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Module 4 Assessment in STEM Education Disciplines
Session 1, Assessment to help us respond to students' diverse needs

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Plenary lecture

Introduction

- Welcome
- Team leading this cluster:
  - Josette and the Maltese team
  - Jesper and the Swedish team
  - Chrisavgi and the Greek team
- Please put the name of your country after your name on zoom:
  - E.g. Josette MALTA
- Attendance form
- Screenshot of the participants & recording
- Introducing this cluster

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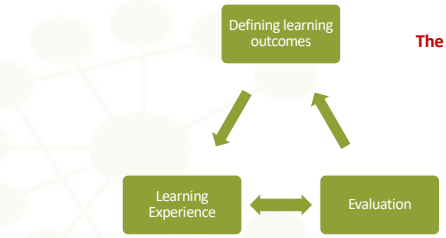
Why discuss assessment?



The teaching-learning process

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Change in the aims of STEM Education

Over the years:

The purpose of STEM education has changed from one with a focus on **transfer of knowledge** to the formation of **scientifically and technologically** informed citizens able to take decisions and act when confronted with issues and problems of a scientific nature.

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Shift of focus from content to competences

Emphasis on acquisition of knowledge

Emphasis on acquisition of competences

Formation of functioning citizen was an implicit purpose

Formation of functioning citizen an explicit purpose

Competences
Personal & social skills, values and attitudes

Functional and social usefulness of STEM education

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Examples of contemporary desired competences

- Ability to develop and apply mathematical thinking and insight to solve a range of problems in everyday situations.
- Use appropriate aids including statistical data, graphs; and understand the mathematical aspects of digitalisation.
- Applications of scientific knowledge and methodology in response to perceived human wants or needs.
- Understanding the changes caused by human activity and responsibility as an individual citizen.
- Ability to communicate and present ideas, argumentation skills …

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Shift in objectives led to change in pedagogies

- Need to change pedagogies
  - Going beyond transmission of knowledge
  - Moving towards student-centred approaches
  - This workshop series has already focused on how we can move towards more student-centred approaches

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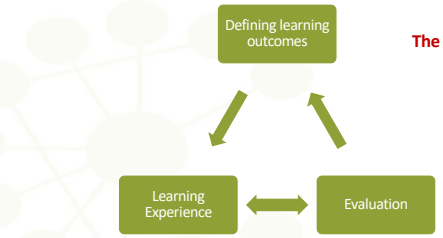
Need for alignment



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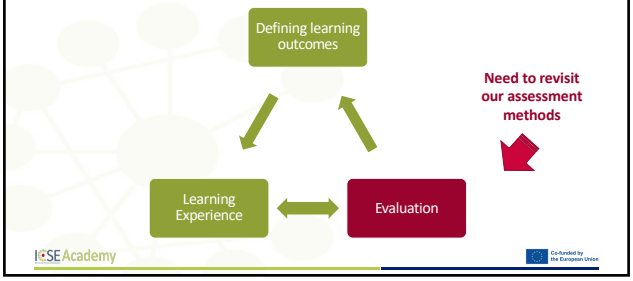
Need for alignment



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Context!

- School context
- Assessment policies
- Educational systems
  - Example
  - A school or education system may give a lot of importance to testing and examinations.
  - Associated with seeing education and lessons as transmission of knowledge
  - Assessment serves to check that this knowledge has been received
  - Possibly **high stakes** examinations/tests

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Interactive task

Think and interact!

- During the first part of today's session we will learn about different assessment policies in our countries.
- Think for a minute about this question:
  - **What type of assessment is predominant in your country?**

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Working group: mixed countries

Discuss (15 minutes)

- Now we will work in groups of mixed countries.
- In your group:
  - Introduce yourself
  - Introduce the predominant type of assessment in your country
  - Discuss your reflections about:
    - To what extent do the predominant type/s of assessment influence the teaching and learning at your school?
    - What are your feelings about these forms of assessment? How do they help or hinder what you would like to achieve in class?
  - Write short reflections from your group in the shared google document provided in the chat.

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Assessment methods that are more responsive

- Having learning outcomes as described earlier, requires the use of assessment methods that are aligned with the learning outcomes.
- Assessment methods that help us be more responsive to students' diverse needs.

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Interactive task

Share

- How are we going to assess these competences? Can we use only traditional assessment methods like tests and exams to assess these competences?
- How can we use assessment to be more responsive to students' needs?
- Choose one or more competences/aims and comment.
- You may share orally or in the chat.

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Reflecting on assessment and re-thinking assessment

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Purposes of assessment

- What learning has taken place
- To know how I can support my students
  - Follow learning-in-progress: identifies gaps, misunderstandings as part of the process.
  - Ongoing and frequent monitoring.
  - Continuous cycle of **feedback** and **adjustments**.
  - Feedback is provided that can lead to further learning by showing strengths and weaknesses and guiding towards improvement.

Recommended video to watch later:
https://www.youtube.com/watch?v=sYdVe5O7KBE

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Methods and tools that can help

- Concept maps
- Concept cartoons
- Diagnostic questions
- Portfolios
- Presentations (e.g. with poster)
- Peer assessment
- Self assessment
- Sharing learning intentions and success criteria
- Sharing of assessment rubrics
- Think-aloud problem-solving sessions
- Allowing students to re-submit their work after feedback

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Diagnostic assessment

- Teachers evaluate students' strengths, weaknesses, knowledge and skills
- May be carried out before, as part of or after their instruction
- Are used to reveal misconceptions, specific errors or difficulties
- Usually do not count for grades

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Diagnostic Questions

- Designed to help identify students' mistakes and misconceptions.
- May be used at any stage of the learning process.
- These may be multiple choice questions or a statement for which students have to say whether it's TRUE or FALSE.
- This is often followed by the question: WHY? Or the instruction: Explain your answer.

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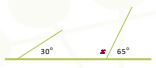
Diagnostic question: Maths

What is the value of angle x?

A. 125
B. 65
C. 115
D. 85



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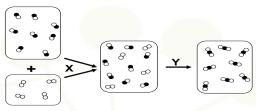
In the diagrams below, the atoms of different elements are represented by the symbols ○ ● .

The diagrams represent the changes which occur when two gases are put together.



(a) Is change X a chemical change?

Tick ONE box (✓) ☐ yes ☐ no

Explain your answer: _____

(b) Is change Y a chemical change?

Tick ONE box (✓) ☐ yes ☐ no

Explain your answer: _____

Diagnostic question: science

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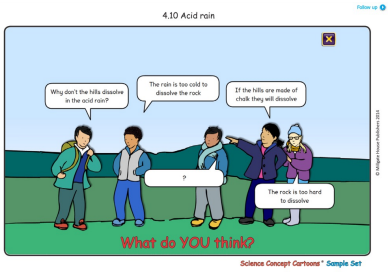

Concept Cartoon

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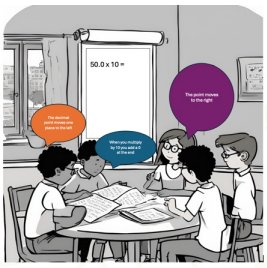

Concept cartoon: maths

Can be used for learning and assessment.

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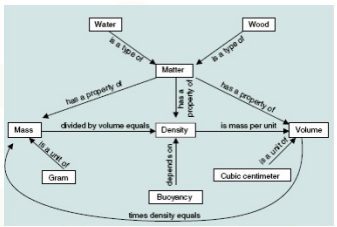
Concept maps



- Open task *or*
- Provide list of words *or*
- Provide the map and students work on linking sentences

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Sharing learning intentions and success criteria

- Teachers share with students what they will be learning (the learning intention) and what they are looking for in their students' work (success criteria)
- This supports students in developing autonomy and responsibility for their learning
- Show the students an example of a good piece of work that meets the learning intention
- Ask students to list things that make it a good example
- Add missing criteria which you feel are important to include

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Learning intentions

To be able to:

- Write a testable hypothesis
- Decide on the most appropriate methods for conducting an investigation
- Explain how reliability, fairness and safety have been considered

Success criteria

To be able to:

- Generates, discusses, and chooses interesting questions to investigate
- Uses scientific ideas to make testable predictions
- Suggests more than one way to investigate the question
- Identifies the variables in the investigation
- Explains the predicted relationships between the variables
- Identifies and justifies the most appropriate way to investigate

I can ....

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1 PEER INTERACTIONS

Description
Within STEAM learning, students are expected to refer to the guidelines of the rubric with their peers to identify group goals and monitor progress towards completing the tasks. Group members then discuss how to divide tasks relying on one other's expertise to equitably complete the work. Students rely on their group members to check for accuracy in the process (e.g. Does the way we are approaching the task make sense?) and the content (e.g. Is the content accurate?). Students provide one another with feedback to help them gauge how they are doing or redirect tasks.

ATTRIBUTE	NEEDS WORK	ACCEPTABLE	PROFICIENT
Monitors tasks and checks for understanding with peers	Student does not rely on peers to discuss criteria, identify goals, monitor progress, and determine accuracy	Student occasionally relies on peers to discuss criteria, identify goals, monitor progress, and determine accuracy	Student consistently relies on peers to discuss criteria, identify goals, monitor progress and determine accuracy; multiple indicators are evident
Negotiates roles, and divides work to complete tasks	Student does not negotiate roles aligned with self/ peer identified expertise, workload is not shared	Student negotiates roles aligned with self/peer identified expertise or attempts to share workload; only one indicator is evident	Student negotiates roles aligned with self/ peer-identified expertise to complete tasks and workload is shared; both indicators are evident
Provides peer feedback, assistance and/or redirection	Student does not volunteer or respond to requests to assist in problem solving, provides little or no feedback	Student occasionally volunteers and responds to group member requests; peer feedback is sometimes evident	Student consistently volunteers and responds to group member requests; peer feedback is noted consistently

NOTES

Assessment Rubrics
(from Herro, Quigley, Andrews and Delacruz, 2017)

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Self-assessment

- engaging **students** in the process of identifying their own strengths and opportunities for growth by reflecting on their progress

Peer-assessment

- students provide feedback to other students
- aim is to help classmates improve their learning
- it is a learning activity and both student receiving feedback from, and giving feedback to, their peers learn through the process.

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https://www.youtube.com/watch?v=CyM72lSNFtk

Recommended video to watch later: some of these assessment tools in practice

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Introducing a task for work in groups leading to your assignment for the cluster

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Interactive task

Introducing the task

According to World Health Organization (WHO), more than seven million people die every year due to air pollution. Air pollutants arise from a wide variety of natural processes (e.g. forest fires, volcanoes, and bacteria) and human activities (use of motor vehicles and industry). A wide variety of pollutants, in particular carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), particulates (PM_{10}), ozone (O_3) are monitored for air quality.
Let's investigate air pollution, how it is monitored and its effects on human health. You can collect or analyze data for your city in terms of the levels of air pollution and investigate the effect of air pollution on human health.

- Use different Air Quality Monitoring sites to see air quality level in your location. What does the graph show? What factors could cause the small peaks and troughs in the graph within the day, week or month?
- Compare air pollutants' levels with those found around the airports, motorways and industry zones. Are they lower or higher than at your home or school's locations?
- What can be done to improve air quality?
- Investigate the effects of air pollutants on human health.

Brainstorm-Box
Let's do a research to find out how clean the air is in the city you are living. Where can you ask for reliable data?

- Integrated STEM approach
- Can be adapted to different age groups
- Can be used to assess a variety of skills and competences

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Instructions

- You will be placed in a group and you will work in this group today and in the coming two sessions. Together you will be working on your assignment for this cluster during the workshops.
- Please follow the link to this Padlet: https://padlet.com/josettefarrugia/ICSE_Assessment_1
- Please note your Group Number and write the names of all the members in your group on the Padlet.

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Working group: mixed countries

Brainstorm, discuss and share (30 minutes)

- Think of different ways how you may use the task. Start from your own field and draw in other things from other STEM areas to enrich your activity. Repeat by starting from another field.
- How can this problem be adapted to a specific age group?
- What learning outcomes can be achieved/assessed through this task?
- What assessment tools will you use?

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Following the group work

- Share your initial ideas.

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Conclusion

- 21st century aims, objectives and desired outcomes need to be aligned with suitable teaching and learning methods and with suitable assessment methods that can assess outcomes that go beyond recall of knowledge.
- Student learning needs to be supported with ongoing assessment. This would help us tailor learning experiences according to students' diverse needs.
- Various tools and methods are available.
- Methods and tools that we already use can be adapted to fit better the new needs.

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