Critical Thinking: Inquiry, Argumentation, Modelling

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Structure of the workshop

- Inquiry-based learning (theoretical framework, compare practices)
- An example in mathematics education
- Reflection on observation tool
- Group activity

Aim of the workshop

» To share ideas and experiences….

What is…

» Write on a post it:

> What do you think is inquiry-based learning?

What else…

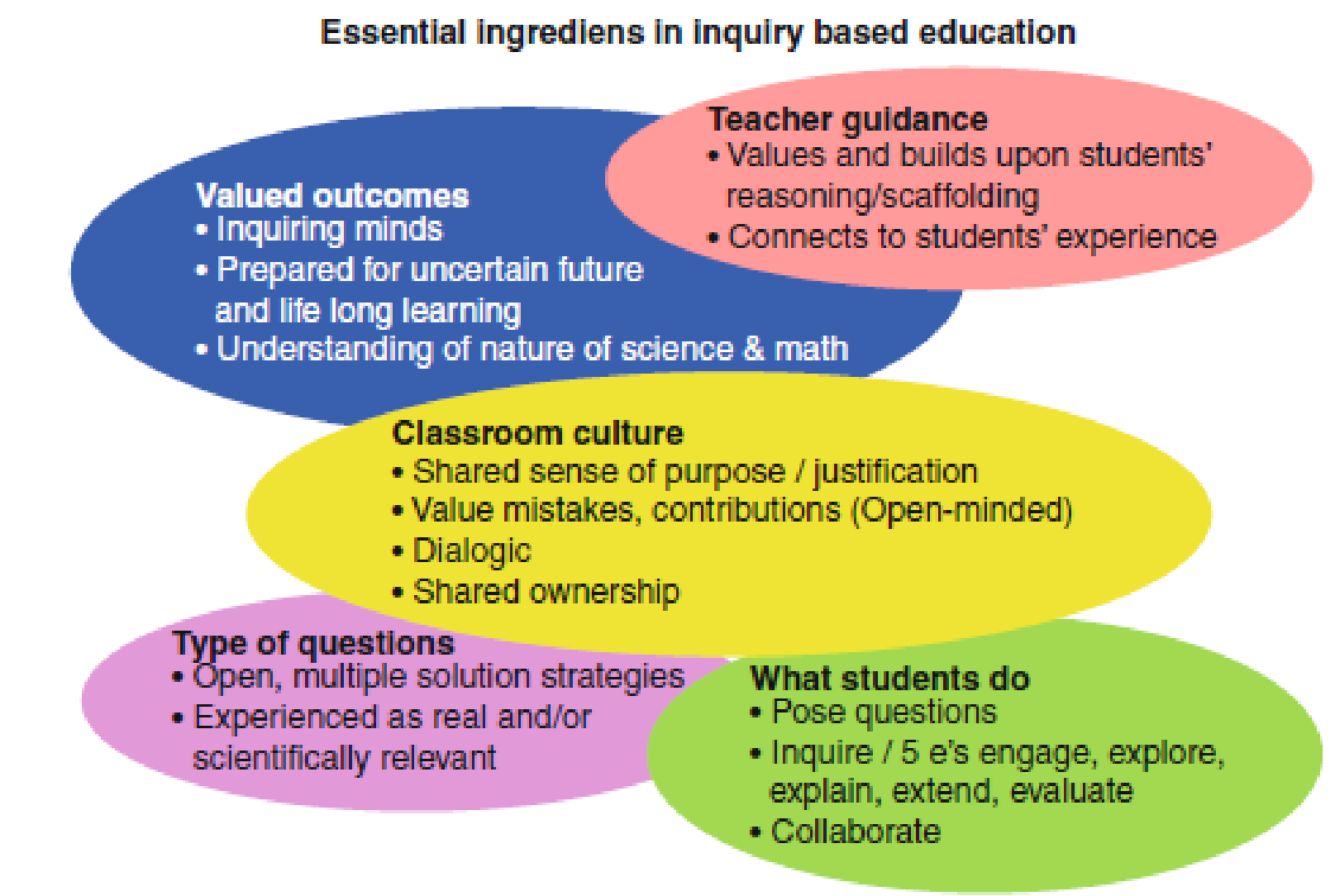
» Write on a post it:

> What is inquiry-based learning connected/related to?

…video

» What is inquiry-based learning?

» What is it connected/related to?



How can inquiry-based learning promote critical thinking?

Inquiry-based learning in maths and science

- Inquired-based learning refers to a student-centered paradigm of teaching in which students are invited to work in ways similar to how mathematicians and scientists work.
- This means they have to observe phenomena, ask questions, drawing diagrams, calculating, looking for patterns and relationships, interpret and evaluate solutions, and communicate and discuss their solutions

(Dorier & Maass, 2014).

What this definition would look like in your subject area?

Are there any practices in your subject area?

Scientific Inquiry and Scientific Practices for students

1. Asking questions and defining problems
2. Developing and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics and computational thinking
6. Constructing explanations and designing solutions
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information

(Quinn et al., 2012)

Common Core Mathematical Practices

1.Make sense of problems and persevere in solving them.

2. Reason abstractly and quantitatively.

3.Construct viable arguments and critique the reasoning of others.

4.Model with mathematics.

5.Use appropriate tools strategically.

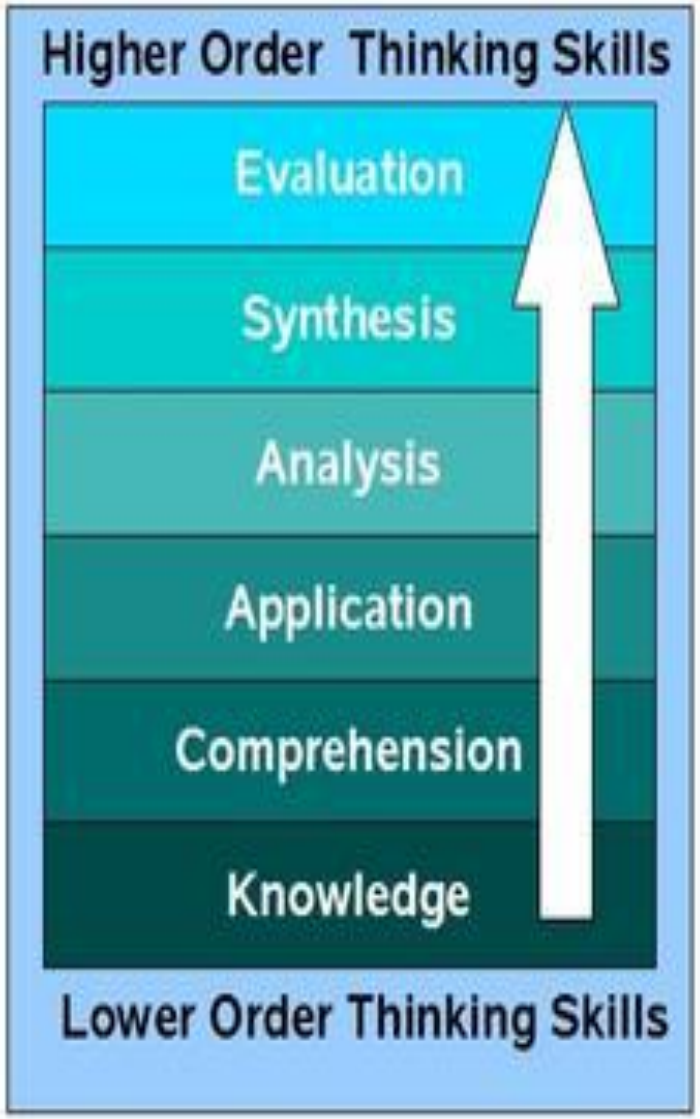
6.Attend to precision.

7.Look for and make use of structure.

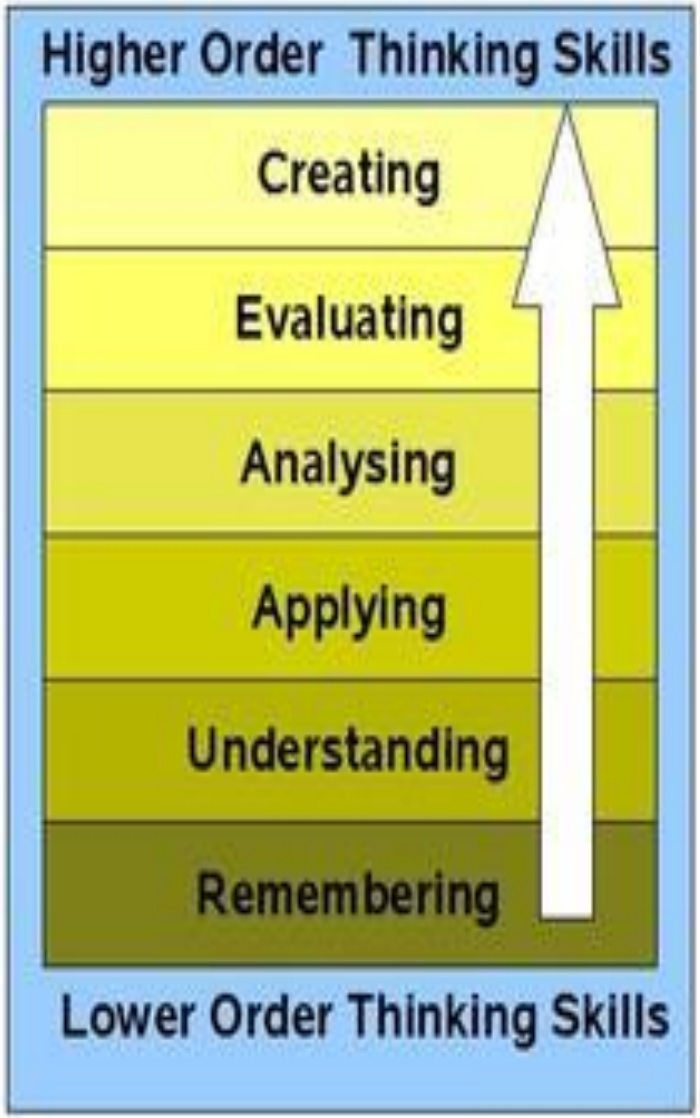
8.Look for and express regularity in repeated reasoning.

NCTM (2012)

Bloom's Taxonomy
Benjamin Bloom



Bloom's Revised Taxonomy
(Lorin Anderson & David Krathwohl, 2001)



Example of a Common Core Math Lesson

- LESSON OBSERVATION part A

Which mathematical practices were promoted in the lesson?

Common Core Mathematical Practices

1.Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3.Construct viable arguments and critique the reasoning of others.
4.Model with mathematics.
5.Use appropriate tools strategically.
6.Attend to precision.
7.Look for and make use of structure.
8.Look for and express regularity in repeated reasoning.

NCTM (2012)

Modelling in Mathematics

- Mathematical modelling is the process of using mathematical tools and methods to ask and answer questions about real world situations (Abrams, 2012).
- Modeling is the process of choosing and using appropriate mathematics and statistics to analyze empirical situations, to understand them better, and to improve decisions (CCSSM, 2010).

Modelling in Mathematics

- Step 1: Identify the Problem
- -What is the situation?
- - What are we trying to figure out? What do we need to know?
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- Step2: Simplify the problem
- -What feature are the most important? What features will we ignore? What assumptions are we making?
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- Step3: Build the Model and Solve the Problem
- -Describe relationships in mathematical terms
- - We might define variables, write equations, draw shapes, measure objects, gather/organize data in tables, make graphs, do calculations
-
- Step 4: Evaluate and Revise the Model
- Do answers make sense in the original situation?
- Do we need to reconsider our assumptions and revise them?

Lesson Observation Tool

LESSON OBSERVATION

INQUIRY-BASED LEARNING / MODELING / ARGUMENTATION

	Students are supported to:	YES	NO	Not-observed
1	ask questions or define problems			
2	generate sub-questions			
3	investigate given question(s) or defined problem			
4	search and locate information/data (design the inquiry process)			
5	analyze and interpret data (presented in graphs, tables, maps, photos, texts, etc.)			
6	synthesize data (presented in graphs, tables, maps, photos, texts, etc.)			
7	communicate information from data			
8	develop and use models			
9	use mathematics and computational thinking			
10	construct explanations and/or design solutions			
11	engage in argument from evidence (connect their ideas with evidence)			

Use the observation tool while watching the lesson…

- LESSON OBSERVATION partB

Lesson Observation

Discuss with your person next to you?

- What were students supported to do? How did that happen?

- How did you find the tool?
- What else would you like to add?

Practice

- Design an activity

  - Design an activity that aims to promote one or more skills presented in the lesson observation tool.
  - You can work with a colleague.
  - Please indicate:
    - Subject Area
    - Age of students
    - Aim of activity
    - Description of the activity
    - What students are supported to do (based on the observation tool)?