critical part of good critical thinking?”
A: “Yes, but rejecting all forms of evidence means one must also reject every belief, and that’s not rational”.

Now think back to the last example and consider the structure of this argument.

Emotions make thinking irrational.

Positive emotions make one too agreeable and inclined to making risky decisions.

Negative emotions make one too sceptical and inclined to reject all forms of evidence.

Sceptical thinking is critical for good critical thinking.

Rejecting all forms of evidence means one must also reject every belief, and that’s not rational.
Consider arguments that reject the claim that emotions make thinking irrational:

A commonly held belief is that emotions make thinking irrational. However, some people argue that neither emotion nor mood necessarily interfere with rational thought. For example, researchers have found that positive emotion often maintains behavior, not disrupts it. Thus, if a behaviour, such as reasoning, is associated with a pleasant, positive feeling, the behaviour is likely to continue.

Also, emotion can enhance cognitive skills other than reasoning. For example, emotion can increase expressive communication. Also, a positive mood may actually help a person on creative kinds of tasks (Isen et al., 1985). However, these forms of cognition are not necessarily forms of rationality.

Note how a good piece of prose puts related arguments into the one paragraph. This rule (one paragraph = one idea unit) often helps the reader to see and extract the structure of the argument.
There are two major objections to the central claim, both of which have a separate paragraph, both of which are supported by sub-claims, and one of which has a rebuttal.

**Paragraph 1**

- **Emotions make thinking irrational**
  - Neither emotion nor mood necessarily interfere with
    - Low levels of positive emotion often maintain behaviour, not disrupt it.
    - If a behaviour, such as reasoning, is associated with a pleasant, positive feeling, the behaviour is likely to continue.

**Paragraph 2**

- Emotion can enhance forms of cognition other than reasoning.
  - Positive mood may actually help a person on creative kinds of tasks (Isen et al., 1985).
    - These forms of cognition are not necessarily forms of rationality.
Analysis also includes the identification of information sources.

• Just as people don’t always tell you the basis for their beliefs, they also don’t always tell you the sources or types of arguments they are using.

• However, once you become familiar with the different types of arguments we can use to support our beliefs, you will come to know what types of arguments another person is using.

• This helps you to evaluate their arguments, because not all argument types are equal – some are better than others.
Identifying types of arguments and considering the strength of each type – some types are better than others!

1. Personal Experience
2. Common Belief
3. Expert Opinion
4. Statistics
5. Research

- Consider the example we used in the first session: Dogs are peoples’ best friend.
What to believe?

What type of argument is this?

Dogs are peoples' best friend.

- Dogs are loyal.
  - Common Belief
    - The claim above is widely accepted in the community.
- Dogs aid people's mental wellbeing.
  - Data
    - Research by The Good Shepherd Group, 2006
- Dogs have evolved to have strong hierarchical social instincts -- they respect the leader of the pack.
  - Expert Opinion
    - Dr. R. Hound, Faculty of Veterinary Science, University of Alsatia.
- My dogs have always been faithful.
  - Personal Experience
    - My dog never abandoned me during my forty two days lost on the Arctic ice.
- Dogs decrease their owners' cholesterol levels.
  - Statistic
    - 87% of dog owners had lower than average cholesterol. "Canis Spaniel Health Watch" 2005.

Common sense statements can be at odds with research or other common sense statements. Research can be of poor quality and can conflict with other research findings. Experts don’t always agree and don’t always have evidence to support their view. Not necessarily reliable; cannot generalize to everyone. Statistics are not always easy to interpret.
Analysis & Evaluation

• It is certainly difficult to establish the truth, and it’s more difficult for some beliefs than for others.

• Consider each of the following:

  1. Human beings are inherently good.

  2. Alcohol consumption during pregnancy disrupts brain development.

  3. Humans will eventually live on Mars.

• When we evaluate:

1. We assess the **credibility** of arguments
2. We assess the **relevance** of arguments
3. We assess the **logical strength** of an argument structure
4. We assess the **balance/bias of evidence** in the argument

Our objective is to arrive at some conclusions about the overall strengths and weakness of an argument.
Credibility

What info would you include based on credibility?

Men generally have higher levels of testosterone than women, and are also more aggressive than women (Knight 1996).

because

Codeine is found in prescription strength cough and cold medications, and codeine can trigger aggression (Spiga, 1996).

because

but

Everyone knows that children are very innocent and loving most of the time. They learn aggression from parents, peers, and media.

but

Spectators model their behaviour on the behaviours they observe (Bandura, 1989).

but

I get very aggressive in the morning if I don't get my coffee.

but

Crime rates tend to be higher in countries with a considerable gap between the rich and the poor (Triandis, 1994).
Relevance

Are all the reasons and objections relevant? Do the propositions below relate to the claim above? Which proposition is irrelevant?

Viewing pornography increases aggressive male behavior towards

- **because**
  - The sales rate of pornographic magazines in different U.S. states is positively correlated with rape rates (Baron, 1984).

- **but**
  - In Denmark, a study conducted for 10 years after the introduction of legal pornography in the country showed a gradual decrease in sexual assaults.

- **but**
  - Marital violence decreased in couples who completed behavioral marital therapy for alcoholism and remained sober during follow up (O'Farrell, 1995).
The overall structure of an argument needs to be logical if the argument is to be convincing.
Logical Strength

Are the propositions that support a conclusion logically related. Do the propositions allow us to infer the conclusion?

Consider this example:

- The youth of today are very aggressive
  - because
  - The youth of today watch too much violent T.V.
  - because
  - Watching violent T.V. makes one aggressive
Balance of evidence

Two extremes of bias. A central claim with:

Only supports, no objections

OR

Only objections, no supports

In both cases, we need to question the intent of the author.
Even a string of anecdotes is weak compared with experimental study evidence.
Inference, involves the “gathering” of credible, relevant and logical evidence based on the previous analysis and evaluation of available evidence; for the purpose of:

• “Drawing a reasonable conclusion” (Facione, 1990, p.9).

• This may imply accepting a conclusion pointed to by an author in light of the evidence they present, or “conjecturing an alternative”, equally logical, conclusion or argument based on the available evidence.
Genetic and hereditary factors play a major role in aggression.

**Evaluating belief to reason**

**because**

- **Genes have been discovered that code for levels of testosterone, and testosterone influences aggression levels.**
  - **because**
    - Men generally have higher levels of testosterone than women, and are also more aggressive than women (Knight 1996).
    - Female prison inmates who displayed unprovoked violence also had very high levels of testosterone (Dabbs, 1998).

**because**

- Inbreeding and selective breeding illustrate the role of genes and hereditary factors in aggression.
  - **because**
    - Inbreeding can create unstable temperaments that are associated with aggressive tendencies.
    - By selective breeding, aggressive and passive strains of mice can be created (Lagerspetz, 1996).
Inferring conclusions with syllogisms (3 proposition structures)

What is happening here is that we are using what we know to be true (some men are aggressive) as a substitute for logical thinking. The inference is invalid.

But consider the following:

All men are animals.
Some men are aggressive.

All men are animals.
Some animals are aggressive.

Some men are female.

Some men are animals.
Some animals are female.

This seems to be a reasonable conclusion, because most people would agree that some men are aggressive.

What is happening here is that we are using what we know to be true (some men are aggressive) as a substitute for logical thinking. The inference is invalid.
Syllogistic Reasoning

- Socrates is mortal.
  - All men are mortal.
  - Socrates is a man.

- Some men are attractive.
  - All men are bastards.
  - Some bastards are attractive.

- Today is cold.
  - Today isn't both sunny and cold.
  - Today isn't sunny.

- I should be at work.
  - If today is Tuesday, I should be at work.
  - Today is Tuesday.

- Gouda is made from milk.
  - All cheese is made from milk.
  - Gouda is a cheese.

- No person of integrity is a liar.
  - All politicians are liars.
  - No person of integrity is a politician.
Inferring intermediate conclusions in larger informal argument structures

Physical attractiveness is the guiding factor in determining who we like.

Physical attractiveness is universally desired (regardless of culture).

People’s physical attractiveness has wide-ranging effects.

There are other factors just as important as physical attractiveness, that determine the liking of a person.

In attempts to look attractive, people around the world have gone to such lengths as to elongate their necks, receive breast implants, nose jobs, etc.

People perceive friendly people as more attractive than unfriendly people, so maybe it’s the way people act that’s important — not how they look (Nisbett and Wilson, 1977).

We perceive attractive people to be healthier, happier, more sensitive, more successful and more socially skilled (Feingold, 1992).

Physical attractiveness predicts frequency of dating, and feelings of popularity (Hatfield et al, 1986).

Sprecher (1998) found reciprocal liking to be one of the major determinants of interpersonal attraction.

The more similar people are the more they like one another.
Inferring intermediate conclusions in larger informal argument structures

- Related arguments are grouped together.
- Groups of related arguments are used to derive intermediate conclusions.
- Intermediate conclusions are used to derive a final conclusion.

When we examine how intermediate conclusions and conclusions are derived, we often see limited logic and coherence in the overall argument structure.
Here’s an example where the logic is better. Working from the bottom up, try to infer the overall conclusion.

Begin here: what can you infer from these two propositions?

Students who achieve their academic goals report higher life satisfaction (Sheldon, 2000).

Students with lower levels of generalized anxiety do better in exams (Fine, 1999).

Higher levels of life satisfaction is associated with lower levels of generalized anxiety (Ito, 1999).

Students who do better in exams get better jobs and earn more money (Rich, 2008).
What Happens During Critical Thinking

1st

I read and understood the argument, making note of the structure of the argument, the source of each of the propositions and any bias the author may have in support or objection to the central claim.

Analysis

2nd

Now that I have read and understood the argument, I can gather the propositions and decide which ones were: relevant to the rest of the argument and central claim, came from credible sources and when presented together, which ones possessed the greatest logical strength.

Evaluation

3rd

Now that I have evaluated the argument I can pick out the propositions that were all relevant, credible and logical, and structure them in a logical fashion so that I can infer a logical conclusion or decide whether or not I agree with the author’s central claim.

Inference

Reflective Judgment
Bats & Balls
Attribute Substitution

• People have a tendency to substitute what they perceive as representative of the real-world for the actual likelihood of something happening.

• People also have a tendency to substitute a similar, though easier question for the question they were actually asked.

• *Heuristics all share a common element – they process information through attribute substitution:*

  • “when the individual assesses a specified target attribute of a judgment object by substituting a related heuristic attribute that comes more readily to mind” (Kahneman, 2003, p.466).
Why do we use heuristics?
General principles of knowledge activation

– We are cognitively lazy
(Kahneman, 2011)

We use Available, Accessible and Applicable information to colour in the (decision) spaces.
Decision Fatigue (Baumeister, 2003)
Reflective Judgment

• Reflective judgment (RJ) is a component of critical thinking and an individual's understanding of the:
  • nature,
  • limits, and
  • certainty

  of *knowledge;* and how this can affect how they defend their judgments and reasoning.

• Moreover, RJ involves the ability of an individual to acknowledge that their views might be falsified by additional evidence obtained at a later time (King & Kitchener, 1994).
Reflective Judgment

• The opposite of intuitive judgment.

• It’s about ‘taking a step back’.

• Recognition that some problems cannot be solved with absolute certainty (i.e. ill-structured problems).

• “What is the best way of decreasing global warming?”

• Because uncertainty exists over the level of ‘correctness’ of any given solution to an ill-structured problem, we must depend on our ability to reflectively judge the situation.

• “Make everyone drive electric cars”, or,

• “Cut down on cattle farming in order to lower methane emissions”
Reflective Judgment

• However, some solutions are deemed better than others based on the organisation, complexity and careful consideration of the propositions within the argument

“Although research is still on-going in this area, mathematical models based on existing research findings suggest that by making small decreases in emissions in all walks of life, whether it be travel, farming, industry or energy production, emissions around the globe will decrease substantially – one consequence of which may be to slow the rate of global warming.”

• Therefore, it is not only the conclusion one reaches or the inference one draws, correct or otherwise (i.e. given the uncertainty associated with making judgments and devising solutions for ill-structured problems); but, also the manner in which one arrives at the conclusion which is important in this context.
Reflective Judgment

• RJ is our way of considering making changes to our views on a topic or even the manner in which we think, in light of uncertainty or the presentation of new information).

• Developmental process which focuses on the hierarchical complexity of RJ by reference to the organisational structure of representations, abstractions and principles.

• RJ development is not a simple function of time or age, but is coupled with the amount of interaction with the types of problems that require RJ.
## Applications of Critical Thinking

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<td>Identifying the problem goal; and generating and selecting solutions among alternatives.</td>
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Argumentation

Recognising the structure of arguments and how to judge their strength or weakness.

• Argumentation is a verbal and social activity of reason aimed at increasing (or decreasing) the acceptability of a controversial standpoint, by putting forward a constellation of propositions intended to justify (or refute) the standpoint.
Argumentation

• Argumentation and Persuasion:

1. **The Bandwagon Argument** - *everyone is doing it, so why don’t you?*

2. **Use of Pity** - an appeal for compassion

3. **Card-Stacking** - the use of an unbalanced and biased argument, which purposefully omits important counter-arguments

4. **Circular Reasoning** - *we need to cut spending as too much money is being spent*
Verbal reasoning

*Recognising what follows what through the use of induction, deduction and falsification.*

*Beagle is to dog as cobra is to _____.*

- An ability to classify and categorise.
- An ability to evaluate a series of propositions and identify *what follows what*.
Verbal reasoning

John enjoyed himself at Imelda’s party.
Imelda provided John and other guests with a great array of food and drink.

John enjoyed himself at Imelda’s party.
Imelda is afraid of snakes.

Non-sequitur
“Does not follow”
Verbal reasoning

- Deductive Reasoning
  - uses a claim or collection of claims, relevant to the inference of a further conclusion (e.g. examples might be inferred from a general claim or set of claims).
  - *All swans are white* - *If I go to the park, I will only see white swans*

- Inductive Reasoning
  - used to infer a conclusion from more specific propositions or examples.
  - *If I throw a red ball in the air – It will peak and fall back to Earth*

An appropriate use of deductive and inductive reasoning in CT is alternating back and forth between the two as a means of ‘double-checking’ one’s reasoning.
Understanding the limits of correlational reasoning and how to know when causal claims cannot be made.

How do we test it?

- Hypothesis testing refers to:
  - The examination of a belief that is based on a justified rationale, in order to confirm or disconfirm the belief.
  - To make rational predictions about something and subsequently test these predictions.
  - A way of finding out about the way the world works.
Hypothesis testing

- Correlation vs. Causation
Judging Likelihood & Uncertainty

Applying relevant principles of probability and avoiding overconfidence in certain situations.
When we assess the probability of an event occurring, we need to understand that we are calculating the likelihood of something happening *in the long run*.

If we are looking to calculate the likelihood of an event occurring in the short-term, potentially, anything can happen and thus, we must recognise our uncertainty of a specific event occurring.

On the other hand, if we are calculating something happening in the long run, we have a more useful means of helping us in making decisions.
Judging Likelihood & Uncertainty

“92% of all statistics are made up.”
A new ‘super-flu’ has broken out in your town and potentially, 750 people could perish. There are two experimental medications that can be given to the infected. (1) One will cure 250 people; and (2) the other has a 1 in 3 chance of saving everyone, though a 2 in 3 chance curing no one.

If you were in charge of this important decision, which medication would you prescribe for your town?
Problem-solving

• ...the ability to identify both the problem at hand and the goal you want to achieve in light of this problem; and subsequent solution generation and selection that facilitate goal attainment.

• The best strategy for solving a problem depends largely on the context of the problem.

• It is perhaps the most important application of CT because it can be considered as the foundation of each of the other CT applications.
Problem-solving

1. Define the Problem
2. Gather & Organise the Available Information
3. Evaluate Possible Strategies
4. Generate Possible Solutions
5. Monitor the Progress of the Solution Strategy
6. Evaluate Results of the Solution Strategy
7. Verify the Solution
Creative Thinking & Problem-Solving

- *Creative thinking* has been described as producing a solution or conclusion that is (1) unusual or novel and (2) appropriate or valuable.

*Not Practical*

- Multiple ‘components’ must converge:
  - Managing complex thinking associated with the problem-situation
  - Knowledge of heuristics for generating novel ideas
  - A work-style characterised by concentrated effort and self-regulation
  - Motivation
“The chief enemy of creativity is good sense.”

– Pablo Picasso

“Creativity is just connecting things. When you ask creative people how they did something, they feel a little guilty because they didn’t really do it, they just saw something. It seemed obvious to them after a while.”

– Steve Jobs
Thank you for your time and attention!

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