

### THE COGNITIVE DIMENSION

 represents the intellectual aspect of learning, which covers the range of thinking skills that a learner needs in order to achieve a desirable level of understanding and performance and the learner's ability to make the best use of cognitive capacity.

#### Higher order thinking

Lewis and Smith (1993) defines higher order thinking as the kind of thinking that occurs "when a person takes new information and information stored in memory and interrelates and/or rearranges and extends this information to achieve a purpose or find possible answers in perplexing situations" (p.136).

Lewis, A., & Smith, D. (1993). Defining higher order thinking. *Theory into Practice*, 32(3), 131-137.

#### HIGHER ORDER THINKING

 The learner's tendency to learn for understanding and their ability to go beyond memorisation to operate at a level of thinking that is characterised by understanding, application, and the creation of new ideas and solutions to unfamiliar problems and situations.

#### **UNDERSTANDING LEARNING**

 The learner's interest in knowing more about learning theories and cognitive sciences and their ability to apply that knowledge and understanding to improve their own learning.

## BLOOM'S TAXONOMY

Originally proposed in 1956 by Bloom et al, this version is based on a revised version developed by Anderson and Krathwohl in 2001. For more information, see: <u>https://www.celt.iastate.edu/teac</u> <u>hing/effective-teachingpractices/revised-bloomstaxonomy/</u>

Create	Combining parts to make a new whole Build, combine, formulate, devise, change, adapt, construct, produce	
Evaluate	Judging the value of information or ideas Validate, justify, critique, rate, prioritize, select, assess, monitor	
Analyze	Breaking down information into basic parts Classify, divide, differentiate, research, discover, simplify, dissect	
Apply	Applying the facts, rules, concepts, and ideas Practice, implement, develop, solve, generalize, operate, plan	
Understand	Understanding what the facts mean Discuss, paraphrase, infer, interpret, outline, review, organize	
Remember	Recognizing and recalling facts Define, list, name, recognize, match, choose, show, find	

Source: The Academic Success Center, Texas A&M University https://asc.tamu.edu/Study-Learning-Handouts-(1)/Bloom-s-Taxonomy

## SOLO TAXONOMY

Proposed by Biggs and Collis in 1982, SOLO is another taxonomy for classifying learning outcomes. The 'relational' and 'extended abstract' levels are qualitative phases of understanding associated with deep approach to learning, while the lower levels quantitative phases of understanding associated with surface approach to learning. Some believe that SOLO taxonomy has better hierarchical structure than Bloom's taxonomy (e.g. Gulzar).



## Source: Anwaar Ahmad Gulzar, Educare https://www.educarepk.com/solo-taxonomy-versus-blooms-taxonomy.html



# TOWARDS HIGHER ORDER THINKING

# WHY STUDENTS ROTE LEARN?

Students said:

- For some subjects you have to memorize a lot of materials. I studied that only because I need to take examination, I have forgotten all.
- In the examinations, it is more important to memorize the content. If you have good ability in memorizing, you can get a good score.
- You just can't understand the lectures. I memorise the things to take the examination.
- Basically we can't understand them when we read, so we just memorize them.

Source: Ho, A.S.P., Chan, C.H., Sun, L., & Yan, J. (2004). Students' perceived difficulties in learning and their implications for learning to learn. In O. Kwo, T. Moore & J. Jones (Eds.), Developing learning environments: Creativity, motivation and collaboration in higher education (pp.245-268). Hong Kong: Hong Kong University Press.

# WHY STUDENTS ROTE LEARN?

Students said:

- The content is too abstract, ... only equation and formula.
- We learned a lot of things, but we don't know how to apply these in work.
- I find it difficult to follow. Sometimes I find it difficult to link the lectures.
- There are courses that are supposed to have connection with each other. But I fail to relate them.
- I seem to understand the theory when I listen to the lecture. But I can't use it since every case is different.

Source: Ho, A.S.P., Chan, C.H., Sun, L., & Yan, J. (2004). Students' perceived difficulties in learning and their implications for learning to learn. In O. Kwo, T. Moore & J. Jones (Eds.), Developing learning environments: Creativity, motivation and collaboration in higher education (pp.245-268). Hong Kong: Hong Kong University Press.

# WHY STUDENTS ROTE LEARN?

- Students rely on memorization because:
  - they have a quantitative conception of learning
  - they can't understand the materials
  - of the backwash effect of assessment
  - they lack higher order thinking skills

# RAISING LEVEL OF UNDERSTANDING



Based on SOLO Taxonomy; Biggs (1999)

HELPING STUDENTS TO BECOME 'DEEP' LEARNERS

	Learning issues	L2L goals
Mindset	Think of learning as collection of information	<u>Reorient mindset</u> to emphasise quality of understanding instead of quantity of information
Skills	Lack high level cognitive skills	<u>Develop skills</u> for deep understanding, e.g. relate, apply, analyse, create
Habit	Used to rote learning and recitation	<u>Engage</u> in higher level thinking regularly

## KNOWLEDGE BUILDING WORKSHEET

A simple tool for helping students to attain higher level understanding. Can you imagine adding it to your assigned readings? If they do it every week, they may develop the habit of thinking beyond the factual recall level. The collection of KBWs can be a useful resource for revision too.

## GUIDE STUDENTS THROUGH 3 STEPS (LEVELS OF THINKING):

- Collect: What are the key concepts introduced in this article?
- 2. Connect: Draw a diagram to explain how the key concepts relate to each other?
- 3. Create: What problems does this understanding help to solve? What implications does it have? What new ideas can you generate on this basis?



## LINKING THEORY TO PRACTICE

#### O diagram

Thinking: Put relevant theories and concepts inside the circle

Doing: Write process of inquiry around the circle

Linking: Draw lines to link the two, point by point



Do you really need specialised tools to help students develop higher order thinking skills?



# DEVELOP HIGHER ORDER THINKING

Survival learners	Maturing learners	Sophisticated learners
Learn for examination; learn mainly by rote	Learn for understanding; learn by comparing, analysing, relating and applying ideas	Learn for creation of new knowledge; learn by reflection, critique, theorising, creating new ideas, solving problems, etc.

# RUBRIC (HIGHER ORDER THINKING)

# EXAMPLES OF HIGHER ORDER THINKING

Critical thinking

**Creative thinking** 









# FROM LEARNING TO LEARNING TO LEARN

#### LEARNING OUTCOMES THAT REQUIRE HIGHER ORDER THINKING

- Apply computer programming techniques to solve practical engineering problems.
- Formulate and evaluate care plans to assist the client in achieving adaptation, restoration, and/or maintenance of optimal health and evaluate the effectiveness of care provided.

#### LEARNING OUTCOMES THAT FOCUS ON DEVELOPING HIGHER ORDER THINKING

- Develop higher order thinking skills and apply them in academic studies.
- Evaluate and strengthen one's capability for problem solving.



# BASIC CONDITION

ALIGNMENT

# WHAT ELSE? GIVE STUDENTS THE CHANCE TO...



# U.PET

Unpack Practise Evaluate Transfer



Inpack

The best definition for critical thinking may well be your own. (Fowler, 2004)

- Critical thinking is reflective and reasonable thinking that is focused on deciding what to believe or do (Ennis, 1985, p.45).
- Critical thinking is the intellectually disciplined process of actively and skillfully conceptualizing, applying, analyzing, synthesizing, and/or evaluating information gathered from, or generated by, observation, experience, reflection, reasoning, or communication, as a guide to belief and action. In its exemplary form, it is based on universal intellectual values that transcend subject matter divisions: clarity, accuracy, precision, consistency, relevance, sound evidence, good reasons, depth, breadth, and fairness (Scriven and Paul, n.d.).



#### Skills

Analyse argument Identify propositions Identify fallacy in argument Identify assumptions Identify criteria for evaluation Judge relevance Query evidence Conjecture alternatives Use criteria in making choices Formulate argument Justify conclusions



#### Disposition

Consider different point of view Suspension of judgment Re-examine beliefs Mindful of evidence in claims Conscious of personal biases Objectivity in judgment Open-minded Fair-minded Inquisitive Truth-seeking Confident in one's ability to reason



#### **Barriers (skills/knowledge)**

Misunderstanding Lack of detailed knowledge Poor communication skills



#### **Barriers (disposition)**

Reluctance to critique

Wanting to know the answers without having to ask questions

Over-reliance on feelings or emotions

Self-centred or societal/cultural-centred thinking

Unconscious bias / selective perception

Close-mindedness

Fear of being wrong

Apathy

Lack of personal honesty



## CREATING CHANCES FOR PRACTISING CRITICAL THINKING

Lecture	<ul> <li>Ask thoughtful questions and allow ample time for students to answer (Schafersman, 1991)</li> <li>Encourage students to ask questions or to raise alternative explanations</li> <li>In presentation, illustrate how conclusions are reached graphically (van Geldar, 2005)</li> </ul>
Laboratory	<ul> <li>Given a purpose for investigation, let students design the procedures (or part of it) themselves</li> <li>Ask students to explain the rationale behind the procedures</li> </ul>
Assignment	<ul> <li>Essay-type assignment can be set to require evaluation of different viewpoints, analysis and formulation of arguments, justification of claims etc.</li> <li>Problem-solving assignment can be set to demand informed judgments to be made, consideration of alternative solutions etc.</li> <li>Reading assignments can be structured such that students are required to raise questions or critically analyse propositions etc.</li> </ul>
Exams	<ul> <li>Set questions that require analysis, evaluation, and justification.</li> <li>Make sure students aware that demonstration of critical thinking is a requirement of the test</li> </ul>
Group discussion	<ul> <li>Ask students to present not only the conclusion, but also how they arrive at the conclusion</li> <li>Ask students to justify and evaluate their viewpoints</li> </ul>
Multiple choice questions	<ul> <li>Set questions that require reasoning rather than recalling. Such a question may have a structure like this: a problem/scenario is described in the question and the student is required to choose among different solutions/explanations.</li> </ul>



## GUIDING STUDENTS TO CREATE THEIR OWN CRITICAL THINKING QUESTIONS

King, A. (1995). Designing the instructional process to enhance critical thinking across the curriculum. Teaching of Psychology, 22(1), 13-17.

- What are the strengths and weaknesses of...?
- How are... and... similar/different?
- Explain why/how...?
- What would happen if...?
- Why is... happening?
- What are the implications of...?
- What does... affect...?
- Why is... important?
- How does... tie in with what we learned before?
- How does... apply to everyday life?
- What is the best... and why?
- What is a solution to the problem of...?
- What is a counterargument for ....?
- Do you agree/disagree with... and based on what evidence?
- What is another way to look at...?

## FACILITATE SELF-EVALUATION WITH A RUBRIC

Source: Facione, P.A., & Facione, N.C. (1994). Holistic Critical Thinking Scoring Rubric. Millibrae, CA: California Academic Press. Consistently does all or almost all of the following: Accurately interprets evidence, statements, graphics, questions, etc. Identifies the salient arguments (reasons and claims) pro and con. Thoughtfully analyzes and evaluates major alternative points of view. Draws warranted, judicious, non-fallacious conclusions. Justifies key results and procedures, explains assumptions and reasons. Fair-mindedly follows where evidence and reasons lead.

Does most or many of the following:

Accurately interprets evidence, statements, graphics, questions, etc. Identifies relevant arguments (reasons and claims) pro and con. Offers analyses and evaluations of obvious alternative points of view. Draws warranted, non-fallacious conclusions. Justifies some results or procedures, explains reasons. Fair-mindedly follows where evidence and reasons lead.

Does most or many of the following:

Misinterprets evidence, statements, graphics, questions, etc. Fails to identify strong, relevant counter-arguments. Ignores or superficially evaluates obvious alternative points of view. Draws unwarranted or fallacious conclusions. Justifies few results or procedures, seldom explains reasons. Regardless of the evidence or reasons, maintains or defends views based on self-interest or preconceptions.

Consistently does all or almost all of the following:

Offers biased interpretations of evidence, statements, graphics, questions, information, or the points of view of others.
Fails to identify or hastily dismisses strong, relevant counter-arguments.
Ignores or superficially evaluates obvious alternative points of view.
Argues using fallacious or irrelevant reasons, and unwarranted claims.
Does not justify results or procedures, nor explain reasons.
Regardless of the evidence or reasons, maintains or defends views based on self-interest or preconceptions.
Exhibits close-mindedness or hostility to reason.



## FROM COMPETENCE TO CAPABILITY

Capability is characterised by being able to use one's competencies in unfamiliar as well as familiar circumstances, learner self-efficacy, communication, creativity, collaboration, and positive values.

Blaschke, L.M., & Hase, S. (2016). Heutogagy: A holistic framework for creating twenty-first-century self-determined learners. In B. Gros et al. (eds.), The Future of Ubiquitous Learning. Lecture Notes in Educational Technology, DOI 10.1007/978-3-662-47724-3\_2.

## UNPACKING THE SKILL

• Identify the underlying principles at work

## TRANSFER OF LEARNING

- Apply critical thinking in a similar scenario
- Apply critical thinking in another subject
- Apply critical thinking in daily life



How to help students understanding a complex concept like critical thinking? You don't have to 'teach' it (although you can); they can unpack it for themselves with your guidance.

- Find a (good) definition.
- Look up a few academic theories/models for inspiration.
- Think of a time when you did it [say, solve a problem] successfully. How did you do it?
- Think of a time when things did not work out so well. What might have been the barriers to [problem solving] (e.g., mental blocks, lack of relevant skill/knowledge)?
- Think of people/friends who are very good at it. What characteristics do they have that make them good [problem solvers]? What do they do to [solve problems]?



Practice makes perfect. This applies to most skills, including higher order thinking skills. Your subject provides endless possibilities. Have the potentials been realised/utilised?

- What kinds of activity requires [critical thinking]? Have we got enough of such activities?
- Does the way I present my lectures give students [something to think about]?
- Does my assignment [challenge students to think critically]?
- Does my feedback [prompt students to think critically]?
- Can students be engaged in identifying scenarios in which [critical thinking] may apply?



One important thing that learners must learn is to evaluate their progress and attainment. Do students have chance to reflect on their development of higher order thinking skills?

- Do students have chance to reflect on their development of higher order thinking skills in my subject?
- Can elements of reflection be incorporated into lectures / tutorials / assignment?
- Do students know how to evaluate their higher order thinking skills?
- Is there anything I can provide them with to aid the evaluation (e.g., a critical thinking rubric)?
- Can students be engaged in identifying the evaluation criteria? Can I co-develop the rubric with students?



Although higher order thinking skills are generic, it is not always easy to transfer the skills beyond the context where it is acquired/developed. How can you increase the chance of transfer?

- Do students have the chance to apply the skill on a variety of materials?
- Do students have the chance to apply the skill in a variety of scenarios?
- Can materials/scenarios from daily life be brought in the learning process?
- Do students think that this skill is of relevance to this subject only? Can I broaden their views?
- Can students be engaged in exploring the commonality between subjects where the skill may be applicable?



# UNDERSTANDING LEARNING

WE CAN'T TEACH STUDENTS EVERYTHING THEY NEED TO KNOW FOR EVERY SITUATION; SOMETIMES THEY JUST NEED TO FIND THE ANSWER BY THEMSELVES.

# COGNITIVE SKILLS

ATTENTION MEMORY LOGIC PROCESSING

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# ON THE STUDENT'S PART



# ON THE TEACHER'S PART







## EXAMPLES

Many ideas and research findings from psychology and neuroscience are useful for learners. But why would they want to explore them? Maybe hearing a few examples would inspire them to so?

## DID YOU KNOW THAT...

- Multisensory experience improves retention?
- Some people learn better in the morning/evening?
- Sleep plays an important role in memory?
- You need to relax to be creative?

## HAVE YOU HEARD ABOUT...

- The magic number 7±2 and 'chunking'?
- The Pomodoro technique?

## POINTERS

There are lots of materials on learning and study skills on the internet. A few suggestions on where and how to look for more information may just be what students need to get started.

## Some prompts for students:

- What is your learning need/problem? Attention? Memory? Procrastination?
- Is this a trustworthy source? Is the host just presenting opinions or are the techniques shared based on scientific research?
- How can you try out this technique?
- Is this technique suitable for you? Did it work for you? Can it be modified so that it works for you?

## SPACE (OR SETTING)

Developing cognitive skills may seem like a luxury when there is a packed curriculum to deal with, yet it is crucial for academic success. Can we create meaningful space/setting within the curriculum for students to enhance their cognitive skills?

- Can it be legitimised?
- Can it be integrated with the subject matters?
- Can it be integrated into the learning process?
- Can it be made part of the assignment?
- What about academic advising?
- What about sharing among students on their discoveries and experiences?

Survival learners	Maturing learners	Sophisticated learners
Have little knowledge about the science of learning	Actively seek to understand more about learning and to apply that understanding to improve their own learning	Have some insights into the nature of learning and adopt sound strategies to expand and make the best use of their cognitive capacity

# RUBRIC (UNDERSTANDING LEARNING)