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Enhancing learning and teaching of mathematics and science in Hong Kong – A reflection based on the TIMSS 2019 results

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About me

Background

- Science education researcher
- Chemistry teacher educator

Research interest

- Chemistry education
- Modelling-based teaching and learning

Give 1-3 words/phrases about basic science process skills

Go to **www.menti.com** and use the code **42 60 17 3**

Strand 3: Science and Technology in Everyday Life

This strand aims at arousing students' curiosity and interest in science and technology through hands-on and minds-on activities, and help them develop basic science process skills and technology learning skills. Students are expected to have an increased

- observing, predicting, measuring, recording, classifying, identifying variables, inferring and communicating during the investigation process

Do we need to develop students' science process skills in specific sequence?

What teaching activities do you employ to develop students' science process skills?

Go to **www.menti.com** and use the code **42 60 17 3**

Value 0 — Seldom

Value 10 — Frequently

- Lecturing (blackboard and chalk)
- Teachers' demonstration
- Watching video (e.g., youtube)
- Manipulating simulation (e.g., PhET simulations)
- Involving students in practical work
- Others

Is it a must to conduct hands-on practical work to develop students' science process skills?

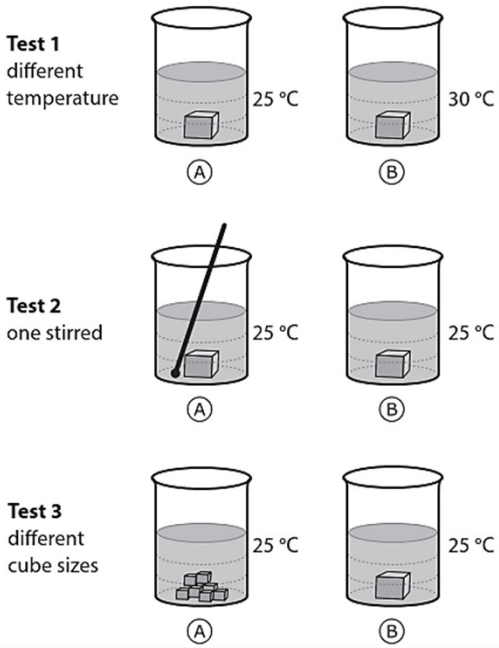
Example:
Develop understanding of the solar eclipse and lunar eclipse

Let's see how our students performed in a TIMSS item

1

Karl is investigating ways to make the same amount of sugar dissolve quickly in water. He sets up three tests.

A. For each of the tests, fill in the circle under the set-up that will dissolve the sugar faster.



10: 20.5%

79: 65.9%

Correct
Girls: 21.5%

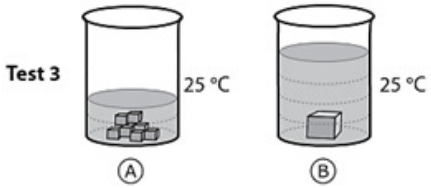
Boys: 19.6%

B. Why is it important that the amount of water in each beaker is the same?

- Which science process skills are useful to answer question B?
- How do you teach the skill(s)?

- Identifying variables
- The amount of water is a control variable
- The amount of water in each beaker is the same to ensure the rate of dissolving is not affected by water

How can the TIMSS item be adapted to develop students' science process skills?



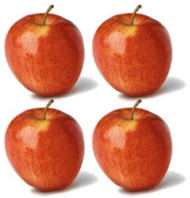
Measuring the time needed for sugar to dissolve completely

Making inferences from the observation

Recognizing the importance of single variable

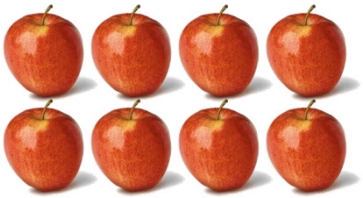
Introducing control variable

Applying the teaching approach to daily-life context



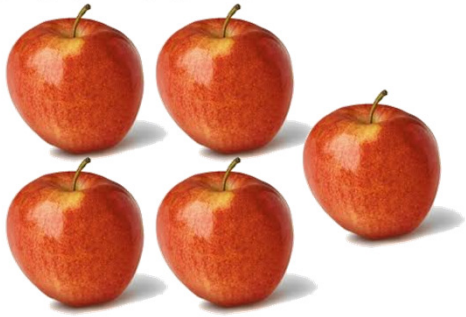
Package A

$20



Package B

$45



Package C

$50

- How do you come up with your choice?
- Have you encountered any problems in deciding which package is the best-buy?
- What additional information do you need to solve the problem?
- Why the additional information is useful to solve the problem?

Let's see how our students performed in another TIMSS item

10: 64.6%

70: 25.0%

79: 6.2%

2

Mark planted a flowering plant in a pot that contained soil with enough fertilizer.

Mark went on a trip and left the plant in a dark room. He knew the room would not get too hot or too cold. When he came back two weeks later, the plant was dying.

Write two reasons the plant was dying.

Correct
Girls: 65.7%

Boys: 63.7%

- Having alternative conceptions
- Not able to apply what they have learnt into this context
- Not able to identify factors in the question
- Lack of authentic experience in planting
- Lack of interest in studying plants

How can the TIMSS item be adapted to develop students' science process skills (and interest)?

Mark planted a flowering plant in a pot that contained soil with enough fertilizer.

Mark went on a trip and left the plant in a dark room. He knew the room would not get too hot or too cold. When he came back two weeks later, the plant was dying.

Write two reasons the plant was dying.

Ask students to design a setup that simulates these conditions

How to tell the plant is dying? (Observation/ Measurement)

Make inferences about what plants need to survive

Evaluate the inference using given data

How to test?

Inquiry Video Simulation

Introducing photosynthesis

Reflect on our teaching and learning

- There is no specific sequence for teaching science process skills
  - Scientists do not follow a fixed set of steps
  - Intellectual advancement in science doesn't necessarily involve hands-on practical work
- Develop students' science process skills using daily-life context
- Provide students opportunities to practise the science process skills

Thank you