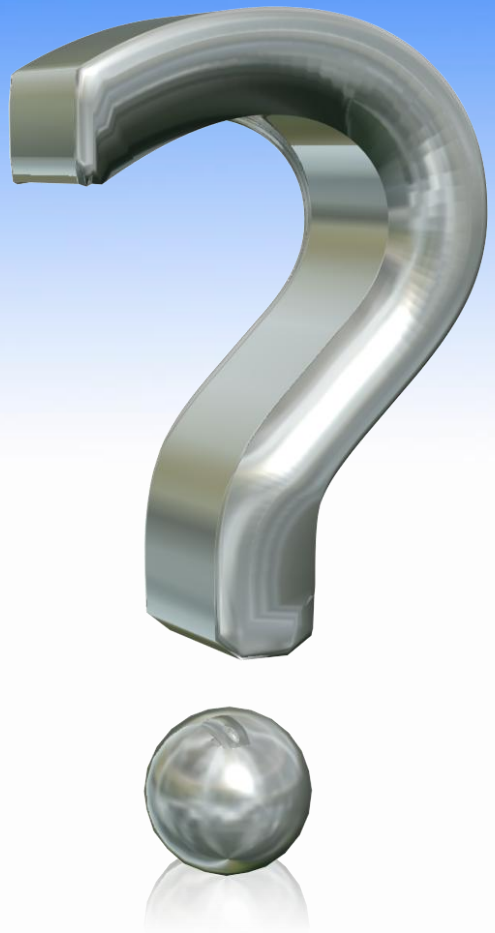
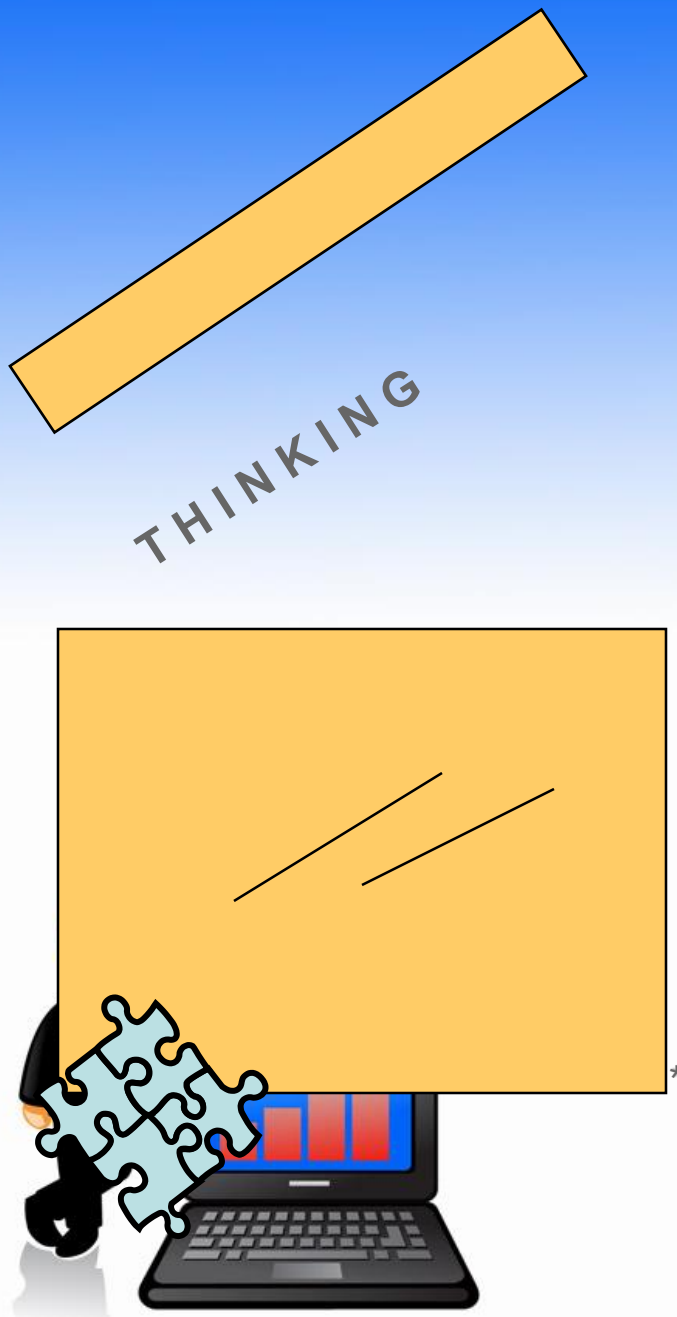
Critical thinking
Dana adas

What does “critical thinking” mean to you?





“The intellectually disciplined process of actively and skillfully conceptualizing, applying, analyzing, synthesizing, and evaluating information.”*

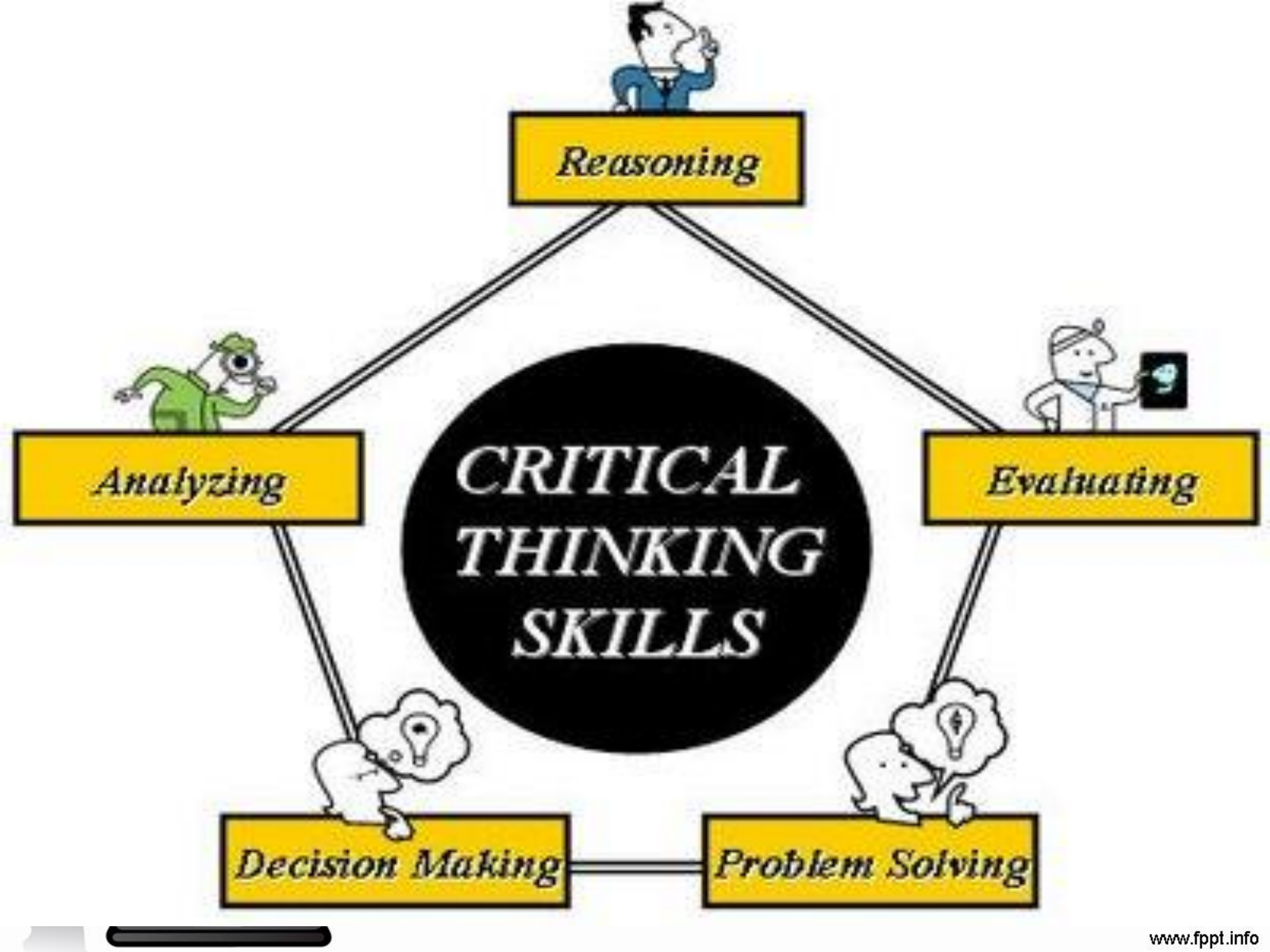
* The National Council for Excellence in Critical Thinking, 1987.

What skills are considered important to employ critical thinking??

Key skills in critical thinking

1. Separate fact from opinion.
2. Recognize others' opinions.
3. Question the validity of evidence.
4. Prepare persuasive arguments using evidence.
5. Ask questions.
6. Verify information.
7. Listen and absorb.
8. Resist jumping to conclusions.
9. Seek to understand multiple conclusions.
10. Seek truth before being right.

Mayfield 2011



How do our students approach problems?

Doing the right thing is more important than doing things right?

Which one is related to…

Top-down thinking **Bottom-up thinking**?

Bloom's Revised Taxonomy

Higher order thinking

Creating — Generating new ideas, products, or ways of viewing things
Designing, constructing, planning, producing, inventing

Evaluating — Judging based on criteria; experimenting, checking, hypothesizing, critiquing, justifying

Analysing — Breaking information into parts to explore relationships
Comparing, organizing, deconstructing, interrogating

Applying — Using information in another familiar situation
Implementing, carrying out, using, executing

Understanding — Explaining ideas or concepts; Interpreting, summarizing, paraphrasing, classifying, explaining

Remembering — Recalling information
Recognising, listing, describing, retrieving, naming,

Lower order thinking

Anderson & Krathwohl, 2001

Bloom's Revised Taxonomy & Critical Thinking Skills

Creating

Evaluating

Analysing

Applying

Understandin
g

Remembering

- examine central issues and assumptions in an argument
- Evaluate multiple perspectives
- recognize important relationships
- make correct inferences from evidence
- deduce conclusions from information or evidence
- interpret viability of conclusions, using evidence
- evaluate evidence or authority
- look for--or create--new solutions
- reframe problems, issues, questions

Potts, 1994; Tsui, 2006

Think-pair-share activity 3:

What might keep students from wanting to engage in critical thinking?

Their thinking gets them into trouble because they often…

- Use bottom-up structured thinking.
- jump to conclusions.
- depend on spoon feeding or mother robin teaching.
- By nature accustomed to making meaning.
- Underestimate their own thinking and views.
- Lack of preparatory activities.
- Teacher ‘s role (monologue).
- Tight class time doesn’t allow them to participate.
- Lack of basic knowledge and skill.
- Unwillingness.
- fail to notice contradictions
- ask vague questions

- ignore relevant viewpoints
- do poor problem solving
- make poor decisions
- are poor communicators
- come to unreasonable conclusions

Activity 4: pair-share:

What characteristics should we have as teachers so that critical thinking is promoted in our lectures ?

The teachers Set up Socratic discussions:

1. Observers but could guide discussion
2. Offer prompts
3. Leave discussion for students.
4. Uses counter questioning
5. Quiet individual reflection on a question
7. Share responses with another person
8. Group discussions
9. Step back
10. Ask questions
11. Provide tools for entering the conversation.
12. Employ Bloom's higher order of thinking while teaching

Teaching strategies to promote Critical thinking

1. **CAT**
2. **Cooperative learning strategies** (Cooper, 1995): students are put in groups to get feedback.
3. **Case study**: By using prepared questions, the teacher leads students through a discussion, allowing students to construct a conclusion for the case.
4. **Questioning**

Questions to Promote Critical Thinking

Depth of understanding

- Explain why ...
- Explain how ...
- What is the meaning of ...

Application

- How would you use . . . to ...?
- What would happen if ... ?

Compare/contrast

- What is a new example of ... ?
- How does ... tie in with what we learned before?
- How are ... and ... similar?
- How are ... and ... different?
- Compare ... and ... in terms of ...

Underlying principles

- Why is ... important?
- What is the best ... and why?

Cause and effect

- What do you think causes … ?
- How does ... affect ... ?
- What conclusions can you draw about ... ?

Critique

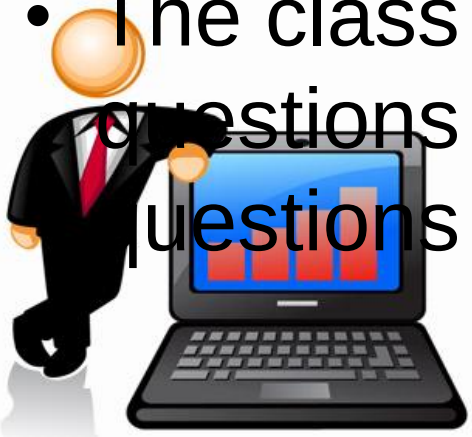
- What are the strengths and weaknesses of ... ?
- Do you agree or disagree with the statement ...?

King, 2002

- 5. **Reciprocal/peer Questioning**: Following a lecture, the teacher displays a list of question stems(such as what are the strengths and weaknesses of.. Students must write questions about the lecture material. In small groups , the students ask each other the question and then, the whole class discusses some of the questions from each small group
- 6. **Dialogues**.

7. **Conference style**: The teacher does not teach the class in the sense of lecturing.

- The teacher is a facilitator of conference.
- Students must thoroughly read all required material before class.
- Assigned readings should be in the zone of proximal development(readings should be challenging).
- The class consists of students asking questions of each other and discussing these questions



- Teacher does not remain passive, but rather helps “direct and mold discussions by posting strategic questions and helping students build on each others’.(Underwood & Wald,1995,p.18).

8. Use Writing Assignments:

With written assignments, the teacher can encourage the development of dialectic reasoning by requiring students to argue both(or more) sides of the issue.

9. Reflection

- means making judgments about what has happened.
- Involves self-understanding requiring contemplation and analysis.
- May involve writing down reactions
- Means evaluating knowledge
- focuses on what is known, what is not yet known, and what has been learned.

Physics:

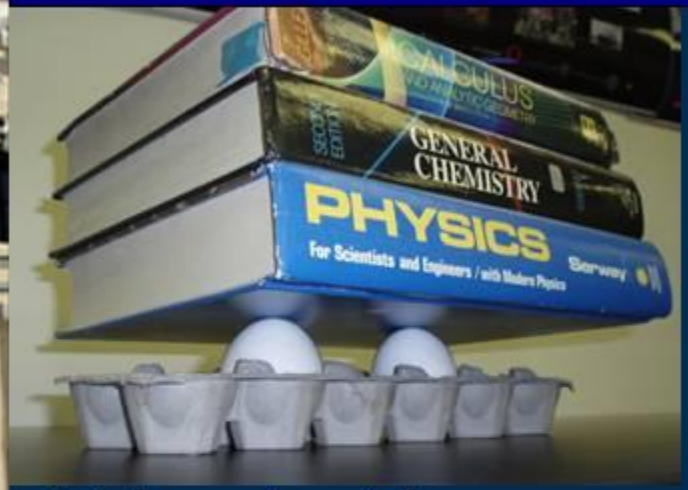
- **Take photos from nature or set up contrived photos and look for physics in them. Write a short reflective paragraph showing how concepts of pressure for example are created, analyzed and criticized.**
- **Write about what is known, what is not yet known and lessons learned.**

Sample 3

Sample 3

This contrived photo was conceived and created to demonstrate Newton's first law of motion. This law states, "Every object in a state of uniform motion tends to remain in that state of motion unless a net external force is applied to it." To stage this photo, a long balloon was filled with water, set on a railing, and punctured with a sharpened screwdriver. The balloon's skin retracted almost instantaneously, leaving its contents unsupported and subject to the force of gravity. The water immediately began to accelerate downward but, due to its inertia, moved only a very small amount by the time the photo was taken. The result is a picture of a momentarily frozen log of water.

Sample 2



"In this photo I placed three books each with a mass of 2 kg on top of four eggs, even though it looks like there are only 2 eggs in the picture. That means that each egg was supporting 1.5 kg, or 15N. The reason the fragile eggs could support so much weight is because of their arch-like shape. Arches evenly distribute weight to the sides and base. When the egg is propped up, the steeper arch transfers the weight to the sides more effectively than when the egg is on its side. So, because I rested the books on the arch part of the egg, I could put more weight on than if the eggs had been on their sides. I also used the egg carton to help keep the eggs standing upright, and I spaced the eggs out so that the weight of the books was evenly distributed. Because of the eggs' arch-like structure, and my careful placement of the books the eggs were able to hold a surprising 60 Newtons of weight."

- **Activity**: leadership and management skills at workplace
- **ILO**: analyzing engineers skills needed at workplace.
- **Steps**:
- 1. Individually: Read the following sentences: Doing things right vs. doing the right thing. What is the difference in meaning?

- 2. In-pairs: Which one is more important for you as an engineer? Why? Which one is related to managers? Which one is closely related to leaders?
- 3. An open discussion with the class.
- How to assess this activity?
- Which standard should I follow?

Assessment of a critical thinking task:

"Learner-centered teaching does not deny the importance of grades"(Weimer, 2002).

"Evaluation changes when teaching is learner-centered"(Weimer, 2002).

Assessment of thinking depends on many intellectual standards

like what??

Accuracy: How could we find if that is true

Relevance: How is that related to the problem?

Clarity: how could you give more examples?

Precision: Could you be more specific?

Depth: what factors make this a difficult problem?

Breadth: Do we need to look at this from a different perspective?

Logic: does this make sense all together:

Significance: which of the presented facts are most important

Fairness: Am I sympathetically representing the viewpoints of others?

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Assessment rubric:

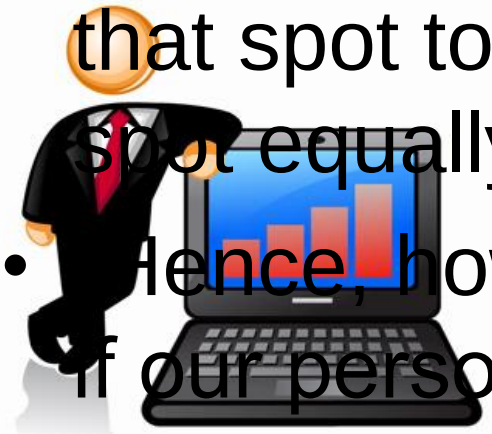
You will gain 5 points if you provide:

a reply that offers some additional, information (gives a complete response to all the questions). The answer should be clear, precise, relevant, related or contrary to others' comments. It should provide new ideas/resources to further discussion.

Activities related to critical thinking

- Hands on activities.
- Inquiry based activities.
- Reflection journals (portfolios)
- Picture analysis.
- Problem sloving

- Justice is a standard of rightness.
- -Fairness is the ability to make judgments situationally; i.e. case by case.
- -If justice is equality, how about the concept of treating our own children different than the rest of children?
- -For example, if there is only one place left in a particular school, and you want your child to get it, but there are 100 other children waiting for that spot too, do you want your child to get the spot equally as the other 100 children?
- -Hence, how can our systems be just and equal if our personal lives aren't?



Activity

Think of a topic you teach and make it into a critical thinking opportunity or activity.

<u>or</u>

Write down one of the recent assignments you gave to your students and name the CT skills you want to promote and how you will do it?

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