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# The Use of “DragGame” for Enhancing Learning and Teaching in Science (S1-3)

Workshop on Classroom Dialogue using  
Student-generated Representations

May 25, 2023

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# Outline of the workshop

- Dialogic teaching for meaningful science learning
- Critical analysis of productive classroom dialogues
- How to design productive classroom dialogues around student-generated representations
- Teacher sharing

# In-class discussion and collaborative learning

## Questioning

- Systematic use of questioning improves students learning
- Classification of questions according to a particular system (e.g., Bloom's taxonomy) allows determination of the current levels of your students, which supports your pedagogical decision-making

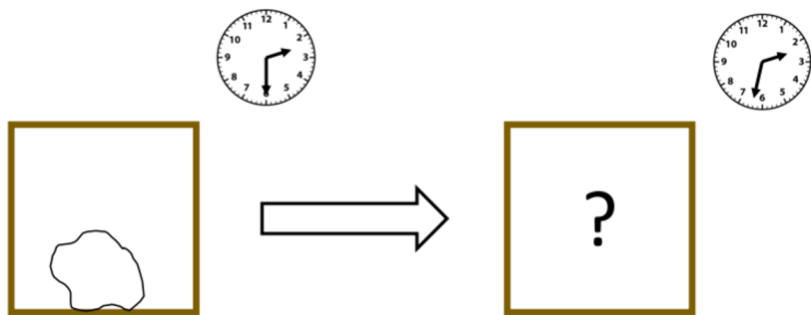


# In-class discussion and collaborative learning

- Questioning allows students' de-facto prior learning to be identified
- Questions should be adapted in view of students' ability, and they should encourage the participation of as many students as possible
- Questions should be logically developed, possibly in the form of a written plan

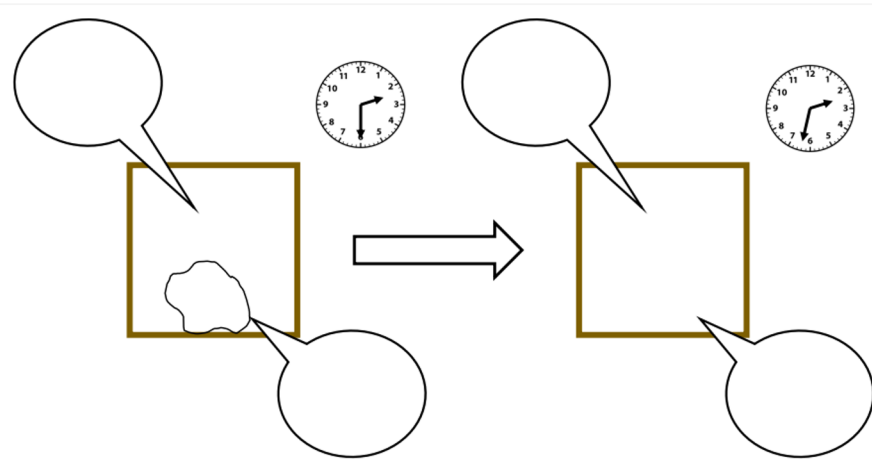
# Activity 1a

Diagram A



- A teacher put a dry ice in a box, and told the students that the situation is just like the left-hand-side of diagram A. He would like to what do students think about what would happen 2 minutes later.

Diagram B

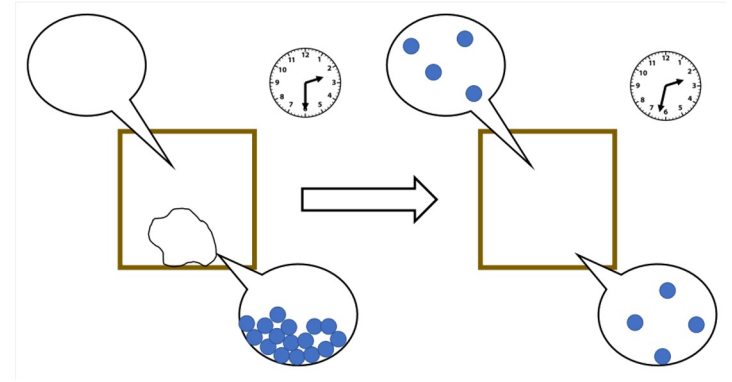


- After having the initial macroscopic speculation, the teacher showed the Drag Game to the students and asked them to put particles (to be represented by blue circles) into the speaking bubbles to provide sub-microscopic descriptions and explanations of the macroscopic happening.

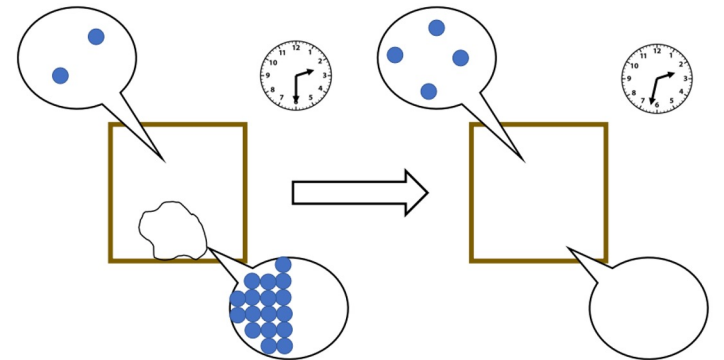
- Students were then shown Diagrams C and D, which were screenshots of the Drag Game products of Sam and Jo respectively.
- Try to formulate as many questions as possible to facilitate the discussion. Write each of the question on a piece of memo paper. (5 min)



**Diagram C**



**Diagram D**



# Questioning strategies

Types	Details
Convergent	Focuses on a narrow objectives and low-level learning, which tends to elicit short responses
Divergent	Designed to evoke multiple & longer students' responses, which does not have right or wrong answers
Evaluative	Requires students to both put forward judgement and state the reasoning behind
Reflective	Elicits students' critical thinking, e.g., identifying motives, inferring values & assumptions

- Categorize your questions based on the types of questioning strategies on the left. **Identify 1-2 things that you have learned from your categorization. (5-8 min)**
- Formulate one question for the type(s) which is not shown in your categorization. (3 min)

# Questioning environment

How could we encourage students to respond in a richer and in-depth manner?

1. Using questions positively
  - Questions should not be used for punitive purposes, e.g., as a “punishment” for providing a wrong answer to the preceding question.
2. Framing the statement clearly
  - Ask a clear and succinct question
  - Pausing (wait-time, for up to 5-7 seconds), before you call on a student



# Questioning environment

## 3. Use wait time after students' responses

- allows time to digest the utterance and for other students to respond

## 4. Positive prompting

- Follow-up clarification, elicitation for fuller/additional responses

## 5. Handling alternative ideas

- try to provide neutral but not negative responses
- forward the question to another student without commenting

# Questioning environment

## 6. Promoting multiple responses

- use divergent and evaluative questions that allow multiple students to provide different responses

## 7. Connecting previously learnt materials with the new ones

- Use compare & contrast-typed questions, or other strategies, to support revision and identification of the links between the previously and newly learned materials

# Questioning environment

## 8. Encouraging non-volunteers

- Ask questions that require easier and shorter answers first, which leads to relevant and higher-order questions later to build students' confidence and make a game out of questioning (e.g., lots-drawing).

## 9. Avoiding idiosyncrasies that interfere with smooth verbal interactions

- Avoid answering the questions by yourself, not allowing students to complete their responses, not listening to the students, especially after they have been called on, and exhibiting favouritism

# Activity 1b

- Now study the dialogue, which took place after Sam had presented his reasoning. Discuss how the teacher had created a good questioning environment. (8 min)
- Modify the dialogue with what you have learned about the types of questioning strategies and good questioning environment. (8 min)  
Role play in pairs. (3-4 min)



Diagram C

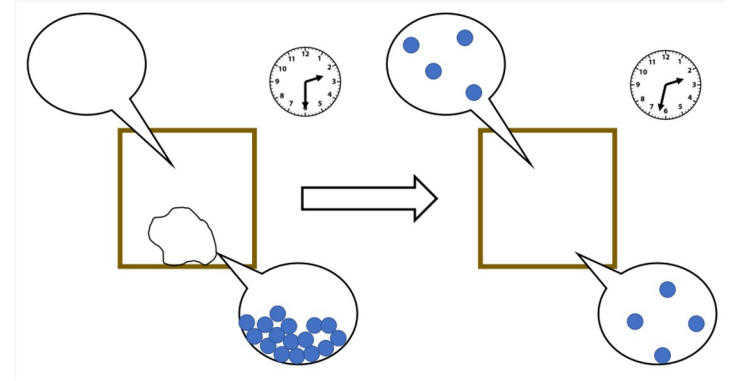
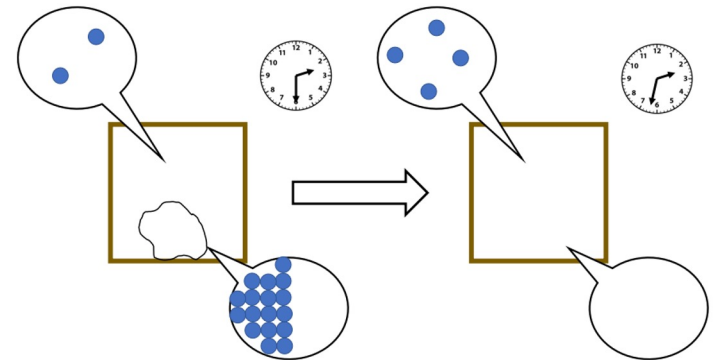


Diagram D



# Dialogic teaching for cognitive development

# What is dialogic teaching?

- “Dialogic” teaching focuses on the inter-connectedness between utterances and co-construction of meaning
- Collective: Teachers and students address learning tasks together
- Reciprocal: Both teachers and students listen, share ideas and consider multiple viewpoints together
- Supportive: Students share ideas in a non-threatening and supportive environment that anticipates and is equipped to handle alternative conceptions
- Cumulative: Teachers and students build on one another’s thinking coherently during the whole process of learning
- Purposeful: Planned in view of certain educational goals and objectives

# Interactions = dialogues?

	Interactive	Non-interactive
Dialogic	Teachers and students explore diverse ideas and points of view together	Teachers identify, explore and summarise different viewpoints without students' input
Authoritative	Teachers involve students in questioning, yet only one particular point of view is considered	Teacher presents a specific point of view without requiring students to be involved

# Communicative acts

Communicative acts	Contributions and Strategies	What do we hear?
<b>IB – Invite to build on ideas</b>	Invite others to elaborate, build on, clarify, comment on or improve own or others' ideas/contributions	'Can you add', 'What?' 'Tell me', 'Can you rephrase this?' 'Do you think?' 'Do you agree?'
<b>B – Build on ideas</b>	Build on, elaborate, clarify or comment on own or others' ideas expressed in previous turns or other contributions	'it's also', 'that makes me think', 'I mean', 'she meant'
<b>CH - Challenge</b>	Questioning, disagreeing with or challenging an idea	'I disagree', 'But', 'Are you sure...?', '...different idea'



# Communicative acts

Communicative acts	Contributions and Strategies	What do we hear?
<b>IRE – Invite reasoning</b>	Invite others to explain, justify, and/or use possibility thinking relating to their own or another's ideas	'Why?', 'How?', 'Do you think?', ...'explain further'
<b>R – Make reasoning explicit</b>	Explain, justify and/or use possibility thinking relating to own or another's ideas	'I think', 'because', 'so', 'therefore', 'in order to', 'if...then', 'it's like...', 'imagine if...', 'could',
<b>CA - Coordination of ideas and agreement</b>	Contrast and synthesize ideas, confirm agreement and consensus; Invite coordination/synthesis	'agree', 'to sum up...', 'So, we all think that...', 'summarise', 'similar and different'

# Communicative acts

Communicative acts	Contributions and Strategies	What do we hear?
<b>C – Connect</b>	Make pathway of learning explicit by linking to contributions/knowledge/ experiences beyond the immediate dialogue	'last lesson, 'earlier', 'reminds me of', 'next lesson', 'related to', 'in your home'
<b>RD – Reflect on dialogue or activity</b>	Evaluate or reflect "metacognitively" on processes of dialogue or learning activity; Invite others to do so	'dialogue', 'talking', 'sharing', 'work together in the group/pair', 'task', 'activity', 'what you have learned', 'I changed my mind'

# Communicative acts

Communicative acts	Contributions and Strategies	What do we hear?
<b>G – Guide direction of dialogue or activity</b>	Take responsibility for shaping activity or focusing the dialogue in the desired direction or use other scaffolding strategies to support dialogue or learning	'How about', 'focus', 'concentrate on', 'Let's try', 'no hurry', 'Have you thought about...?'
<b>E – Express or invite ideas</b>	Offer or invite relevant contributions to initiate or further a dialogue (ones not covered by other categories)	'What do you think about...?', 'Tell me', 'your thoughts', 'my opinion is...', 'your ideas'

# Activity 2

- Consider the dialogues again. Identify the communicative acts that had been used. (8 min)



- Modify the dialogue with what you have learned about the communicative acts. (5-8 min)
- Demonstration of the revised version. (3-5 min)



# Productive peer talk

Three ways of talking and thinking among students

Ways of thinking	Key attributes	Verbal features
1. Disputational talk	<ul style="list-style-type: none"><li>- Disagreement</li><li>- Individual decision-making</li><li>- Little constructive criticism</li><li>- Little pooling of resources</li></ul>	Short exchanges of assertions & challenges
2. Cumulative talk	<ul style="list-style-type: none"><li>- Positive yet uncritical building on others' contributions</li><li>- Construction of common understanding</li></ul>	Repetitions, confirmations, elaborations
3. Exploratory talk	<ul style="list-style-type: none"><li>- Critical &amp; constructive engagement</li><li>- Collaborative deliberation</li><li>- Active participation from all</li></ul>	Justifications & alternatives; seeking opinions, explicit reasoning

# Productive peer talk

Students could be taught the verbal strategies for engaging in an exploratory talk

Strategies to be taught	Example sentence openers
Asking open questions	"How might we ... ?"
Paraphrasing or re-voicing key ideas	"So... what you are suggesting is ..."
Summarising the main points	"So far, we've found out that ..."
Using empathetic listening skills	"It sounds like you found it hard to ..."
Clarifying misperceptions	"I'm not sure what you mean by ..."
Assertively expressing a point of view	"I see what you mean but instead we could try ..."
Offering suggestions tentatively	"Would it be worth considering this? ..."
Offering self-disclosure	"When that happened to me, I felt ..."

# Productive peer talk

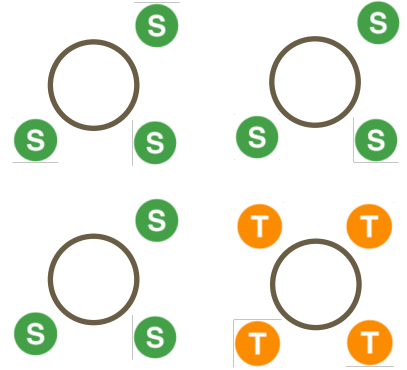
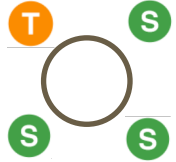
Teachers could also use certain speech behaviours that mediate students' learning, and students could adopt what the teachers have modelled

Strategies to be used by teachers	Examples
Challenges	"What was that ...?" – ( <i>Student's short utterance</i> ) – "Why?"
Cognitive (reasons required)	"I'm going to ask you ... and give us a justification of why ..."
Metacognitive	"What do you think [ <i>the creator of</i> ] this picture is trying to communicate?"
Prompts	"What could you consider next?" #
Focus on issues	"Let's look at ... specifically?" #
Open questions	"Tell me more about..." #
Validation & acknowledgement of efforts	"Let's have a look. Looks good."

# Practising dialogue

## Activity 1: Discussion (10 min)

- Nominate a teacher in your group, the rest will be student actors
- The teacher from each group moves to a new table, student actors remain in their seats

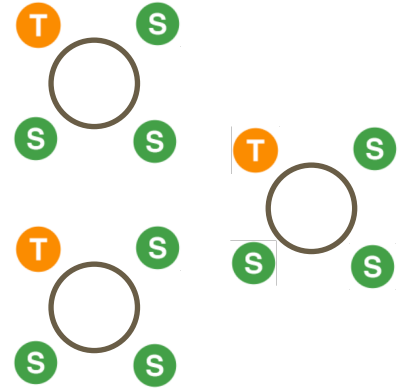




# Practising dialogue

## Activity 2: Role play (15 min)

- The teachers return to your original groups
- The teachers have 2 min to view the presentations from your student group in Padlet
- Student actors:
  - A: always gives scientific terms only
  - B: shy; often responds by saying "I don't know", "I am not sure if it is the answer you want"
  - C: is willing to express ideas, but often uses "it" for unclear subject
- In 12 min, the teachers need to elicit and work on students ideas' using their representations and the dialogue strategies introduced by Anthony.



A fixed amount of alkali is added to a conical flask containing acid for three times.

At start	After adding alkali	After adding alkali	After adding alkali
pH: 1 2 3 4 5 6 7 8 9 10 11 12 13 14	pH: 1 2 3 4 5 6 7 8 9 10 11 12 13 14	pH: 1 2 3 4 5 6 7 8 9 10 11 12 13 14	pH: 1 2 3 4 5 6 7 8 9 10 11 12 13 14

Drag the following particles into the boxes to show the acid and alkali particles in the solution upon addition of alkali. And circle the possible pH.

● Acid particle   ○ Alkali particle   ○ Circle for pH

- Q1. What do you think about the relationship between acid particle, alkali particle, and pH?  
Q2. How do you understand the word "neutralization" from your diagram?

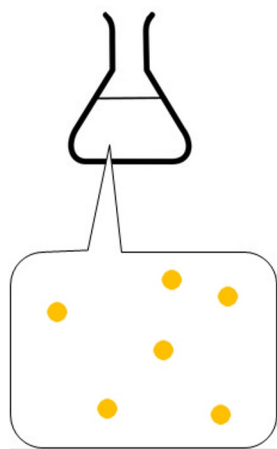
# Reflection (10 min)

- Discuss the questions on Padlet with your groupmates
- Verbal sharing (3 min)

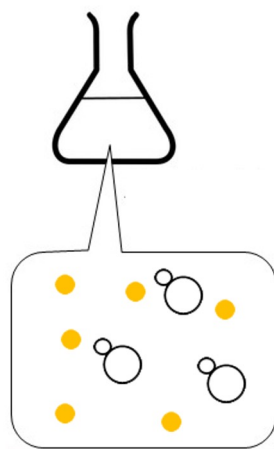


# How will you respond to the following student idea?

- Assume neutral solution is pH7, adding one acid particle will decrease pH by 1 and adding one alkali particle will increase pH by 1



$$\text{pH} = 7 - 6 = 1$$



$$\text{pH} = 7 - 6 + 3 = 4$$

# Working with students' generated representations

- Identify common patterns, alternative ideas
- Identify scientifically appropriate ideas
- Sequence the discussion around students' work with increasing level of sophistication
- Provide opportunities for students to predict, explain, and revise
- Jot down important ideas discussed on the blackboard

# Sharing from In-service Teachers

- Ms Bonnie Sun
  - Yuen Long Merchants Association Secondary School
  - Teaching I.S. and Chemistry
  - Sharing Link: <https://youtu.be/QxFRRt-s-ps>
  
- Ms Yoyo Yiu
  - Fanling Kau Yan College
  - Teaching Biology
  - Sharing Link: <https://youtu.be/14NCCbvywmY>

# Key messages

- Carefully crafted questions could foster students' science learning.
- Questions shape the learning atmosphere and environment.
- Dialogues are more than interactions.
- Communicative acts of different types are used for triggering different kinds of student thinking.
- Students should be taught to talk productively in the science classrooms.
- DragGame is only a tool. What matters is how you design and use the e-learning activities.

**Thank You**