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THE UNIVERSITY OF HONG KONG

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

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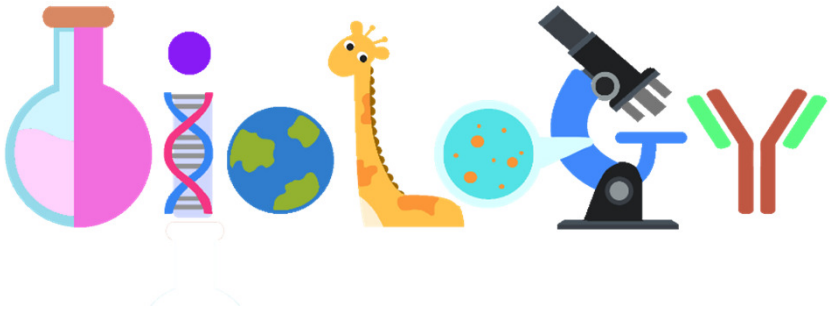
About Me

Background:

- Science education researcher
- Biology teacher educator
- HKDSE CDC–HKEAA Committee (Biology) Chairperson

Research Interest:

- Teacher expertise
- Formative assessment
- Use of videos in teacher education
- Innovative biology teaching



Outline

❶ Examining 2019 Grade 8 TIMSS items (Life Science)

❷ Exploring students' reasoning behind TIMSS items

Why Look at TIMSS Items?

International Assessment Test

(e.g., TIMSS)

Public examination in Hong Kong

(e.g., HKDSE)

Assessment in Schools

Classroom Assessment

Using TIMSS released items and data to inform day-to-day classroom assessment and instruction

❶ Examining 2019 TIMSS Items

❶

Insects that feed on nectar pollinate flowering plants as they move from flower to flower.

What kind of relationship is this?

(A) predation

(B) parasitism

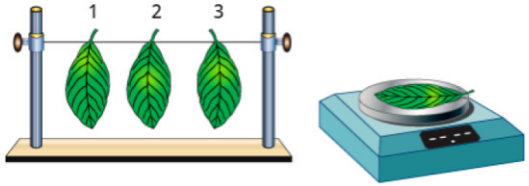
(C) competition

(D) symbiosis

❷

Adam investigates how the mass of leaves changes over time.

He removes three leaves from a tree and finds the mass of each leaf.



After one week Adam finds the mass of each leaf again.

He records his results in the table.

Leaf	Mass at start (grams)	Mass after one week (grams)
1	2.22	1.65
2	1.93	1.34
3	2.08	1.6

Which statement **best** explains this decrease in mass?

(A) The leaves released oxygen.

(B) The leaves used glucose.

(C) The leaves lost water.

(D) The leaves released carbon dioxide.

❸

Francisco had a male rabbit and a female rabbit. He kept them in a fence painted white on the inside. Both rabbits had black hair. When these rabbits bred, some of their offspring had white hair.

Which of the following explains how this pair of black-haired rabbits could produce offspring with white hair?

(A) When any black-haired male and female rabbits breed, they will eventually produce some white-haired offspring.

(B) The male and female black-haired rabbits can pass some traits on to their offspring, even though they do not express the trait themselves.

(C) If the male and female black-haired rabbits are old, they will only produce offspring with white hair.

(D) Male and female rabbits will produce offspring that blend in with the color of their surroundings.

Task 1: *Prediction Task*

1. Make a prediction of the student performance by ranking the items in terms of their performance (Best performance (1st rank) e.g., 1 > 2 >3)

2. Briefly explain *why* you think the students performed most ***unfavourably*** in the item you ranked the lowest.

Post your items on *Padlet*

- Reasons that may account for differential performance
  - Cognitive demands of the items
  - Whether the items target at student learning difficulties
  - Items not in the curriculum
    - *Opportunities to learn:* Students do not have opportunities to learn/study a particular content
  - Items in the curriculum
    - *Instructional alignment:* Cognitive demands in the item and the cognitive demands with which the content is taught do not match

❶ Examining 2019 TIMSS Items

❶

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Knowing

D. 37.2

❷

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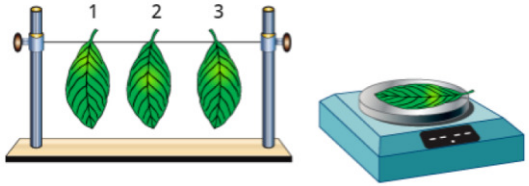

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Applying

C. 55.1

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Applying

B: 48.3

A Short Summary:

- The MC items give as some ideas about ***what*** students chose but cannot provide insights into ***WHY*** students are choosing a particular option

- It is important to investigate ***why*** students choose a particular option and to understand their thinking and reasoning

❷ Exploring Student Thinking

IEA eTIMSS 2019

TIME LEFT 0

1

1

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D Male and female rabbits will produce offspring that blend in with the color of their surroundings.

Let's see the actual data:

- Option A: 12.2
- Option B: 48.3
- Option C: 12.9
- Option D: 25.4

Omitted: 1.3

Not reached: 0.3

Task 2: *Student Thinking Interview Analysis*

Let's listen to a student interview

- Background of the student
  - F.3 Student of medium ability
  - Student in a Band 1 school
  - Using English to learn Integrated Science

Questions:

1. What option did the student choose? Why did she choose that option?
2. What does the student know and not know about the idea of inheritance?
3. How did the interviewers get to know her ideas?

What option did the student choose? Why did she choose that option?

- D
- She was using ‘test-taking’ strategy and thought that the question provided some hints for her to choose the ‘right answer’

What does the student know and not know about the idea of inheritance?

- Some environment factors/conditions may not affect the characteristics of an offspring
- Offspring may not have the same characteristics as the parents
- Hormones can affect body characteristics

What did the interviewers do to uncover student thinking?

- Extensive probing of student thinking and ideas (*Why did you think so? How does that happen? What do you mean by XXX? Can you say more about that? Can you give an example*?)
- Asking students to consider another context

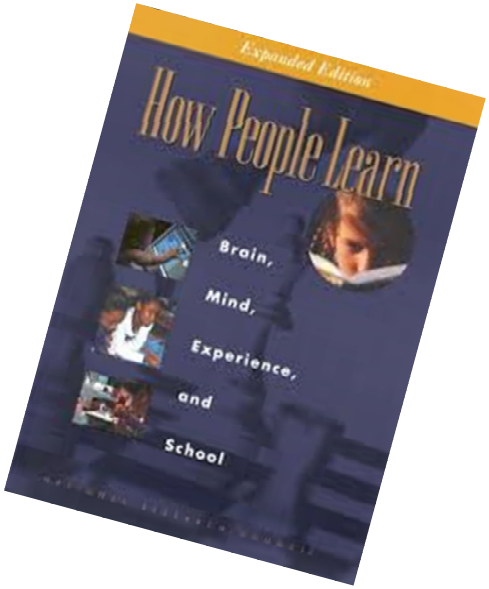
FIGURE 1 Strategies for implementing student-thinking interviews

Interview strategy	Description	Examples
Contextualize the concept	Pose an initial question to access student's intuitive and everyday knowledge.	"Why does ice float?"
Probe student responses	Follow up on student responses with general or specific prompts.	"Can you say more about that?" "What do you mean by that?" "Why does a density of less than 1 mean it will float?"
Seed new ways of thinking	Ask student about related cases or cue additional information about the topic.	"Did you know that wood floats even though it's pretty heavy?"

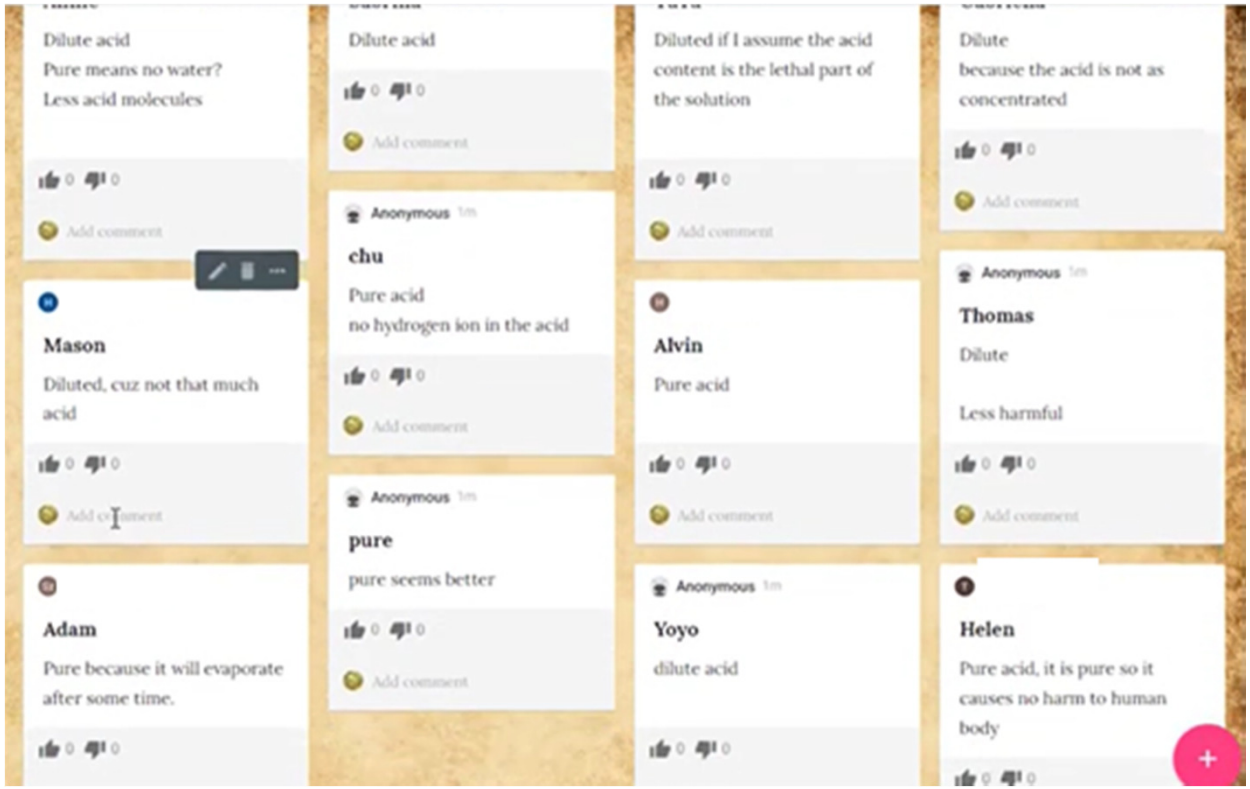
Russ, R.S., & Sherin, M.G. (2013). Using interviews to explore student ideas in science. *Science Scope*, *36*(5), 19-23.

- "Students come to the classroom with *preconceptions* about how the world works. If their initial understanding is not engaged, they may fail to grasp the new concepts and information that are taught, or they may learn them for purposes of a test but *revert to their preconceptions outside the classroom*." (Bransford et al., 2000, pp.14-15)

Bransford, J. D., Brown, A. L., & Cocking, R. R. (2000). How people learn: Brain, mind, experience, and school. Washington, DC: National Academy Press.



- Use technological tools to uncover student thinking and reasoning and make them visible in the classroom



Before/After Classroom Instruction:

- Use two-tier MC question to survey student thinking and reasoning

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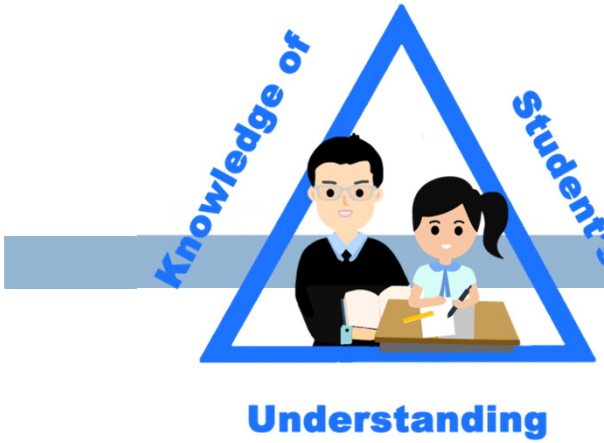
D Male and female rabbits will produce offspring that blend in with the color of their surroundings.

- Explain the reasons for your choice above:

Take Home/ Stay Home Messages

- TMISS questions can be useful “probes” to uncover student thinking and reasoning
  - Use student thinking interviews, talk moves and two-tier MC questions to elicit student thinking
  - Use technological tool to make student thinking and reasoning visible
- Students know much more than we think and are useful resources
  - Adjust your instruction by building on student thinking and reasoning
- Acknowledge what students already know and this is important to make them confidence about science



Knowledge of student understanding

Teachers who know their students' most common misconceptions are more likely to increase their students' science knowledge than teachers who do not.

Sadler, P. M., & Sonnert, G. (2016). Understanding Misconceptions: Teaching and Learning in Middle School Physical Science. *American Educator*, *40*(1), 26-32.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