怎樣設計多元評估的科學科課？
--培養創意的學習和評估方法

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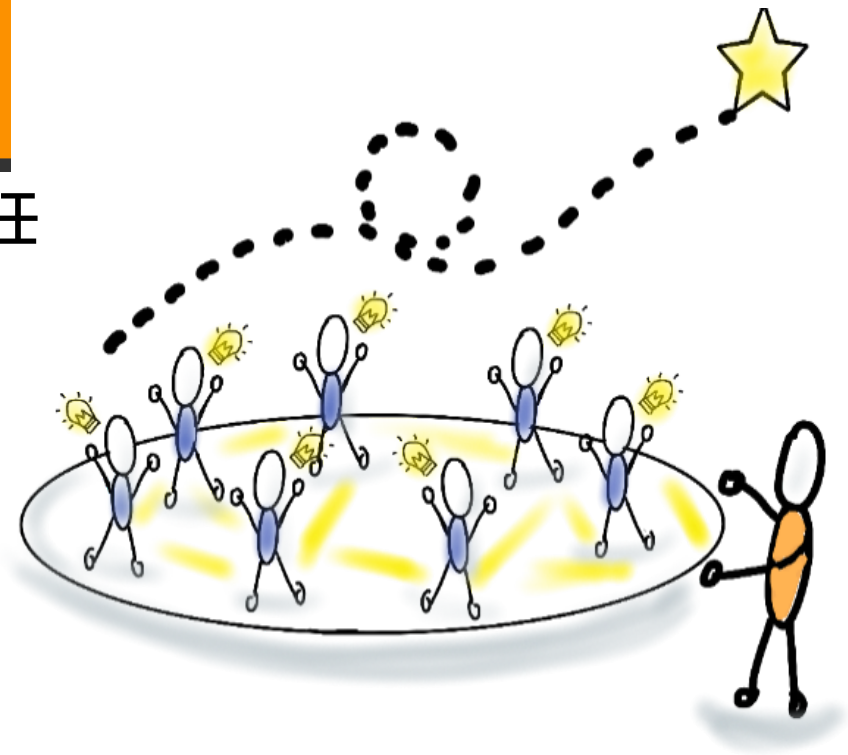
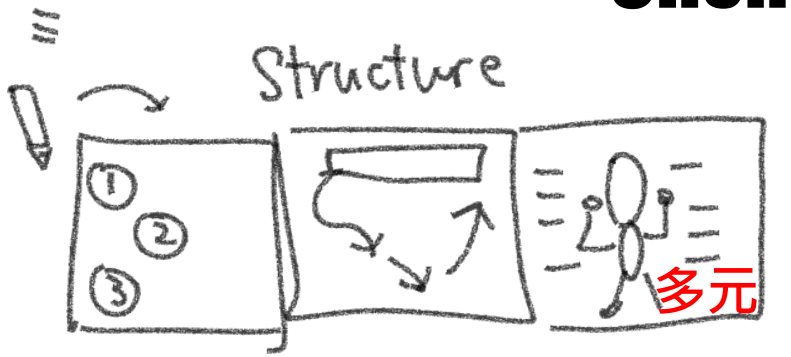
香港翻轉教學協會
科學科召集人



德蘭中學 St. Teresa Secondary School

FLIPEDU - HONG KONG -

Science
Chemistry



自主學習

Motivating every students

視覺化教學

Making Learning
Visible

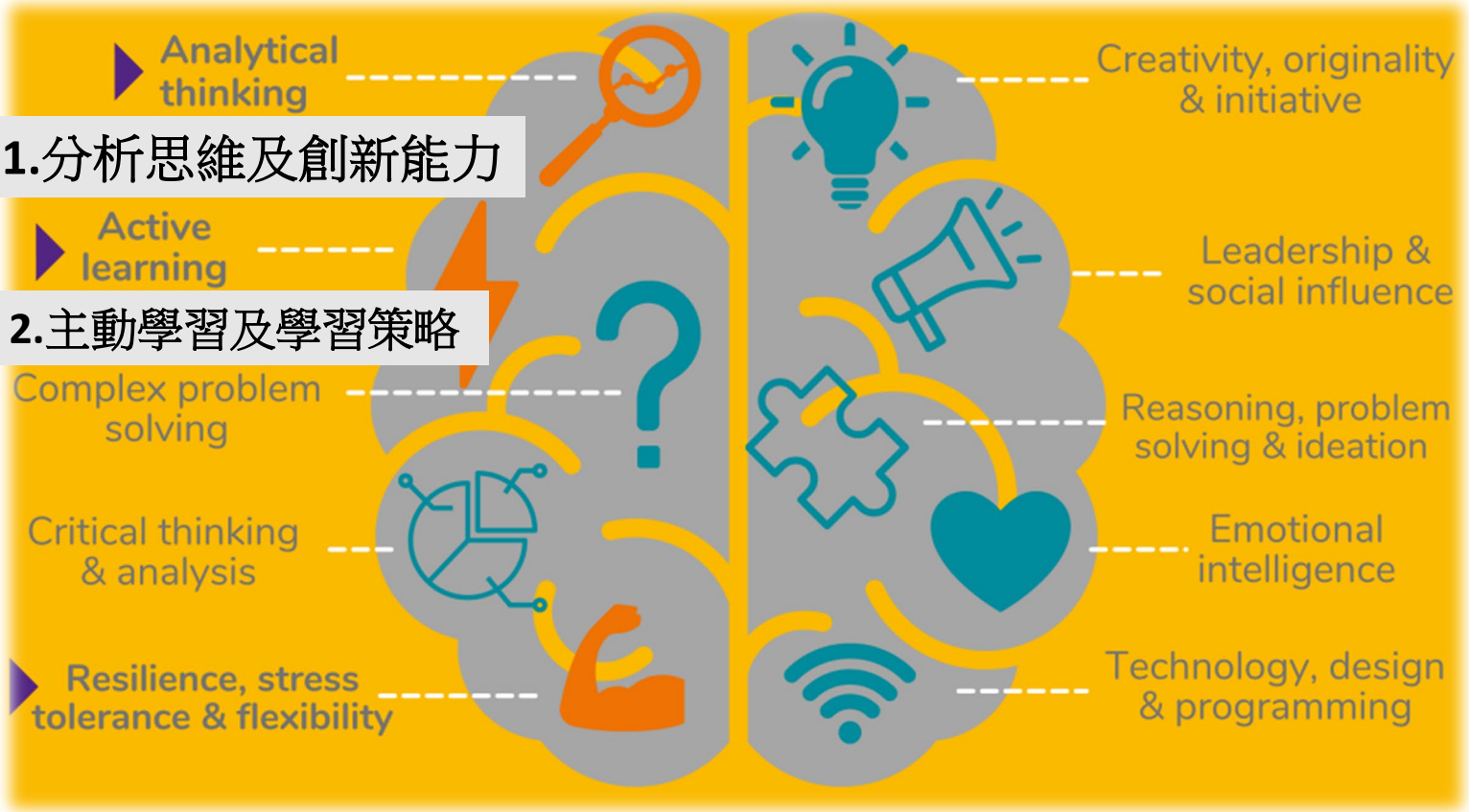
翻轉+創新教學

Flipped Learning
+ Creative approach

怎樣設計多元評估的科學科課？

--培養創意的學習和評估方法

According to a recent World Economics Forum report, the **TOP skills in the lead-up to 2025 :**



2025年
最重要項人才技能
TOP Skills in 2025

Fig.1
How has remote learning affected '21st century skills'?. (2021). Retrieved 7 December 2021, from https://www.cambridge.org/gb/education/blog/2021/05/20/how-has-remote-learning-affected-21st-century-skills/

Top 10 skills of 2025

WORLD ECONOMIC FORUM

Type of skill
- Problem-solving
- Self-management
- Working with people
- Technology use and development

Advanced nations will expect these in future from human resources as the furute supply chain skews toward regions south of Tropic of Cancer due to connectivity, leading to rate dilution and better bang for the dollar

in 2020

1. Complex Problem Solving
2. Critical Thinking
3. Creativity
4. People Management
5. Coordinating with Others
6. Emotional Intelligence
7. Judgment and Decision Making
8. Service Orientation
9. Negotiation
10. Cognitive Flexibility

in 2015

1. Complex Problem Solving
2. Coordinating with Others
3. People Management
4. Critical Thinking
5. Negotiation
6. Quality Control
7. Service Orientation
8. Judgment and Decision Making
9. Active Listening
10. Creativity

in 2030

1. Judgment & Decision Making
2. Fluency of ideas
3. Active Learning
4. Learning Strategies
5. Originality
6. System Evaluation
7. Deductive Reasoning
8. Complex Problem Solving
9. Systems Analysis
10. Monitoring

Your next job move could be easier (or more dificult) than you think --depending on self-development, skills you acquire and trainings you seek, other than "degree and years of experience"

Data Source: Furue of Jobs Reports, WEF

Comment (in Red) added by Irshad Salim Assocs. & DesPardes

in 2030

1. Judgment & Decision Making
2. Fluency of ideas
3. Active Learning
4. Learning Strategies
5. Originality
6. System Evaluation
7. Deductive Reasoning
8. Complex Problem Solving
9. Systems Analysis
10. Monitoring

TOP skills in the lead-up to 2025 :

1.分析思維及創新能力
Analytical thinking and innovation
2.主動學習及學習策略
Active Learning and Learning Strategies

TOP skills in the lead-up to 2030 :

1.判斷力及決策力
Judgement and Decision making
2.意念/思維流暢度
Fluency of ideas
3.主動學習
Active Learning

2022 Skills Outlook

Growing

1. Analytical thinking and innovation
2. Active learning and learning strategies
3. Creativity, originality and initiative
4. Technology design and programming
5. Critical thinking and analysis
6. Complex problem-solving
7. Leadership and social influence
8. Emotional intelligence
9. Reasoning, problem-solving and ideation
10. Systems analysis and evaluation

COMMITTED TO IMPROVING THE STATE OF THE WORLD

Declining

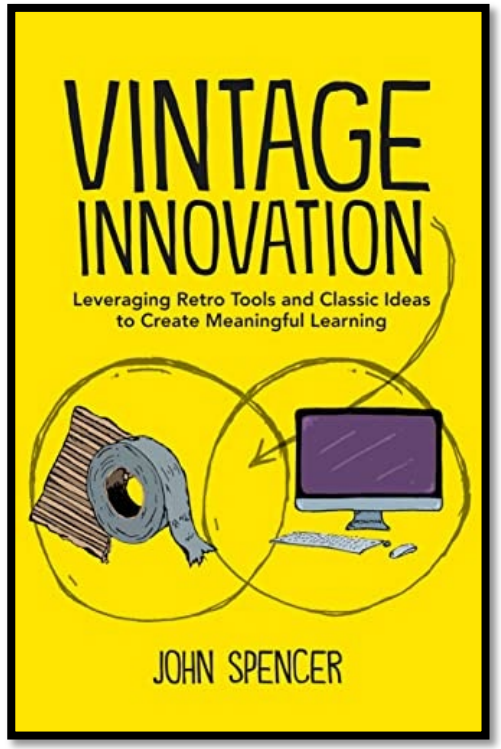
1. Manual dexterity, endurance and precision
2. Memory, verbal, auditory and spatial abilities
3. Management of financial, material resources
4. Technology installation and maintenance
5. Reading, writing, math and active listening
6. Management of personnel
7. Quality control and safety awareness
8. Coordination and time management
9. Visual, auditory and speech abilities
10. Technology use, monitoring and control

WORLD ECONOMIC FORUM

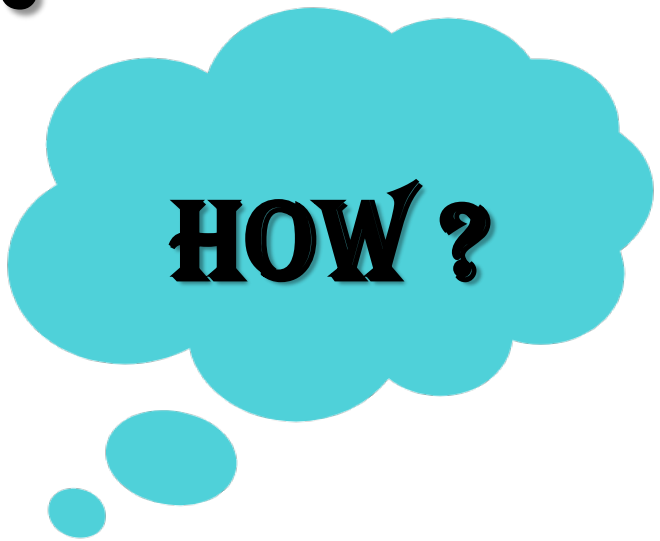
COMMITTED TO IMPROVING THE STATE OF THE WORLD

If we want to prepare students for the FUTURE, **we need to <u>empower</u> them in the PRESENT**.

-John Spencer



EMPOWER?



理科老師

2023 vs 2003

推廣科學素養

Promoting Scientific Literacy in classroom

Science Process Skills

Nature of Science

1. Science curriculum guide(EDB updated 2017)

Science Education

Science education provides learning experiences for students to develop scientific literacy with a firm foundation on science, realise the relationship between science, technology, engineering and mathematics, master the integration and application of knowledge and skills within and across KLAs, and develop positive values and attitudes for personal development and for contributing to a scientific and technological world.

Reference : Supplement to the Science Education Key Learning Area Curriculum Guide

1.Science curriculum guide(updated 2017)

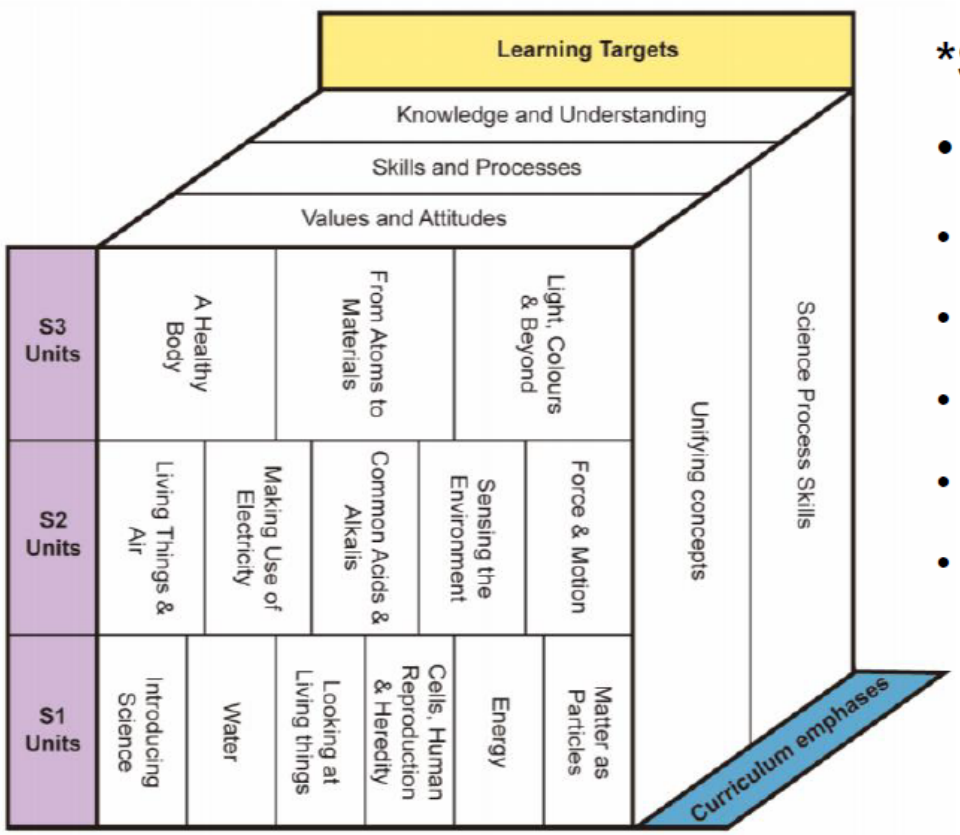
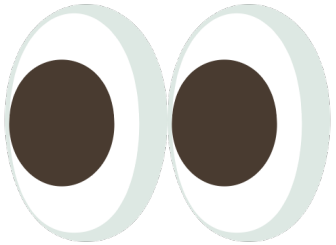
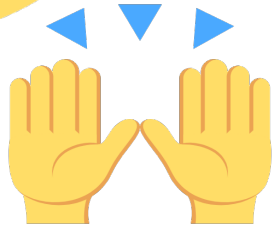


Figure 2 Diagrammatic Representation of the Science (S1-3) Curriculum Framework

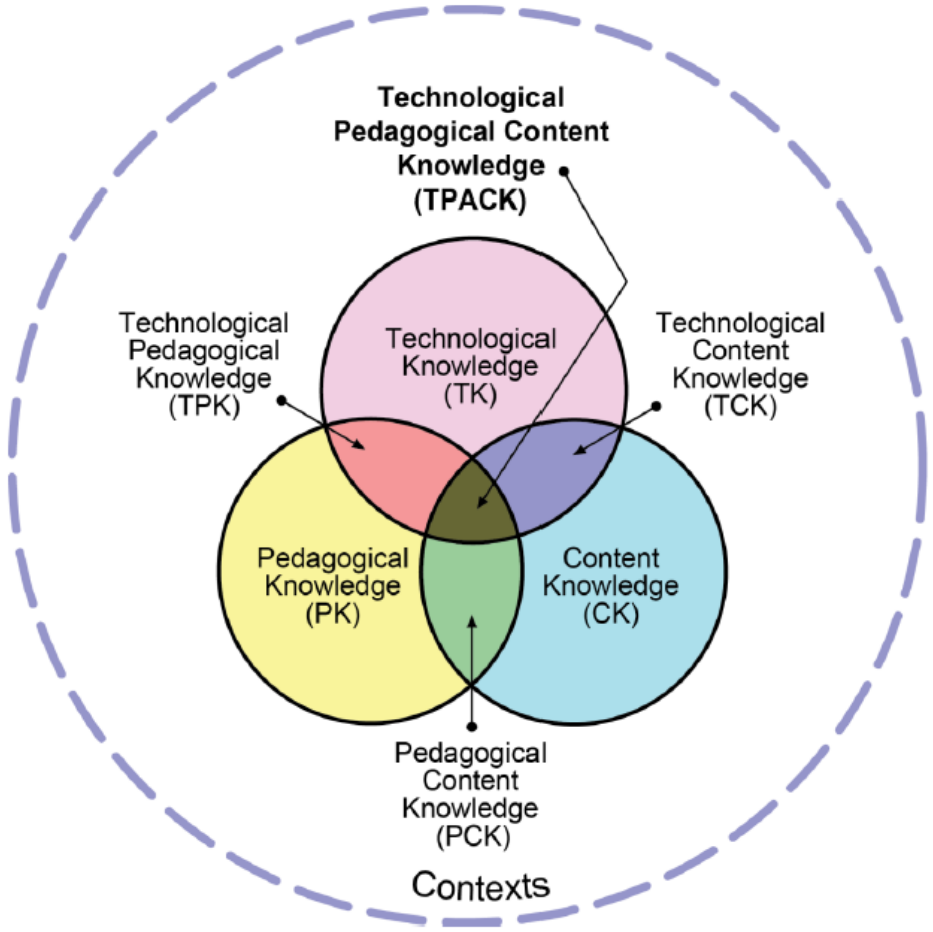
*Science Process Skills

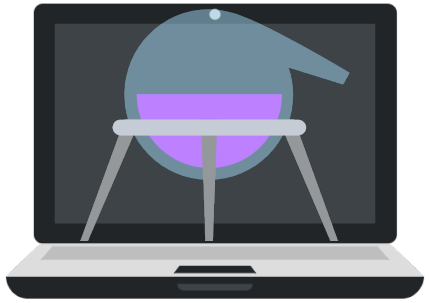
- **Observing**
- **Classifying**
- Designing investigations
- Conducting practical
- Inferring
- **Communicating**



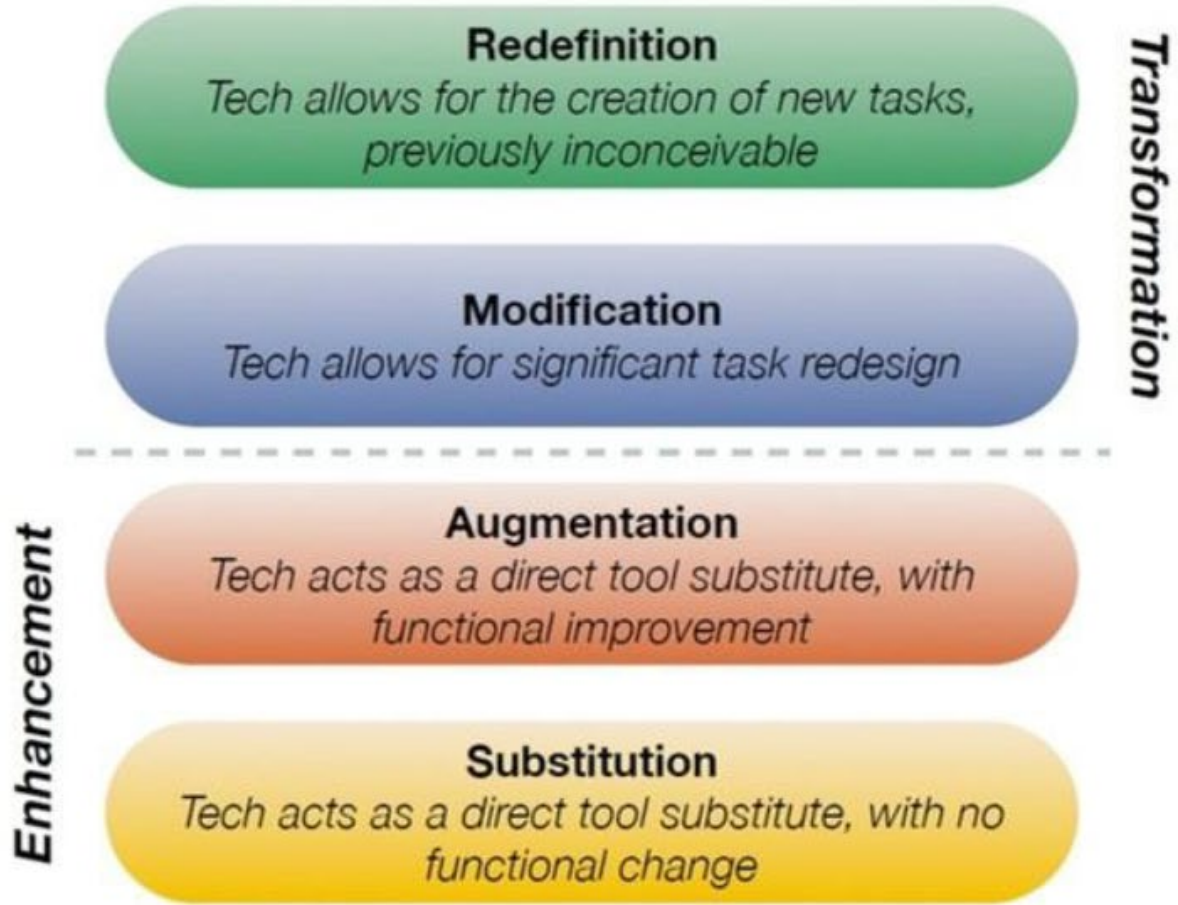


2.TPACK and Science Teaching

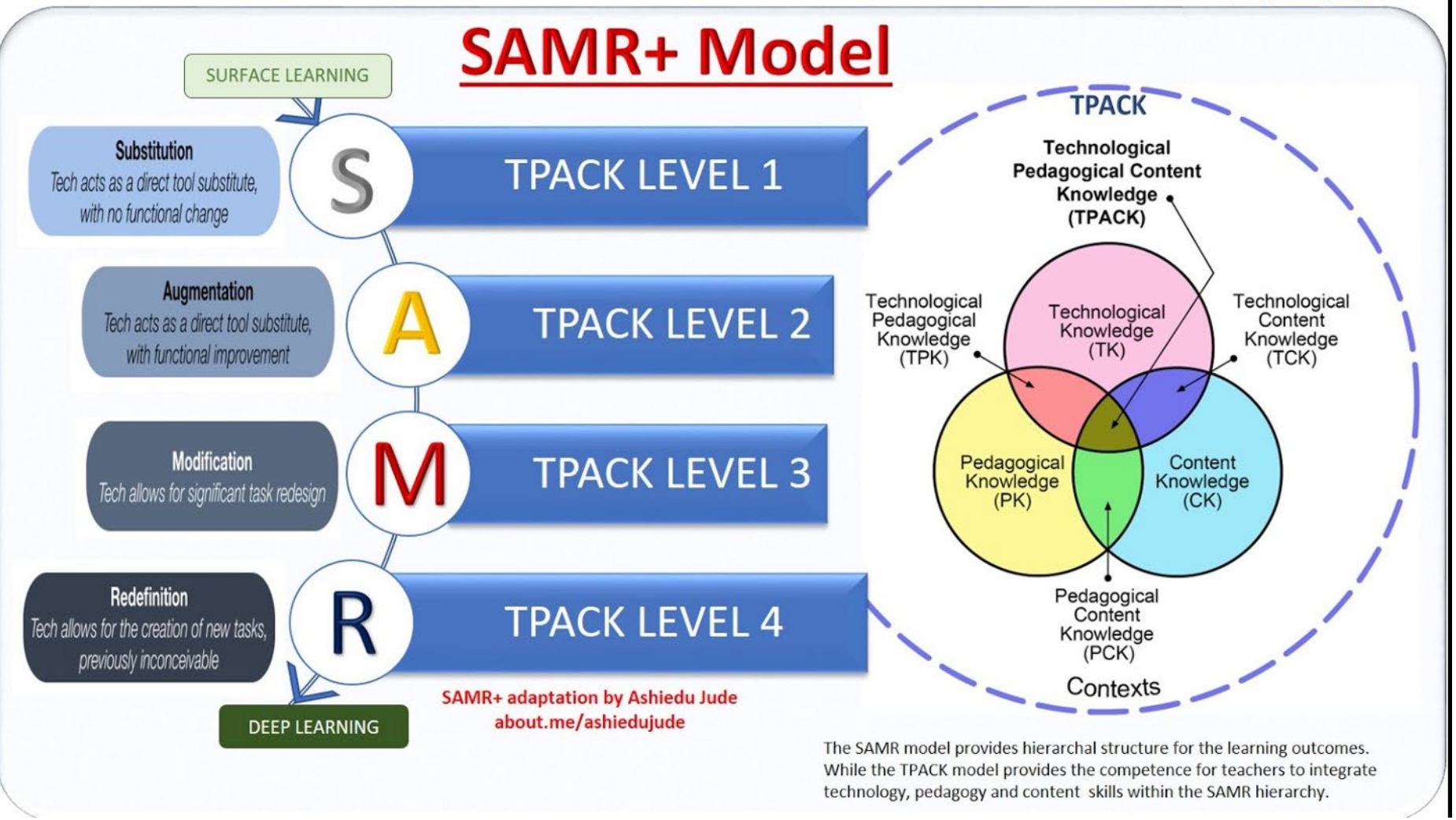




3. SAMR model


Redefinition
Tech allows for the creation of new tasks, previously inconceivable
Modification
Tech allows for significant task redesign
Augmentation
Tech acts as a direct tool substitute, with functional improvement
Substitution
Tech acts as a direct tool substitute, with no functional change
Transformation
Enhancement

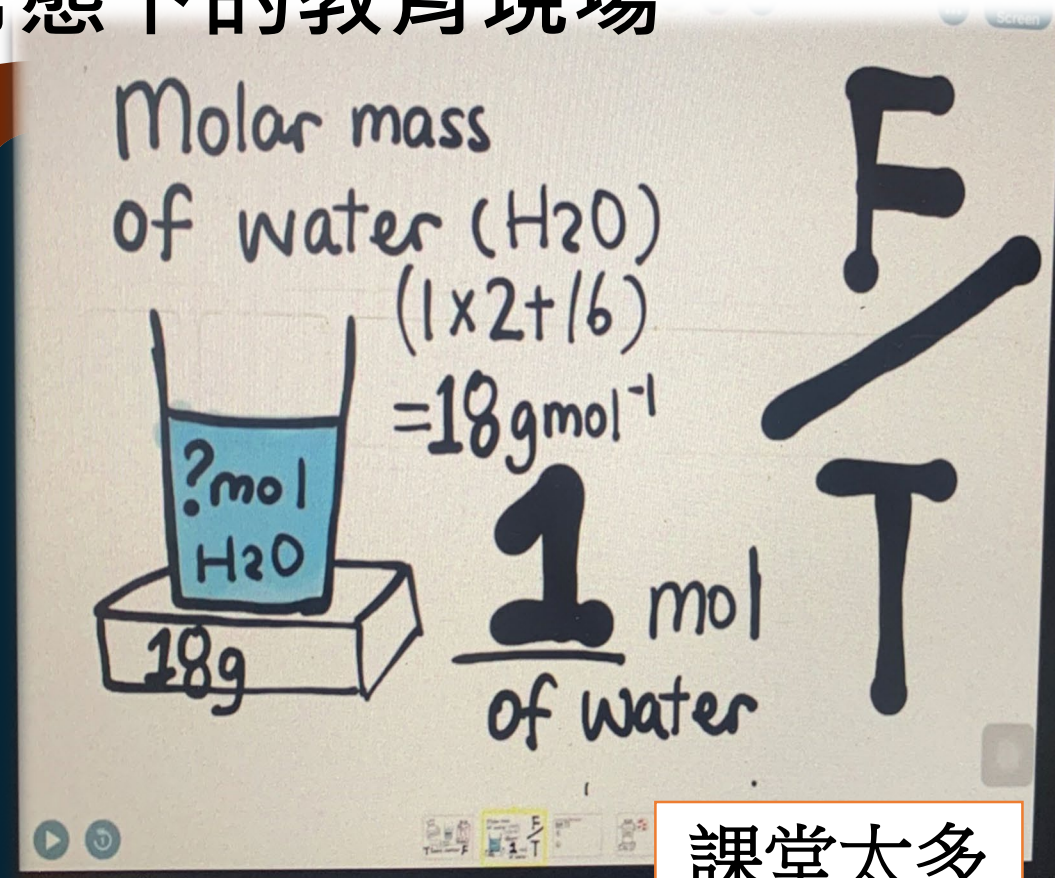
4. SAMR X TPACK

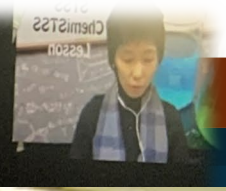


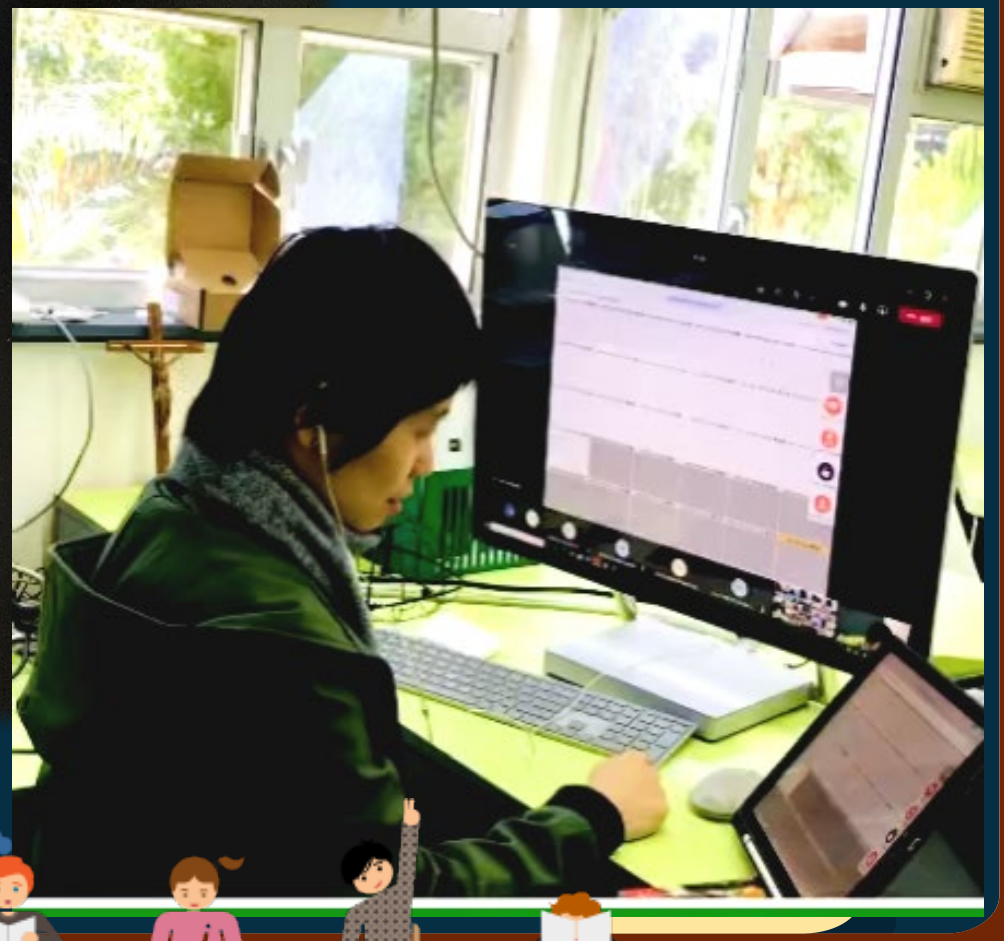
The SAMR model provides hierarchal structure for the learning outcomes. While the TPACK model provides the competence for teachers to integrate technology, pedagogy and content skills within the SAMR hierarchy.

https://youtu.be/SC5ARwUkVQg

新常態下的教育現場





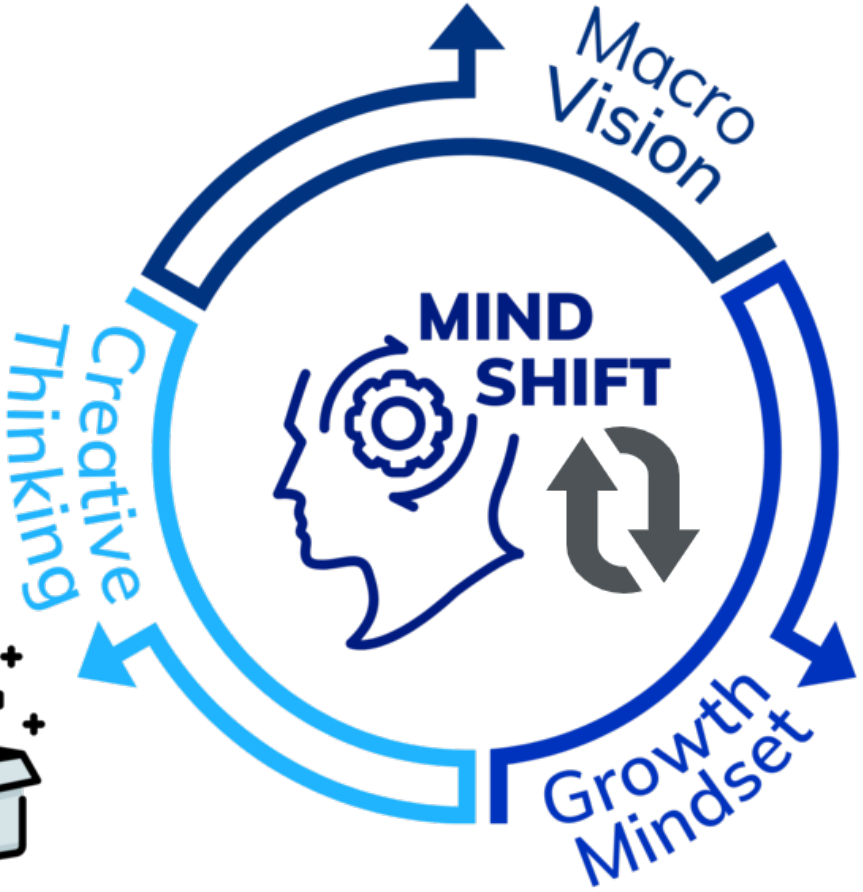


課堂太多
單向教學

內容太抽象

後疫時代
新常態

為未來而教



創新/創意
思維

不斷學習

-John Spencer

學生主導學習

Take Ownership of their learning

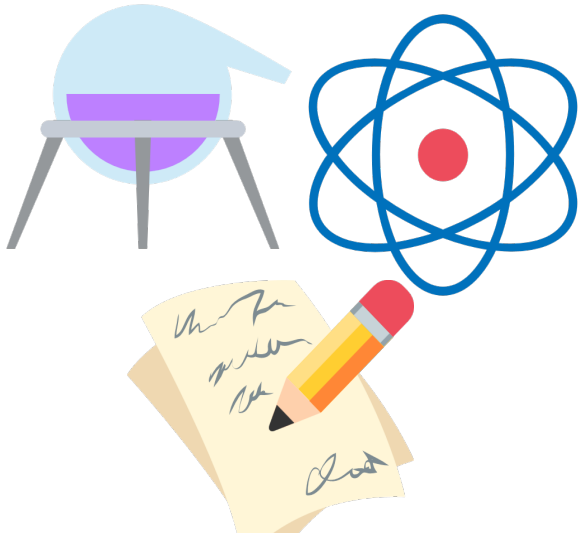
II

信念 → 設計

Believe → Design

如何推動多元化學習及評估學生的學習表現?

理科
知識+技能+態度
A.S.K

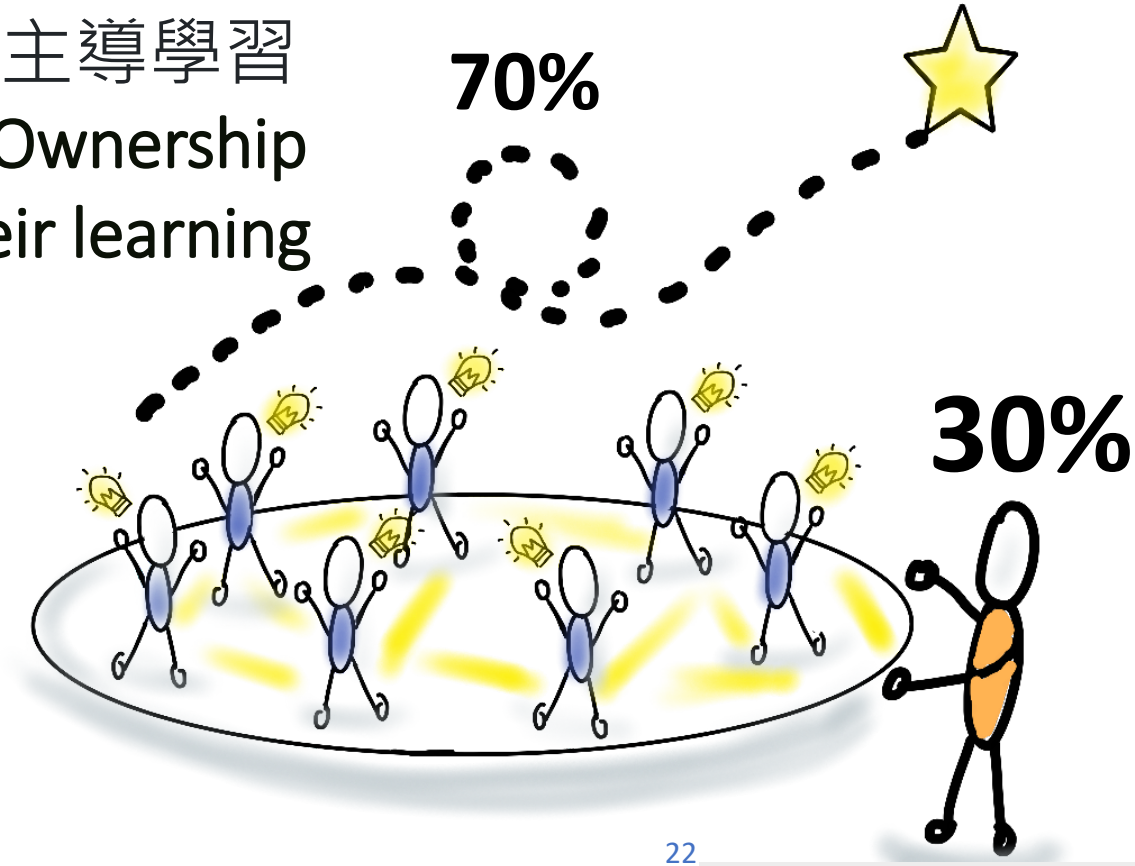


科本(英文)生字/定義
讀寫能力
Rac/Lac

多元化方式
進展性評估
(e.g. STEAM活動)

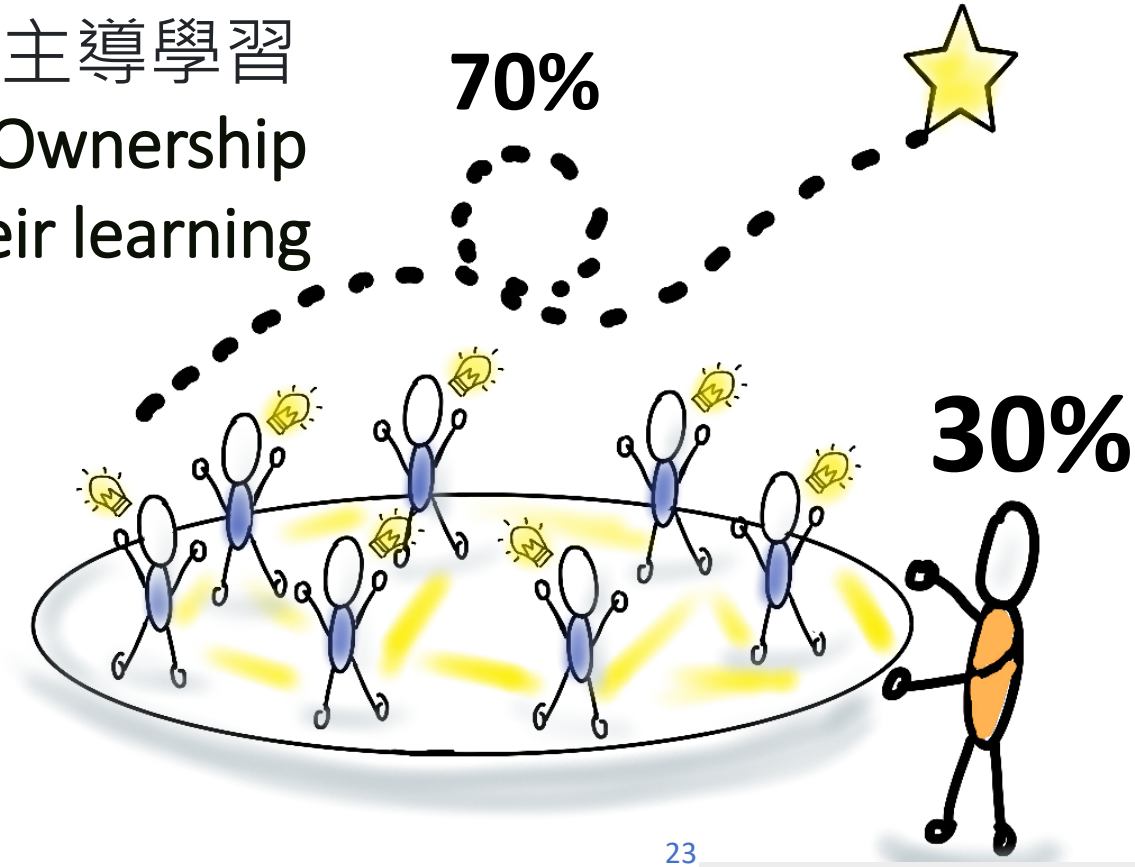
推動多元化學習
如何從教學中協助學生建構知識及
評估學生的學習表現?

學生主導學習
Take Ownership
of their learning



老師作為引導者 (Facilitator)
→不再是單向教授知識

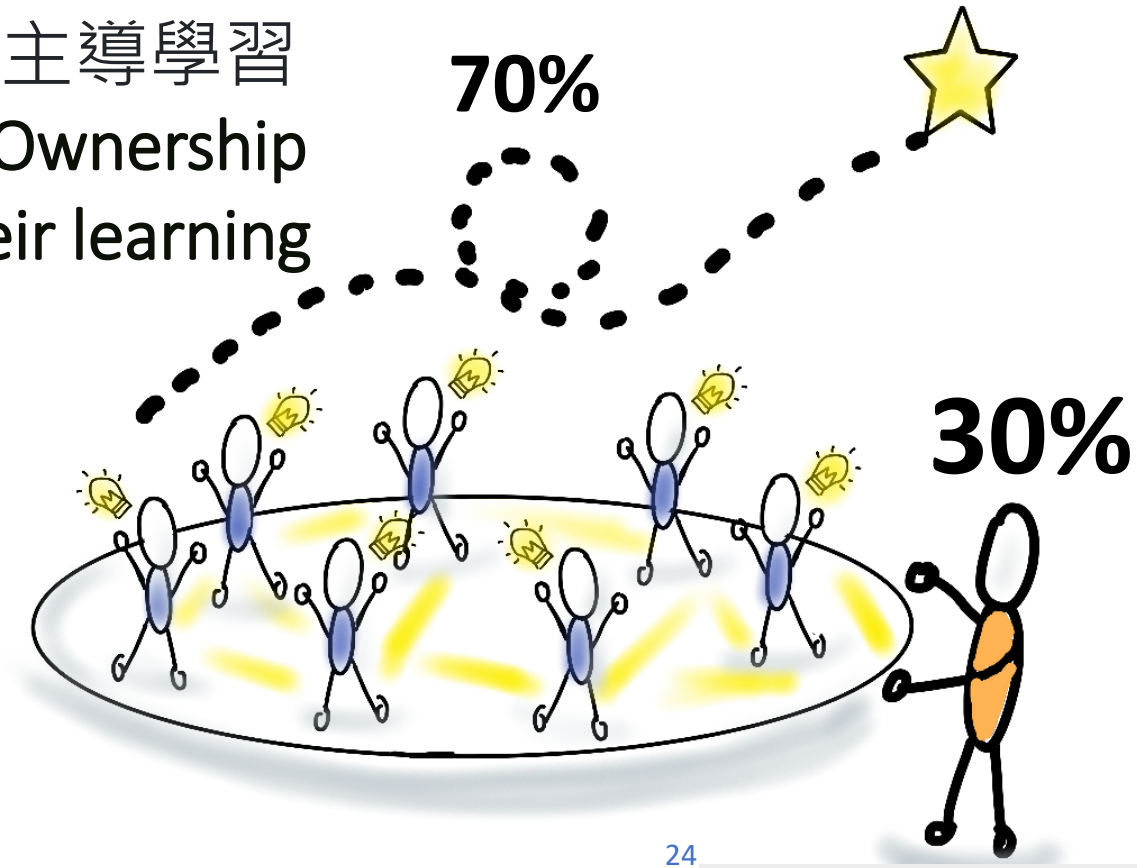
學生主導學習
Take Ownership
of their learning



!?
HOW ?

老師作為引導者 (Facilitator)
→不再是單向教授知識

學生主導學習
Take Ownership
of their learning



以視覺化的方式
引導學生思考

老師作為引導者 (Facilitator)
→不再是單向教授知識

學與教的設計 Learning and Teaching Design

- Ownership of learning
- Voice & Choice

&

- Active participation

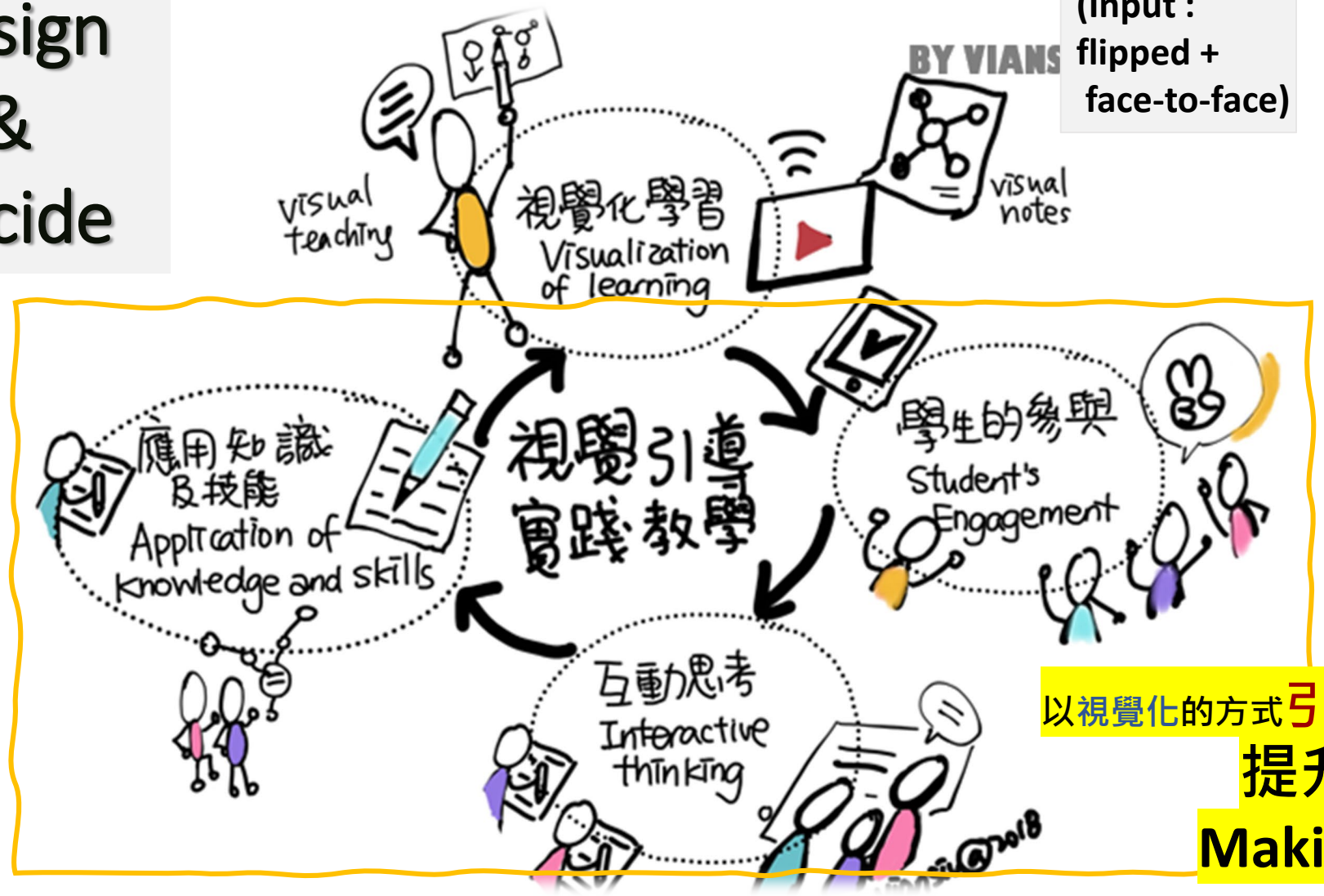
-Engaging Thinking

學與教的設計 Learning and Teaching Design

Design & Decide

30%

(Input : flipped + face-to-face)



70%

(Output : games, WS, takenote projects)

以視覺化的方式引導學生思考

提升教室的互動

Making Learning Visible

推動多元化學習
從教學中協助學生建構知識
及評估學生的學習表現

*有效運用科技及電子資源

1. 設計+配合課題活動
2. 選擇合適電子資源/工具
3. 評估學習表現的工具

為了什麼評估學生學習表現?

測試
教學方式

啟動
學生學習動機

了解學生對
知識點掌握/理解

照顧
學生學習多樣性

如何推動多元化學習

選擇合適線上(評估)工具

評估學習表現的設計

1. 設計+配合課題活動

以科學科為例

- 量性與質性

評估學生學習表現

基本教學重點 → 實時互動 → 學習筆記 → 傳統操練(功課) → 創意功課/回饋 → 線上/傳統測試

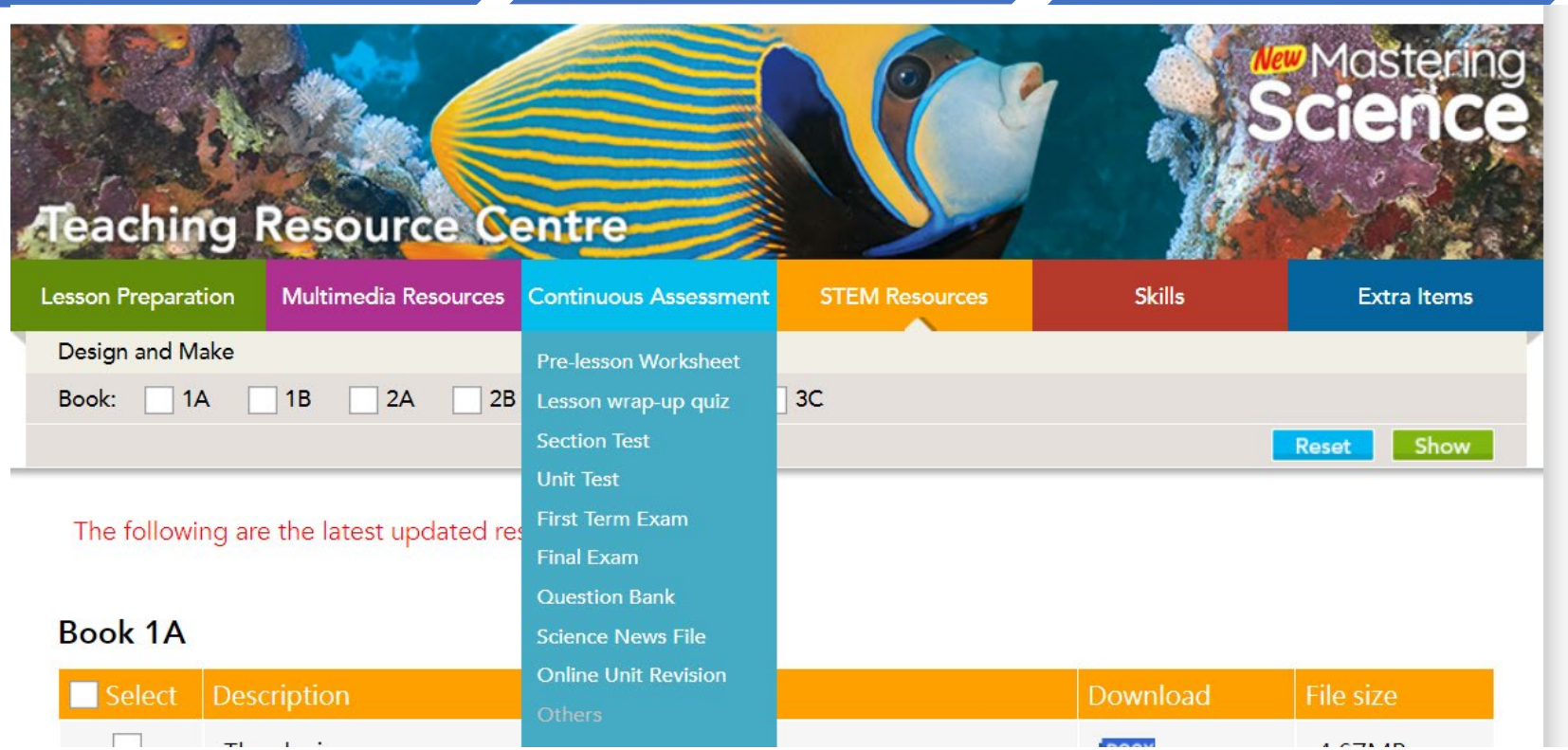
面授? 線上?

2. 選擇合適電子資源+ 工具

測試學生對知識點理解

啟動學生學習動機

掌握學生學習表現

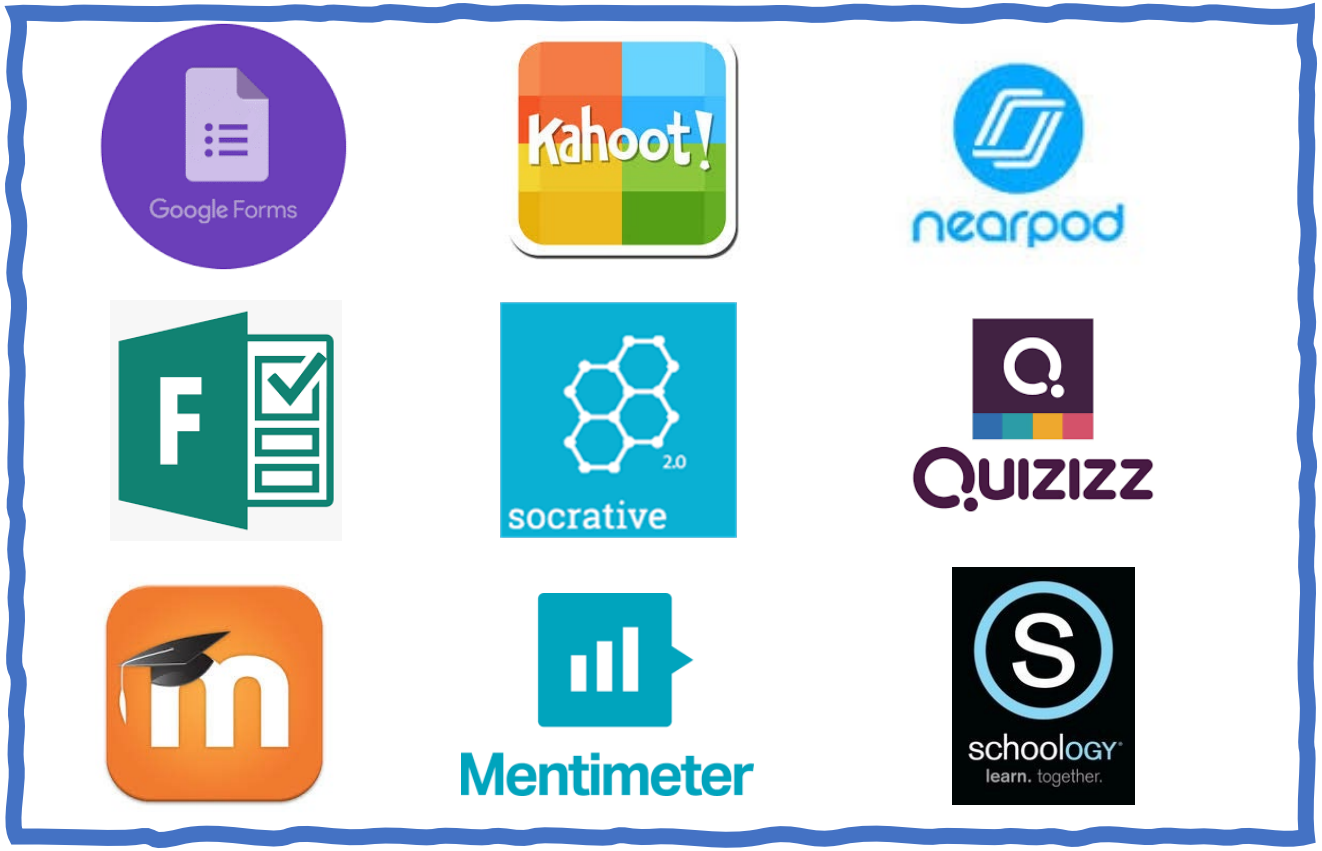


多元教學資源

2. 選擇合適電子資源/工具

測試學生對知識點理解 → 啟動學生學習動機 → 掌握學生學習表現

量性評估學習表現的工具



形式: MC/填圖/TF/有標準答案

目標:評估**基礎知識**

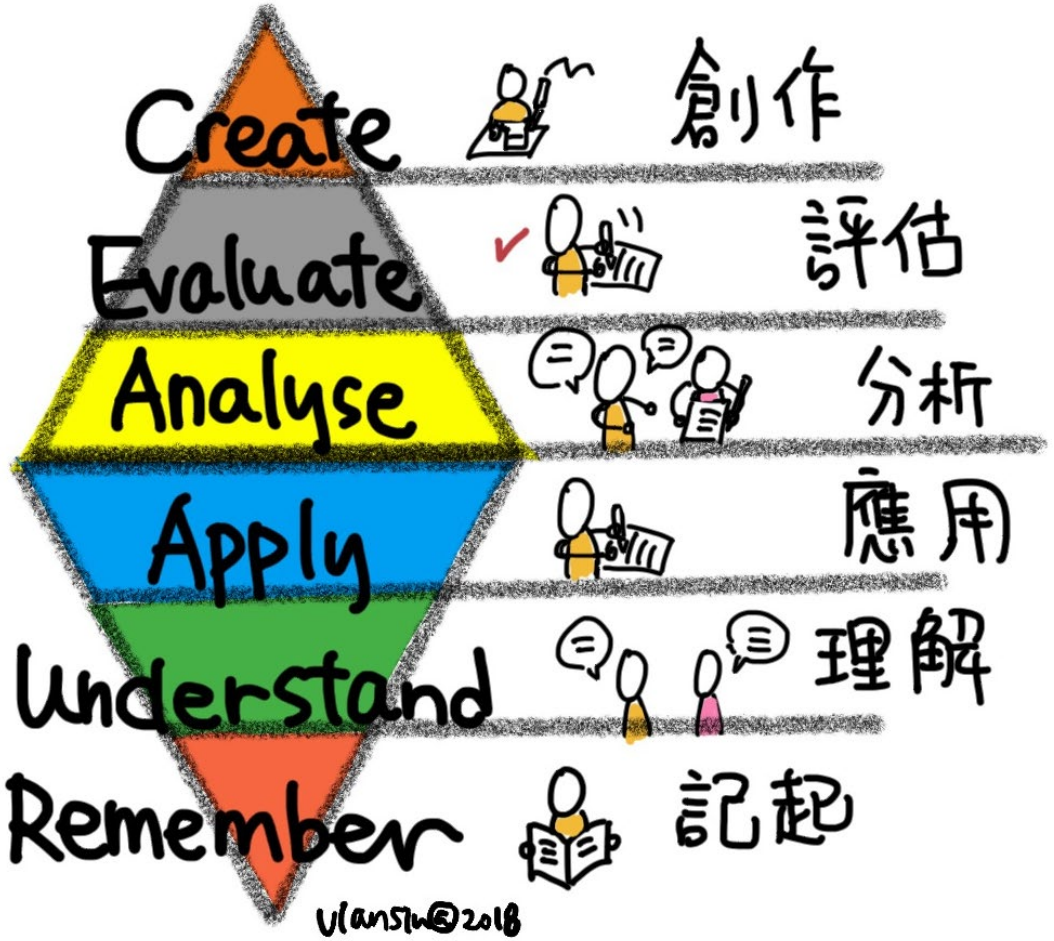
- **了解/考核學生**對課題理解情況

功能:

- 即時聯繫學生
- 直接 • 簡單
- 自動批改
- 數據收集

Kendle, A., & Northcote, M. (2000). The struggle for balance in the use of quantitative and qualitative online assessment tasks.

Bloom's Taxonomy Flipped



2. 選擇合適電子資源/工具

測試學生對知識點理解 → 啟動學生學習動機 → 掌握學生學習表現

質性評估學習表現的工具

形式:開放式問題/任務
個人選擇

目標:
-評估個別學生對內容的理解
-鼓勵創意回饋

功能:

- 可供空間讓學生展示所學
- 多功能/易用/創意
- 老師可批改/回饋
- 同儕交流

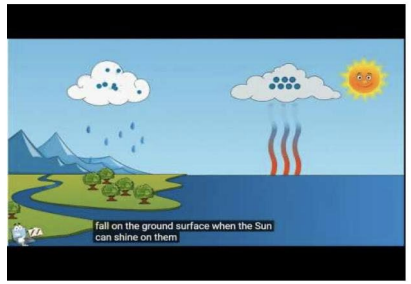
Kendle, A., & Northcote, M. (2000). The struggle for balance in the use of quantitative and qualitative online assessment tasks.

持續性評估設計 以科學科為例

基本教學重點 | 實時互動 | 學習筆記 | 傳統操練(功課) | 創意功課/回饋 | 線上/傳統測試

Google Forms

eaching part of the water cycle. (請各位同學要看教學影片!! 重點係學!!!! 唔止係完成功課!!!)



Which of the following is NOT a process in the water cycle? *

- boiling
- transportation
- condensation
- evaporation

What is the process that occurs when water changes from a liquid to a gas, c
energy from the sun?

Short answer text

Which of the following is NOT a process in the water cycle? *

- boiling
- transportation
- condensation
- evaporation

What is the process that occurs when water changes from a liquid to a gas, caused by heat energy from the sun? *

Short answer text

設計配合課題活動

線上持續性評估設計

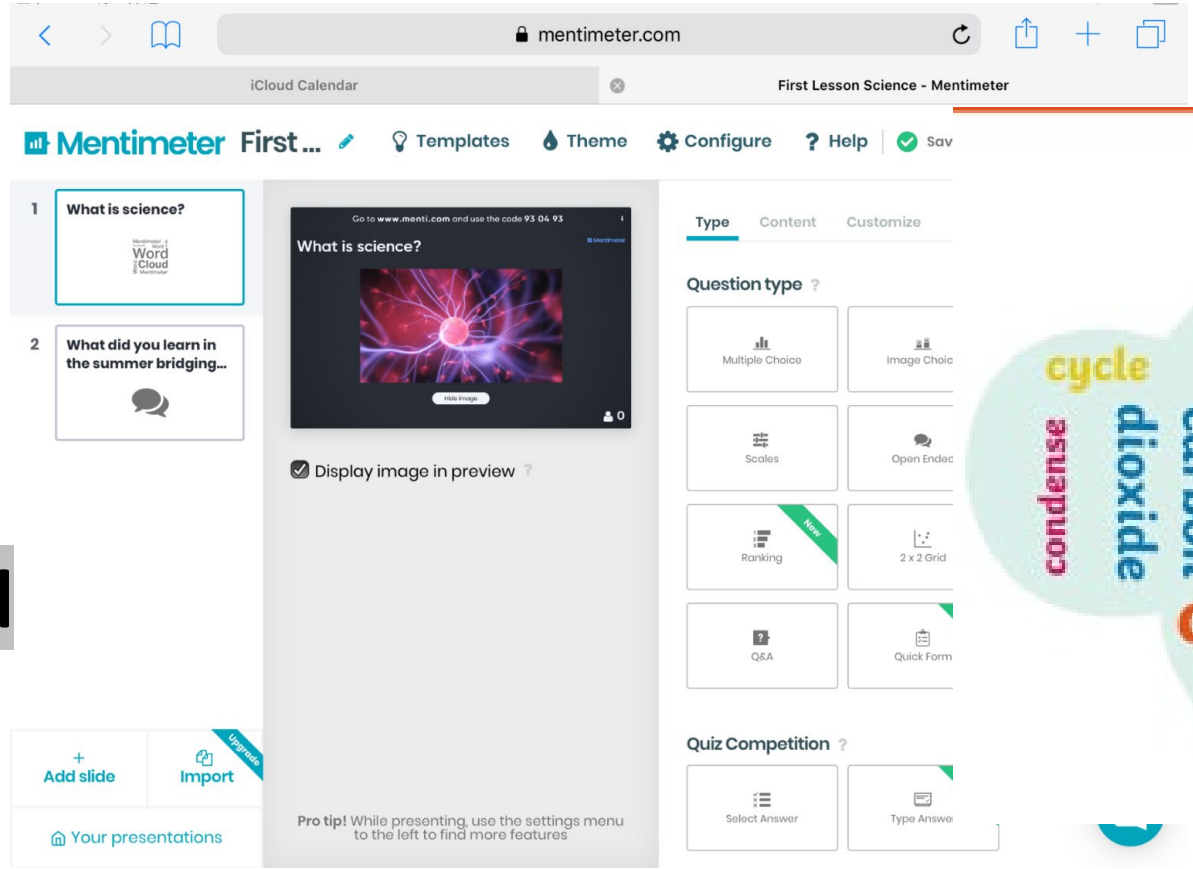
以科學科為例

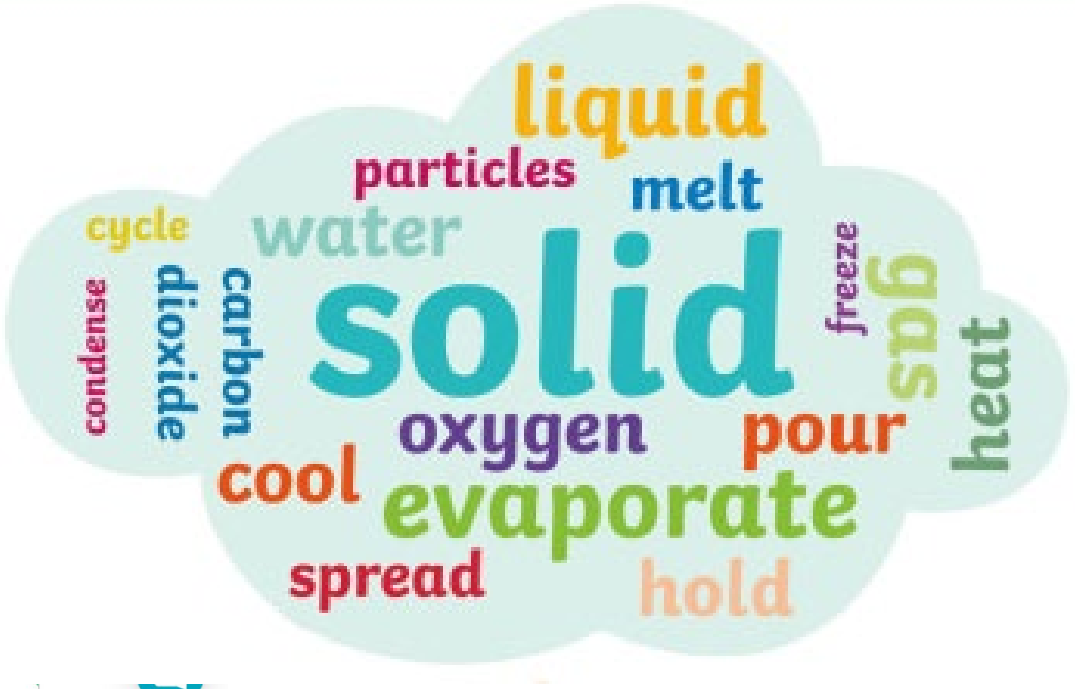
基本教學重點 → 實時互動 → 學習筆記 → 傳統操練(功課) → 創意功課/回饋 → 線上/傳統測試

Mentimeter

Word Cloud

Picture Cloud

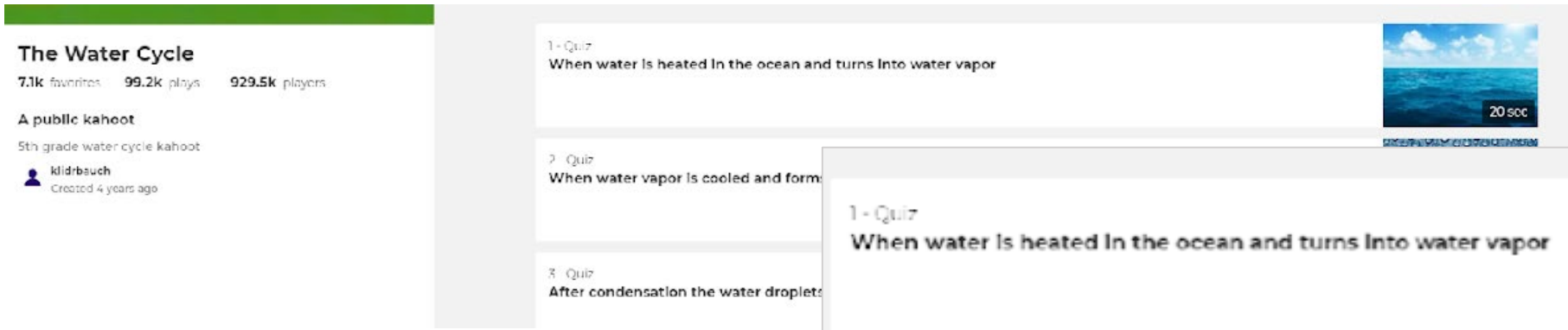




持續性評估設計 以科學科為例

基本教學重點 → **實時互動** → 學習筆記 → 傳統操練(功課) → 創意功課/回饋 → 線上/傳統測試

Kahoot!



Mentimeter

Google Forms

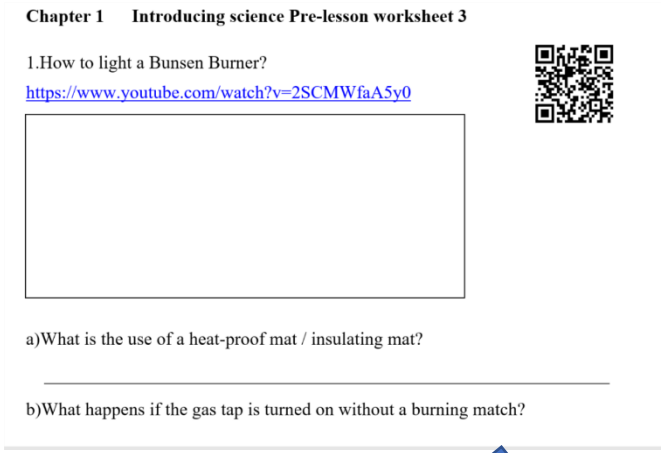
1 - Quiz
When water is heated in the ocean and turns into water vapor

2 Quiz
When water vapor is cooled and forms droplets-

3 Quiz
After condensation the water droplets fall to the Earth in different forms of-

持續性評估設計 以科學科為例

基本教學重點 → **實時互動** → 學習筆記 → 傳統操練(功課) → 創意功課/回饋 → 線上/傳統測試



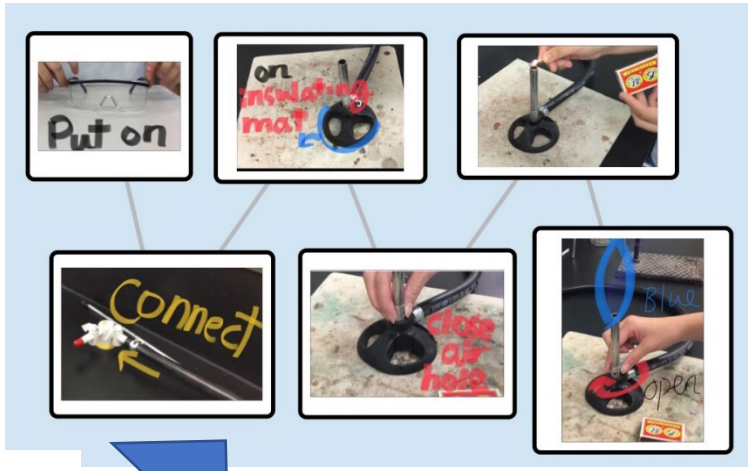
Chapter 1 Introducing science Pre-lesson worksheet 3

1.How to light a Bunsen Burner?

https://www.youtube.com/watch?v=2SCMWfaA5y0

a)What is the use of a heat-proof mat / insulating mat?

b)What happens if the gas tap is turned on without a burning match?



Lighting up Bunsen Burner

Ch 1 how to light a Bunsen Burner (2017-1A2)

https://youtu.be/tEtmxVhLhsc

https://youtu.be/AoX3aOIOQ78

SCHOOL

LOiLONOTE SCHOOL

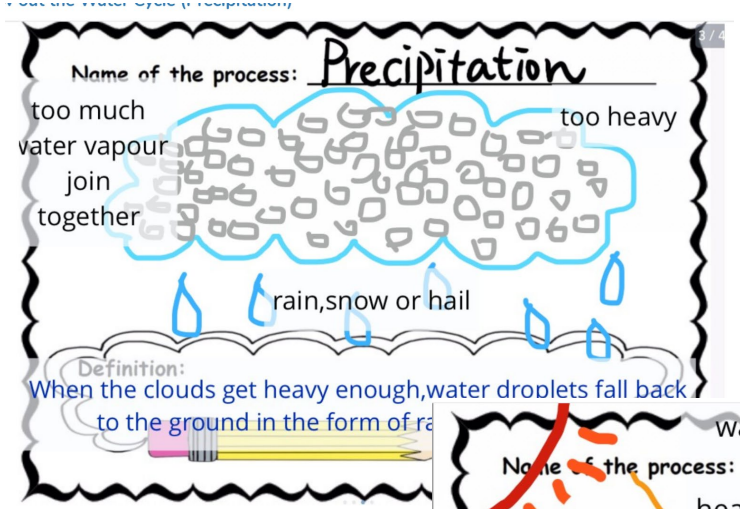
持續性評估設計 以科學科為例

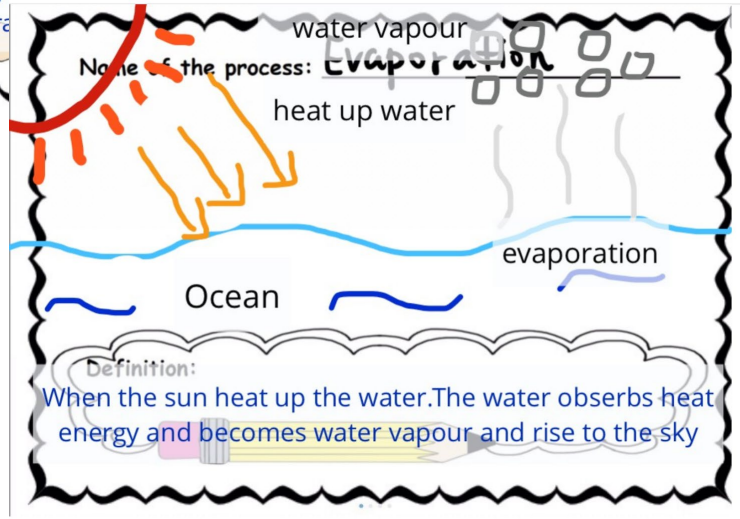
基本教學重點 → 實時互動 → **學習筆記** → 傳統操練(功課) → 創意功課/回饋 → 線上/傳統測試

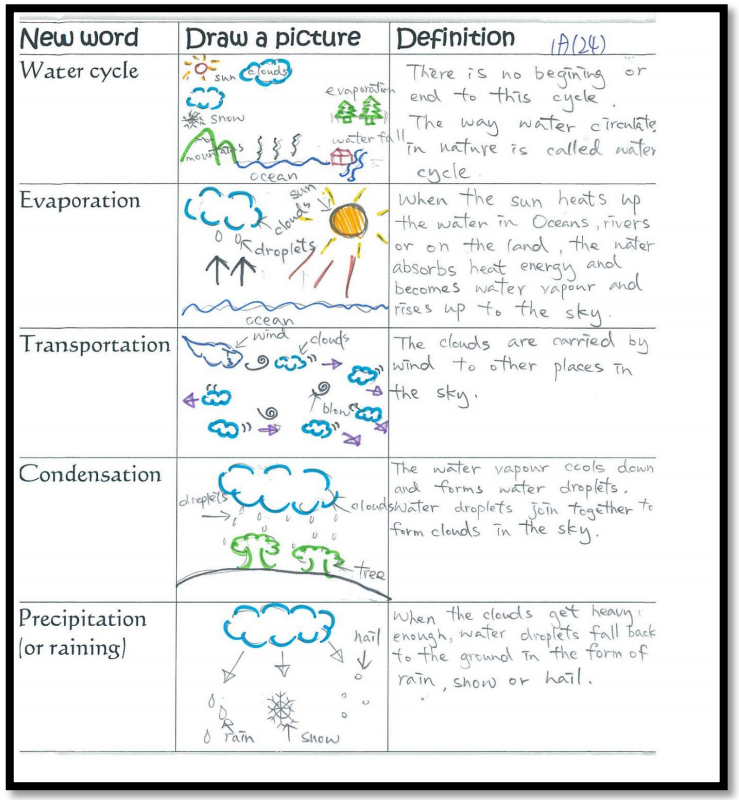
padlet

Seesaw

LOiLONOTE SCHOOL



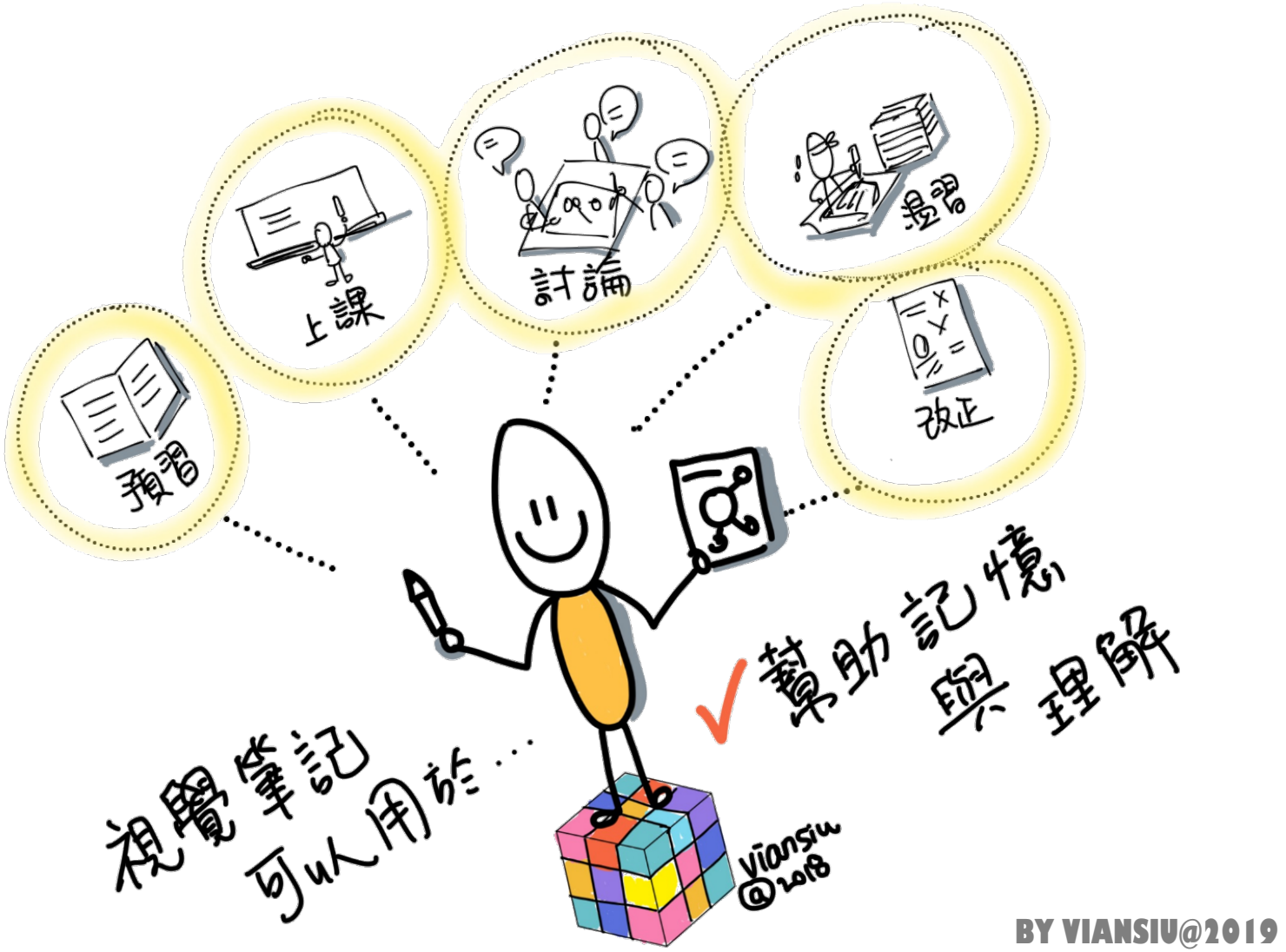




New word	Draw a picture	Definition
Water cycle		There is no begining or end to this cycle. The way water circulate in nature is called water cycle.
Evaporation		When the sun heats up the water in Oceans, rivers or on the land, the water absorbs heat energy and becomes water vapour and rises up to the sky.
Transportation		The clouds are carried by wind to other places in the sky.
Condensation		The water vapour cools down and forms water droplets. Water droplets join together to form clouds in the sky.
Precipitation (or raining)		When the clouds get heavy enough, water droplets fall back to the ground in the form of rain, snow or hail.

學生在學習過程中如何運用

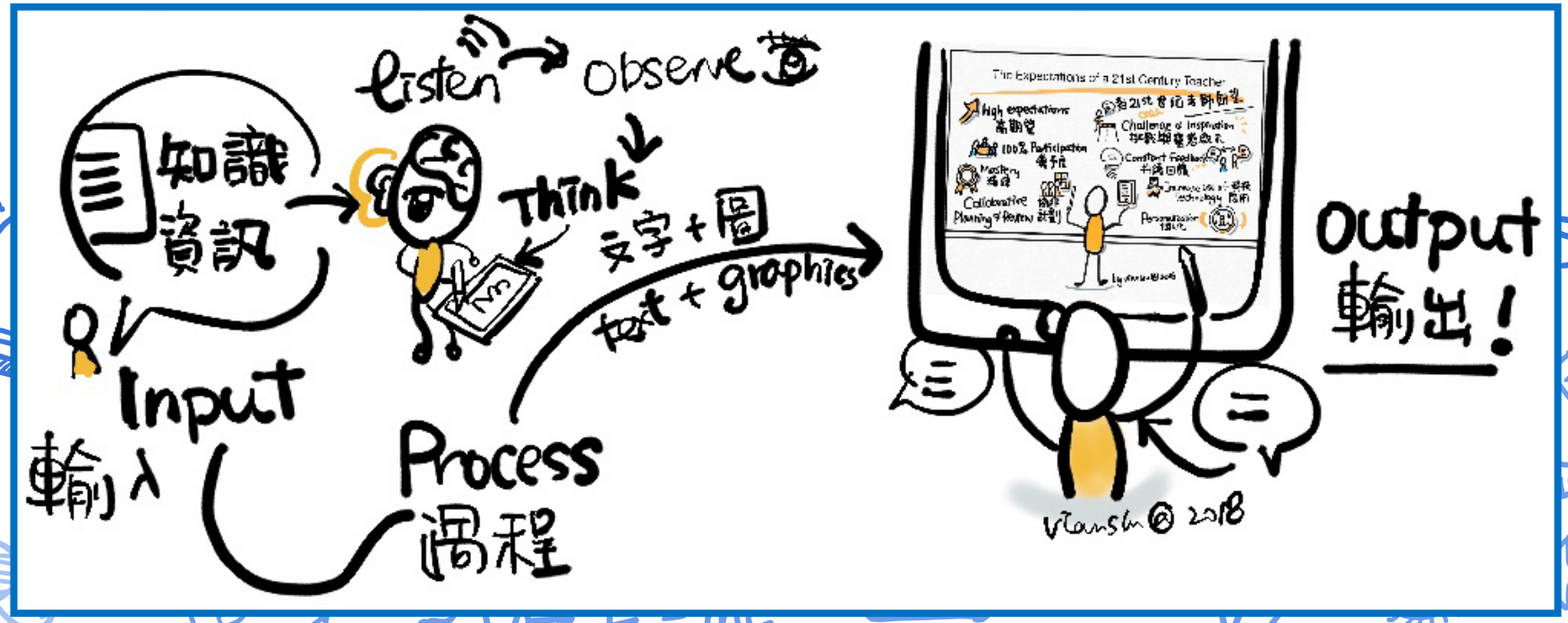
視覺筆記



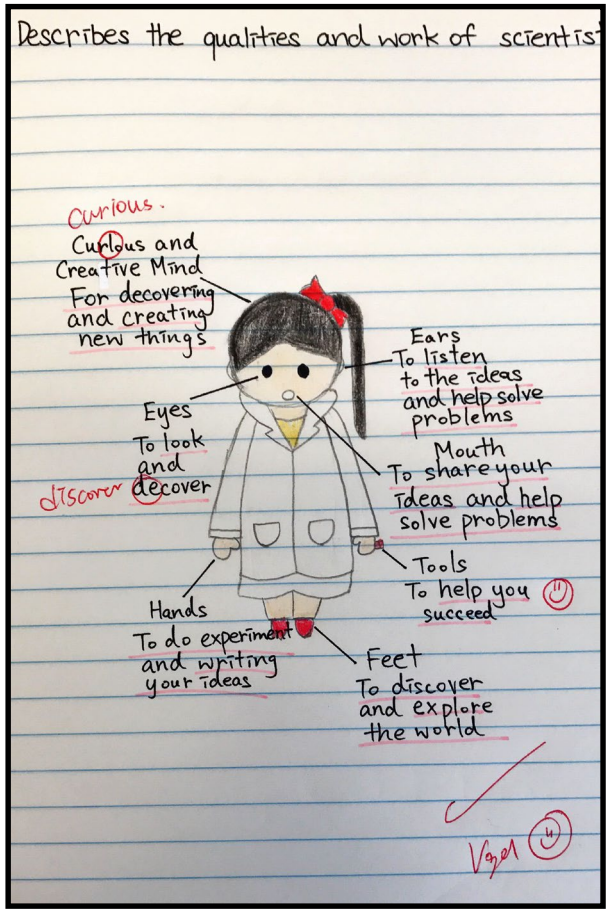
BY VIANSIU@2019

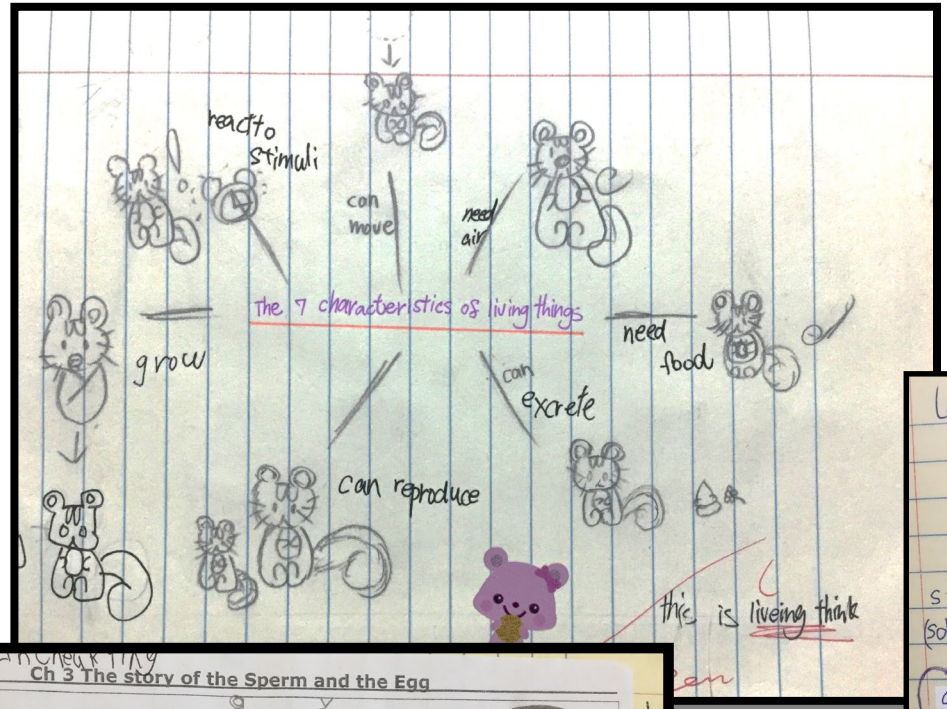
視覺學習筆記Visual-sketch Notes

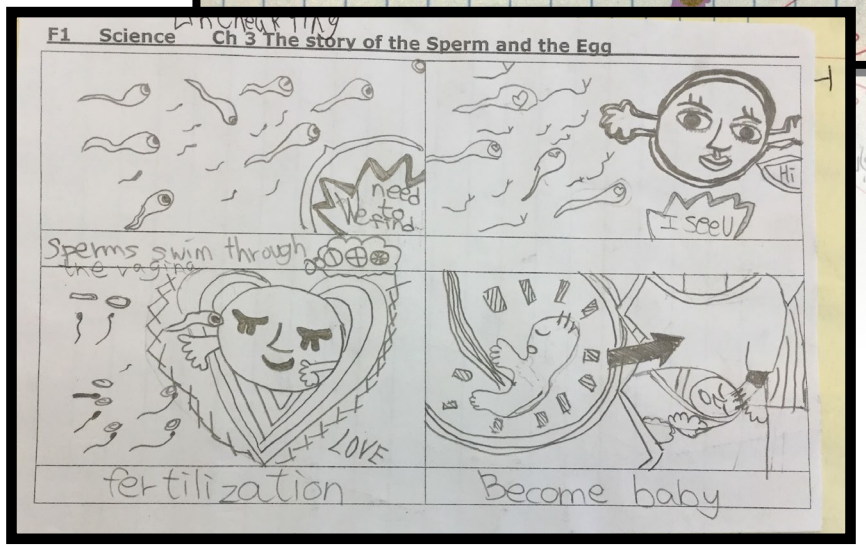
學習策略 Learning Strategies

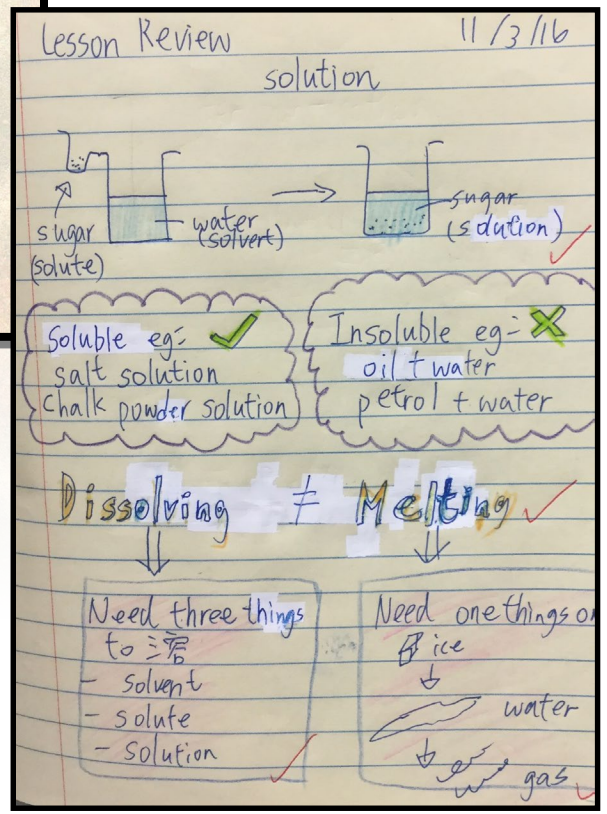


學生的視覺筆記-課堂回顧
Visual Lesson View

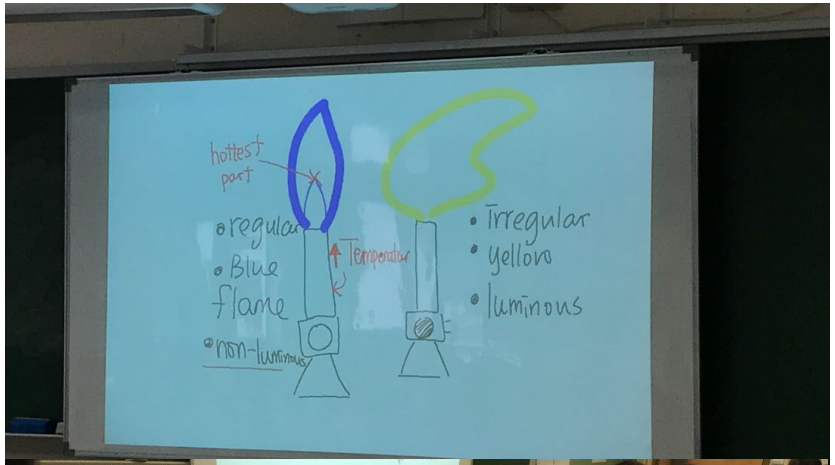


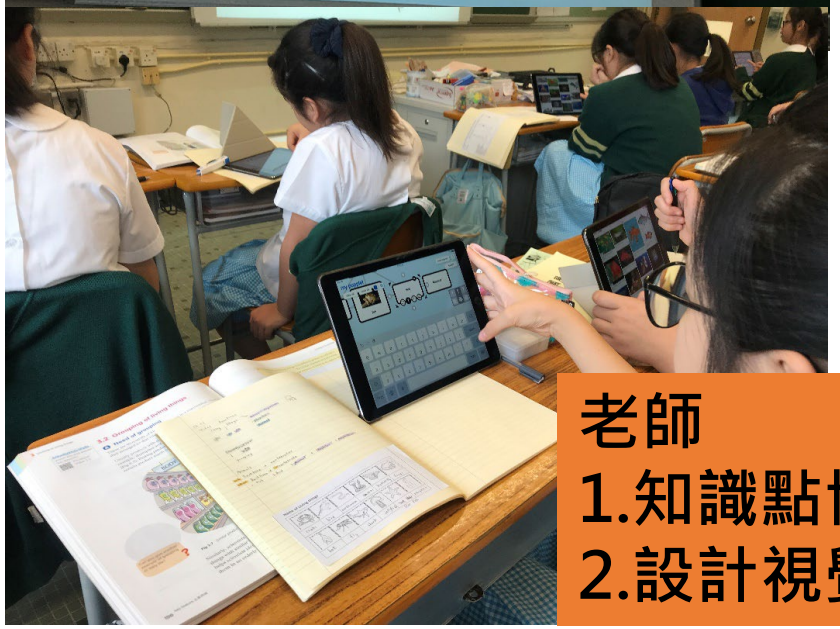


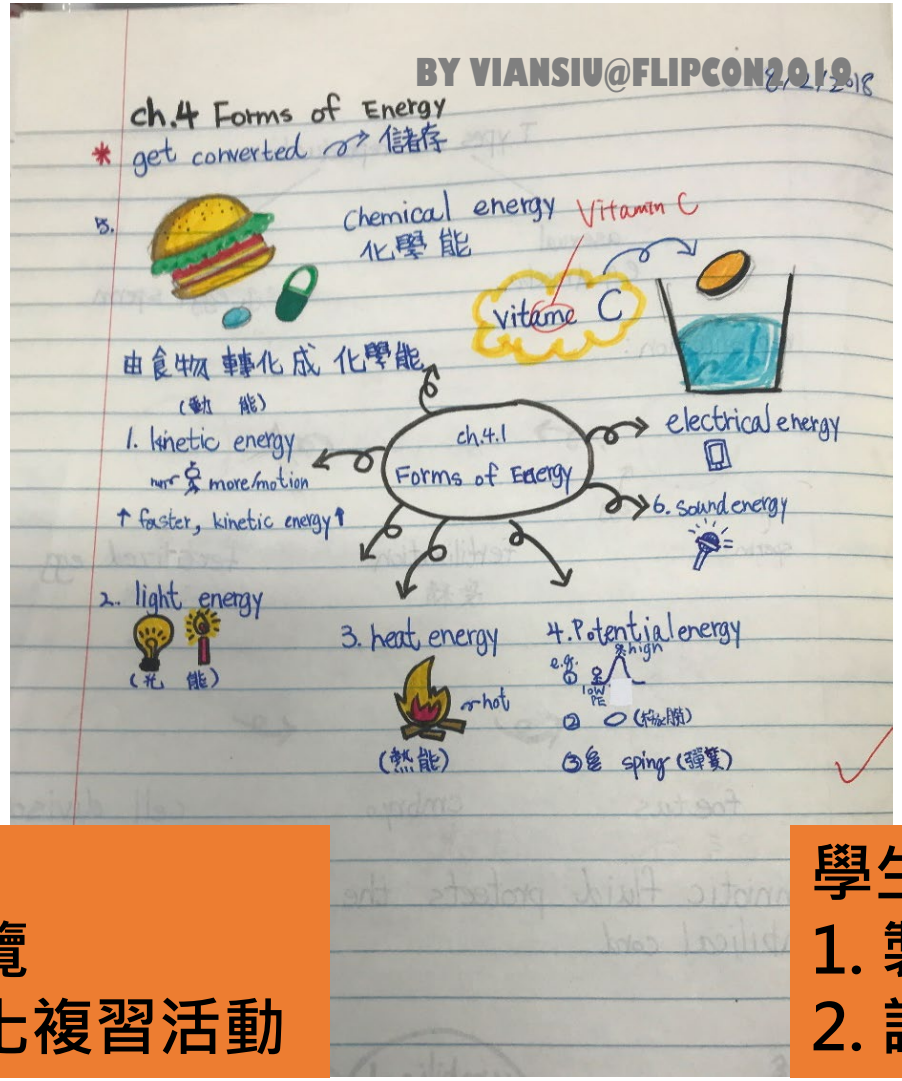




視覺筆記在教學中的應用-科學科

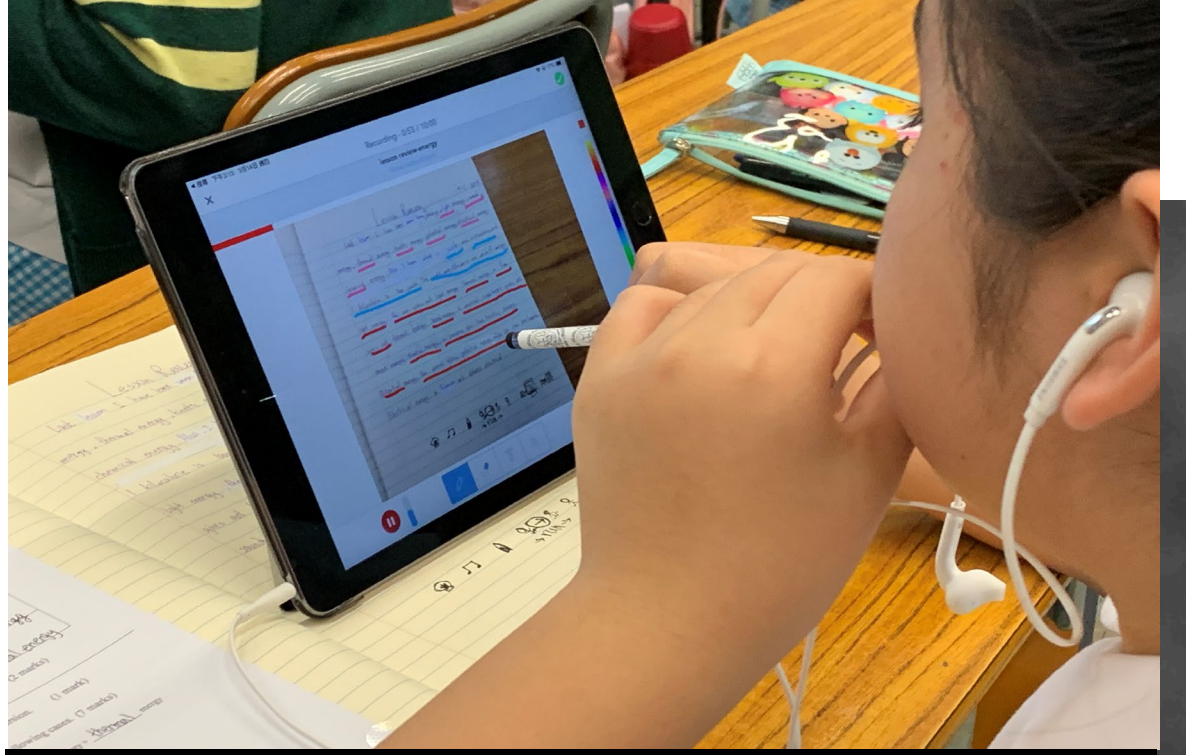


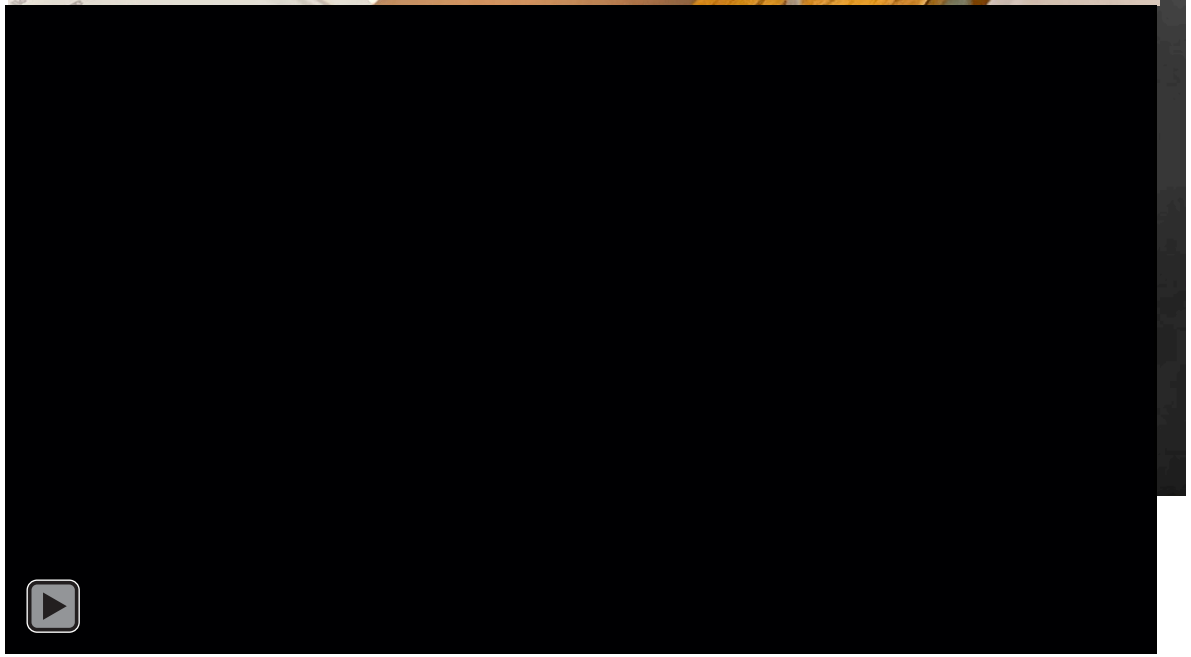




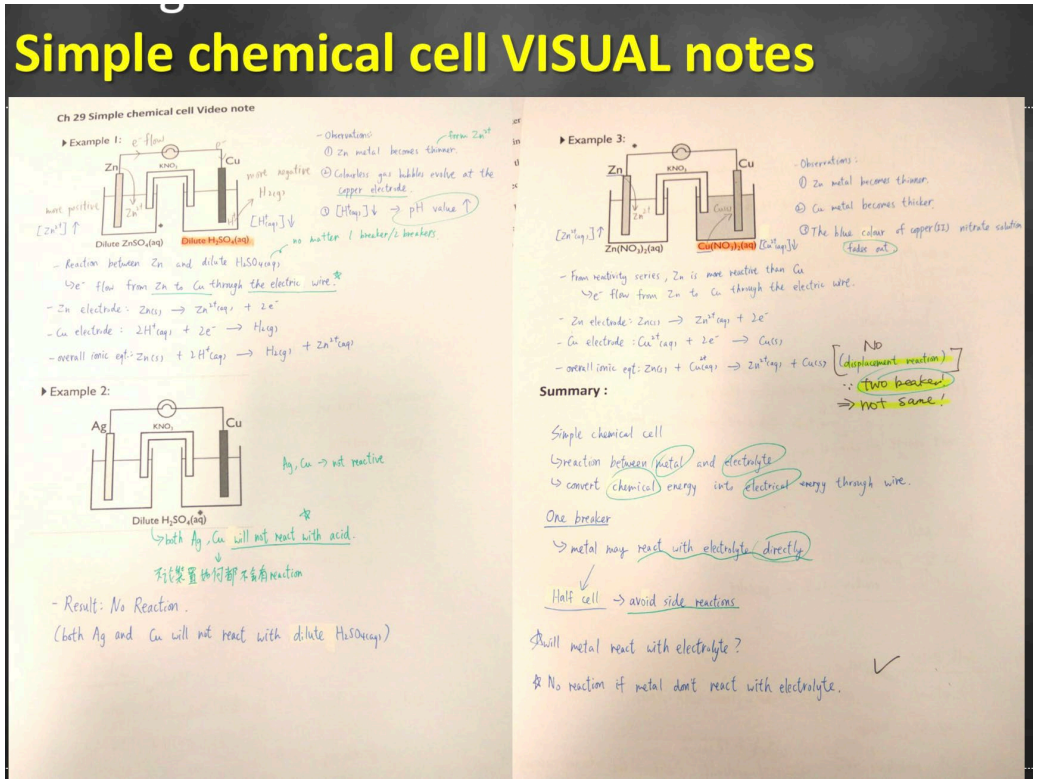
老師
1.知識點博覽
2.設計視覺化複習活動

學生
1. 製作視覺化筆記
2. 課堂回顧





Simple chemical cell VISUAL notes



Ch 29 Simple chemical cell Video note

▸ Example 1:

Zn | KNO3 | Cu

Dilute $ZnSO_4$(aq) | Dilute H_2SO_4(aq)

- Observations:
  ① Zn metal becomes thinner. (from Zn^{2+})
  ② Colourless gas bubbles evolve at the copper electrode. (H_2(g))
  ③ $[H^+_{(aq)}]\downarrow$ → pH value ↑
- Reaction between Zn and dilute H_2SO_4(aq)
  ↳ e^- flow from Zn to Cu through the electric wire.*
- Zn electrode: $Zn_{(s)} \rightarrow Zn^{2+}_{(aq)} + 2e^-$
- Cu electrode: $2H^+_{(aq)} + 2e^- \rightarrow H_{2(g)}$
- overall ionic eqt: $Zn_{(s)} + 2H^+_{(aq)} \rightarrow H_{2(g)} + Zn^{2+}_{(aq)}$

▸ Example 2:

Ag | KNO3 | Cu

Dilute H_2SO_4(aq)

Ag, Cu → not reactive

↳both Ag, Cu will not react with acid.*

不论装置如何都不会有reaction

- Result: No Reaction.
  (both Ag and Cu will not react with dilute H_2SO_4(aq))

▸ Example 3:

Zn | KNO3 | Cu

$Zn(NO_3)_2$(aq) | $Cu(NO_3)_2$(aq)

- Observations:
  ① Zn metal becomes thinner.
  ② Cu metal becomes thicker.
  ③ The blue colour of copper(II) nitrate solution fades out.
- From reactivity series, Zn is more reactive than Cu
  ↳e^- flow from Zn to Cu through the electric wire.
- Zn electrode: $Zn_{(s)} \rightarrow Zn^{2+}_{(aq)} + 2e^-$
- Cu electrode: $Cu^{2+}_{(aq)} + 2e^- \rightarrow Cu_{(s)}$
- overall ionic eqt: $Zn_{(s)} + Cu^{2+}_{(aq)} \rightarrow Zn^{2+}_{(aq)} + Cu_{(s)}$

No (displacement reaction)
∵ two beaker!
⇒ not same!

Summary:

Simple chemical cell
↳reaction between metal and electrolyte
↳convert chemical energy into electrical energy through wire.

One beaker
↳metal may react with electrolyte directly

Half cell → avoid side reactions

*will metal react with electrolyte?

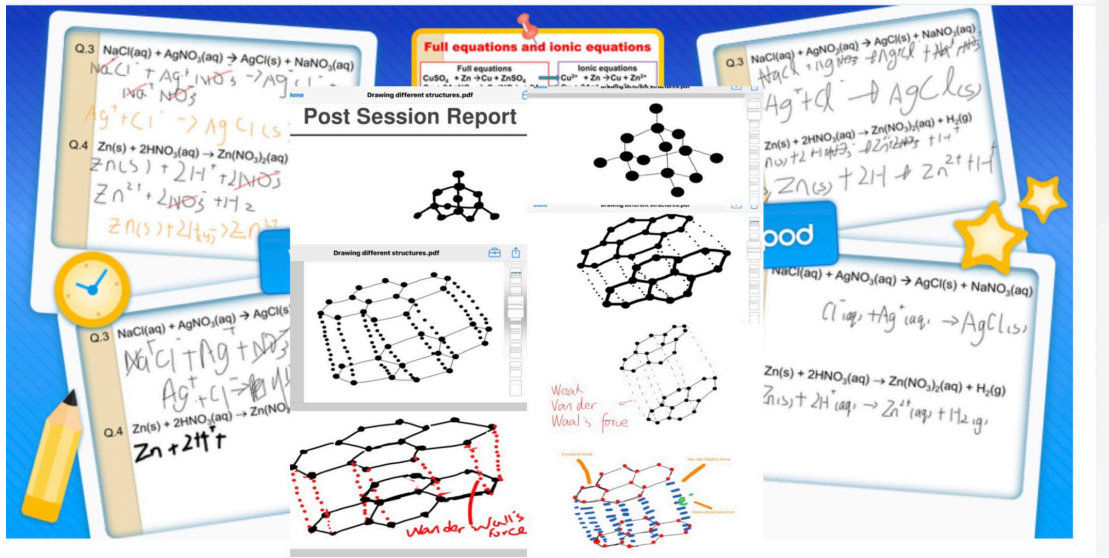
* No reaction if metal don't react with electrolyte.

Apps with drawing

draw it !

Seesaw

nearpod



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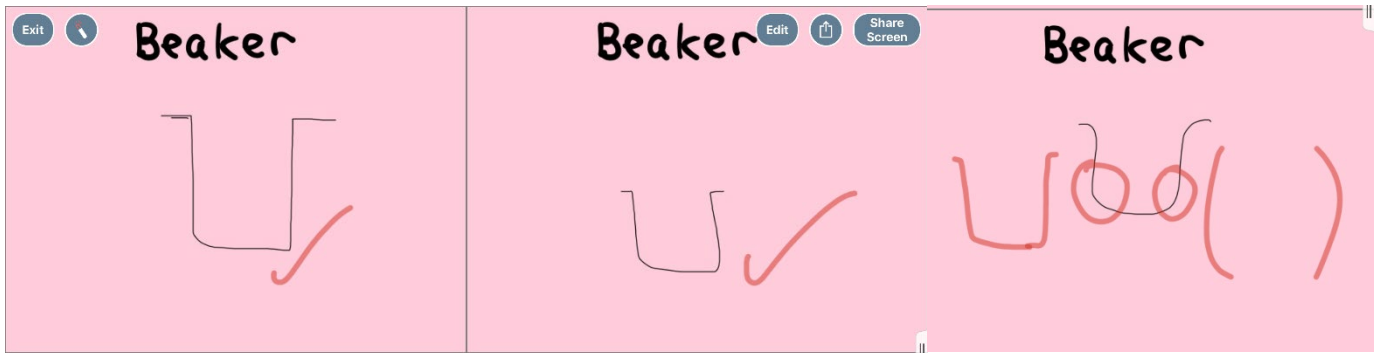
LOiLONOTE SCHOOL



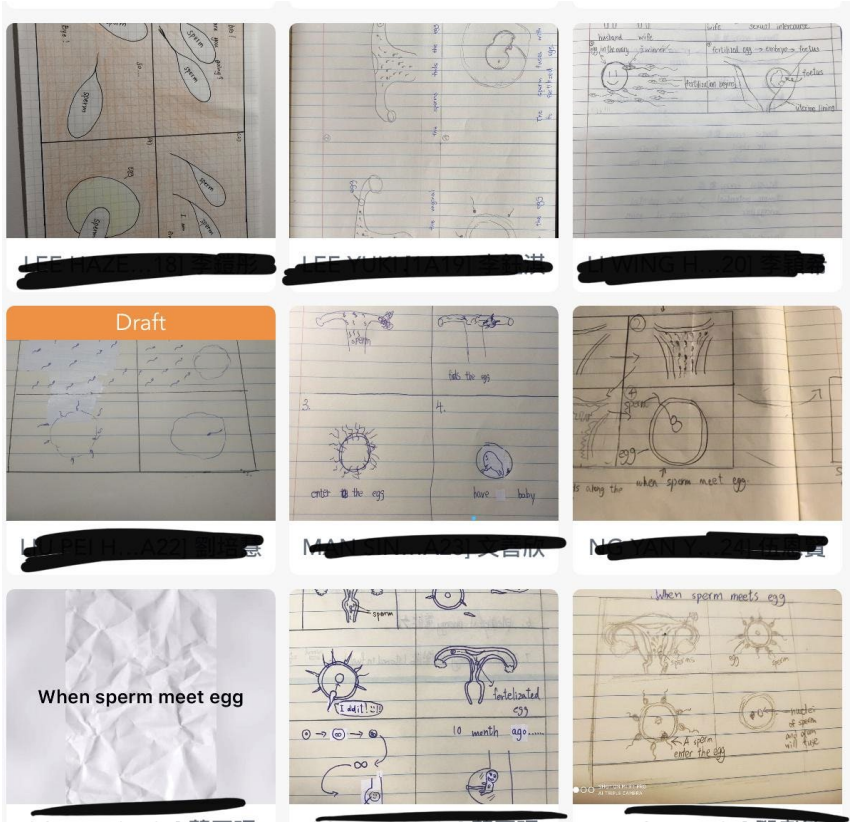
SCHOOL

持續性評估設計 以科學科為例

基本教學重點 → 實時互動 → **學習筆記** → 傳統操練(功課) → 創意功課/回饋 → 線上/傳統測試

padlet

Seesaw



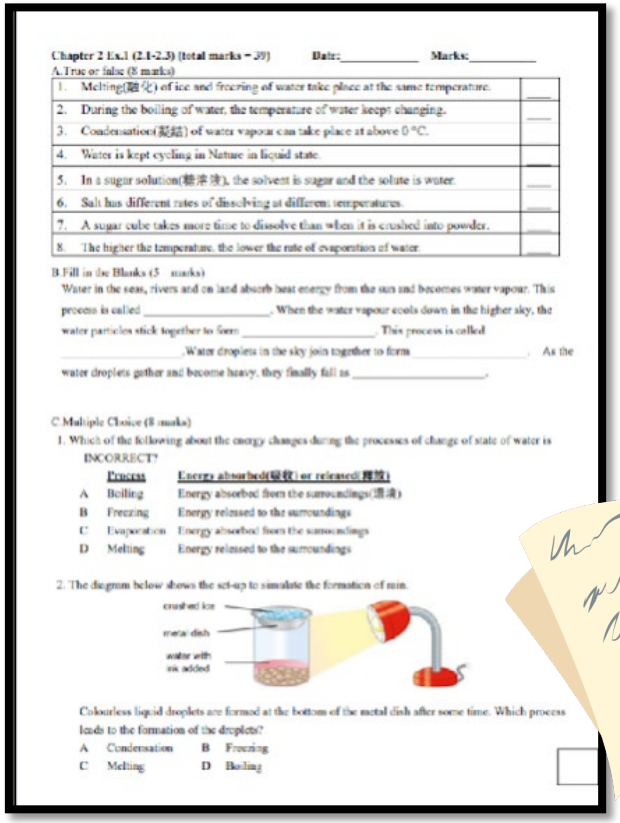
持續性評估設計 以科學科為例

基本教學重點 | 實時互動 | 學習筆記 | **傳統操練(功課)** | 創意功課/回饋 | 線上/傳統測試

LOiLONOTE SCHOOL

Seesaw

Google Classroom



Chapter 2 Ex.1 (2.1-2.3) (total marks = 39) Date:_____ Marks:_____

A. True or false (8 marks)

1.	Melting(融化) of ice and freezing of water take place at the same temperature.	___
2.	During the boiling of water, the temperature of water keept changing.	___
3.	Condensation(凝結) of water vapour can take place at above 0 °C.	___
4.	Water is kept cycling in Nature in liquid state.	___
5.	In a sugar solution(糖水液), the solvent is sugar and the solute is water.	___
6.	Salt has different rates of dissolving at different temperatures.	___
7.	A sugar cube takes more time to dissolve than when it is crushed into powder.	___
8.	The higher the temperature, the lower the rate of evaporation of water.	___

B. Fill in the Blanks (5 marks)

Water in the seas, rivers and on land absorb heat energy from the sun and becomes water vapour. This process is called _____. When the water vapour cools down in the higher sky, the water particles stick together to form _____. This process is called _____. Water droplets in the sky join together to form _____. As the water droplets gather and become heavy, they finally fall as _____.

C. Multiple Choice (8 marks)

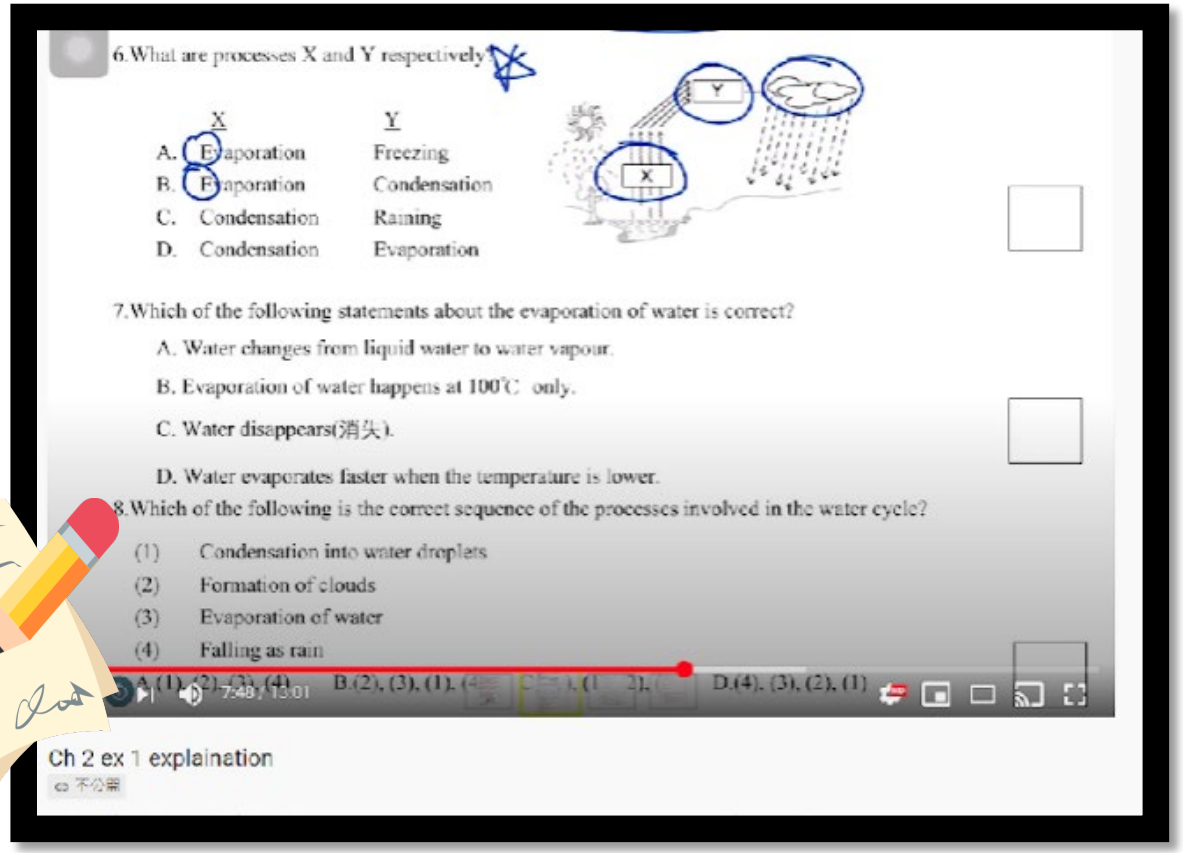
1. Which of the following about the energy changes during the processes of change of state of water is INCORRECT?

	Process	Energy absorbed(吸收) or released(釋放)
A	Boiling	Energy absorbed from the surroundings(環境)
B	Freezing	Energy released to the surroundings
C	Evaporation	Energy absorbed from the surroundings
D	Melting	Energy released to the surroundings

2. The diagram below shows the set-up to simulate the formation of rain.

Colourless liquid droplets are formed at the bottom of the metal dish after some time. Which process leads to the formation of the droplets?

A Condensation B Freezing
C Melting D Boiling



設計配合課題活動

線上持續性評估設計

以中一科學科為例 主題: Water Cycle

基本教學重點 → 實時互動 → 學習筆記 → **傳統操練(功課)** → 創意功課/回饋 → 線上/傳統測試

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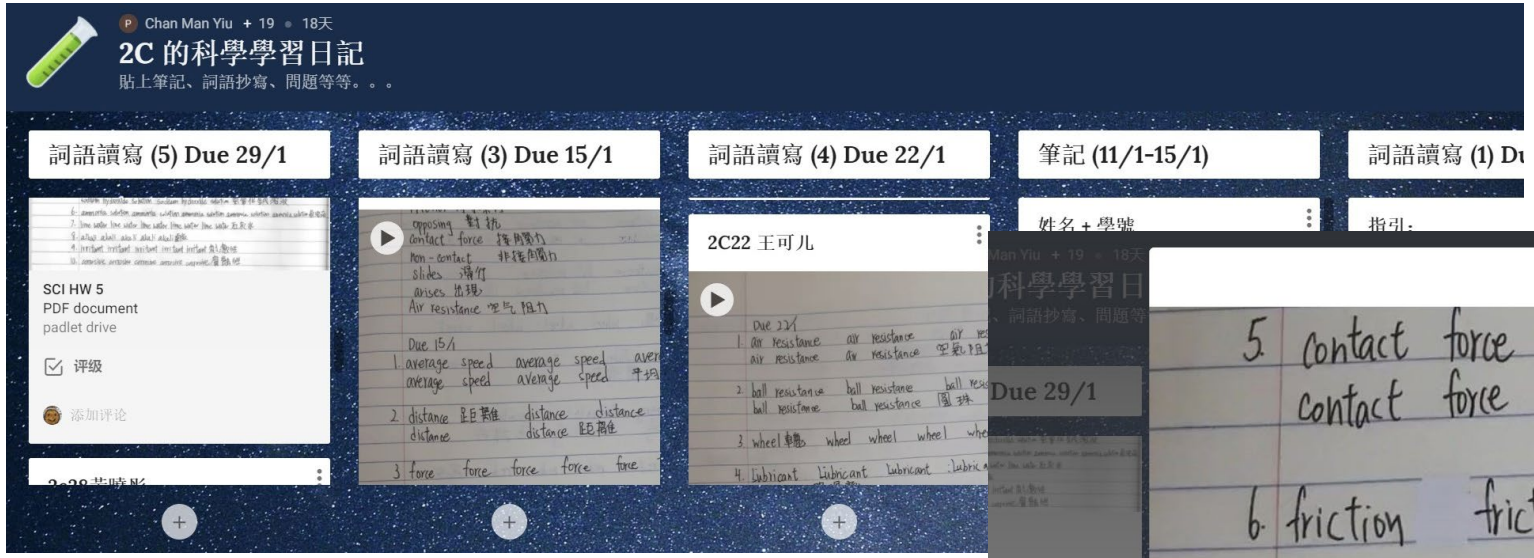
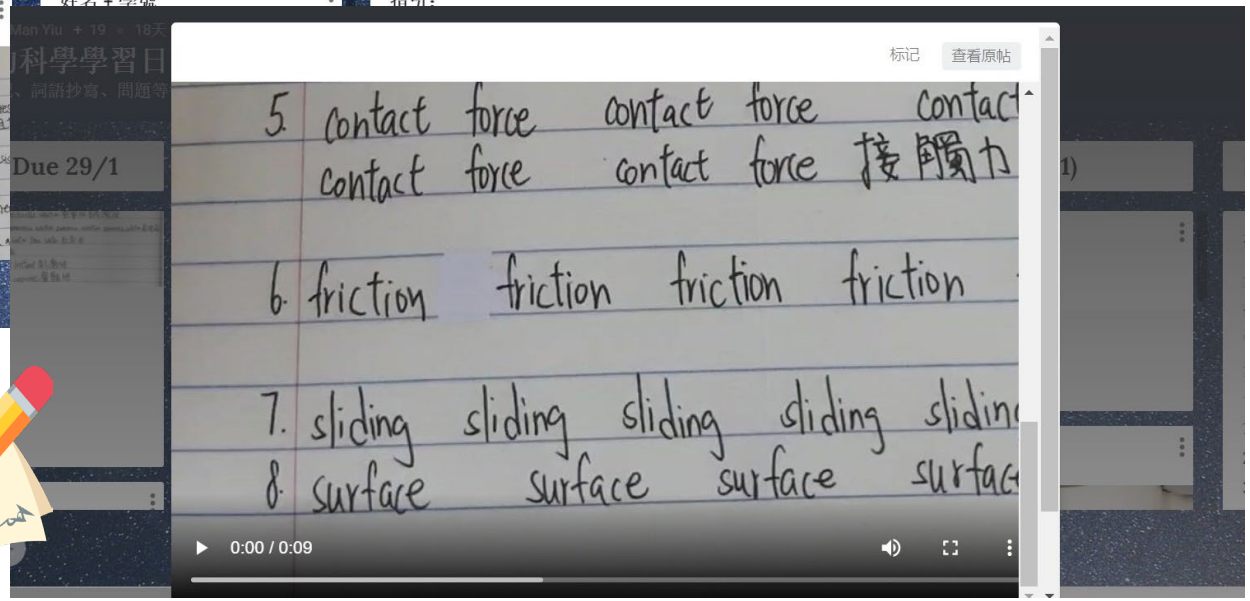


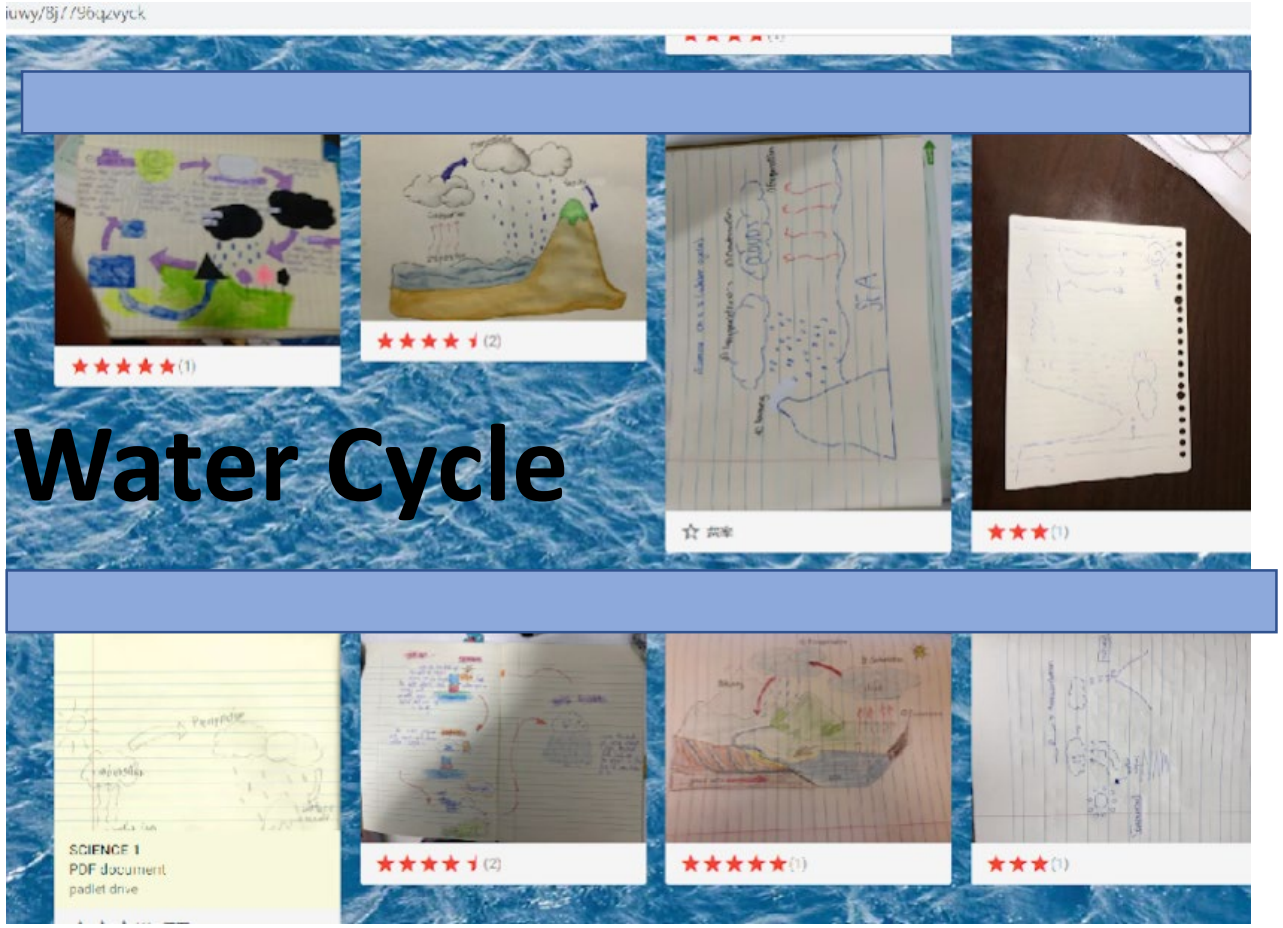


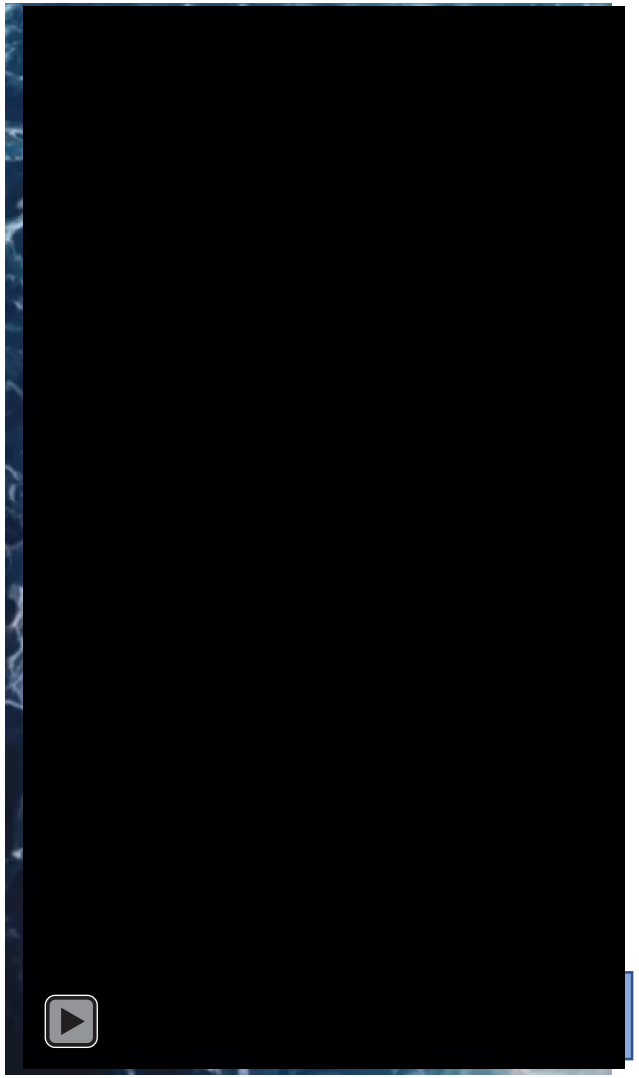
持續性評估設計 以科學科為例

基本教學重點 → 實時互動 → 學習筆記 → 傳統操練(功課) → **創意功課/回饋** → 線上/傳統測試

padlet

Seesaw





持續性評估設計 以科學科為例

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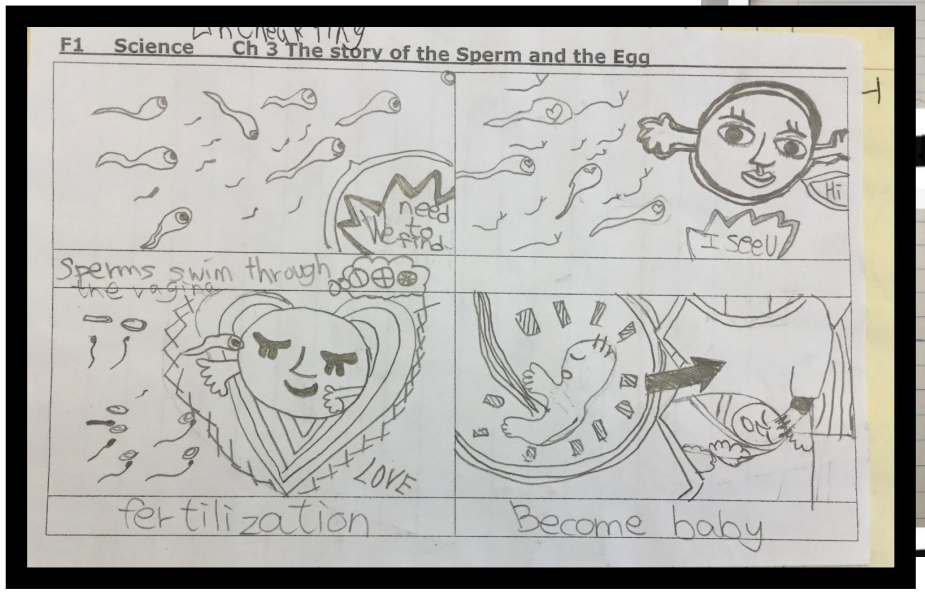
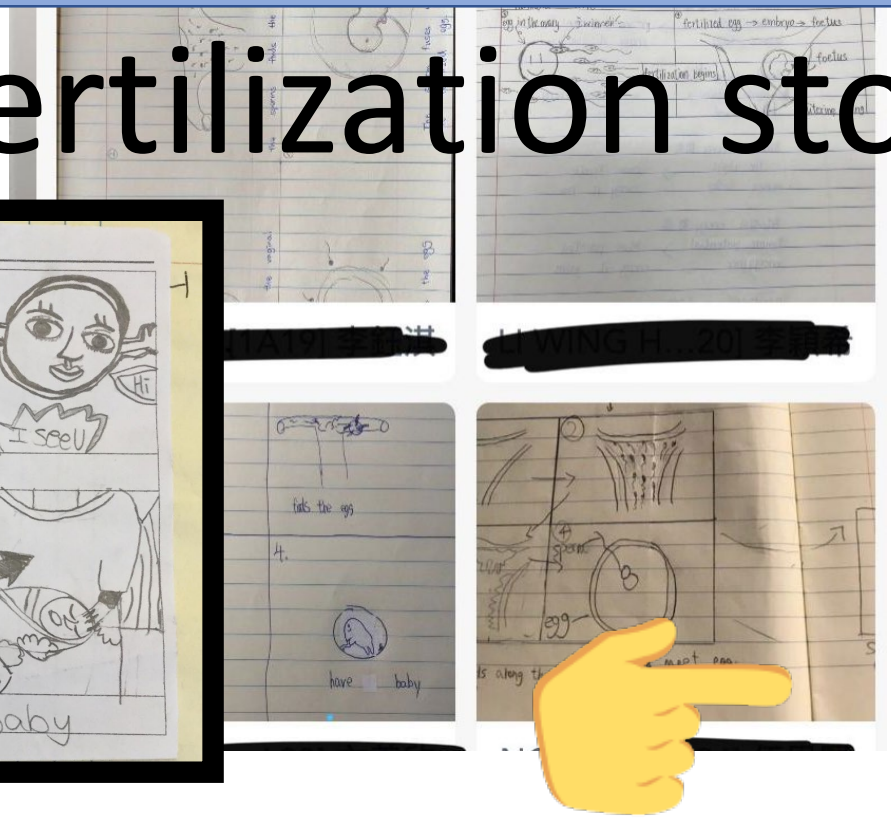
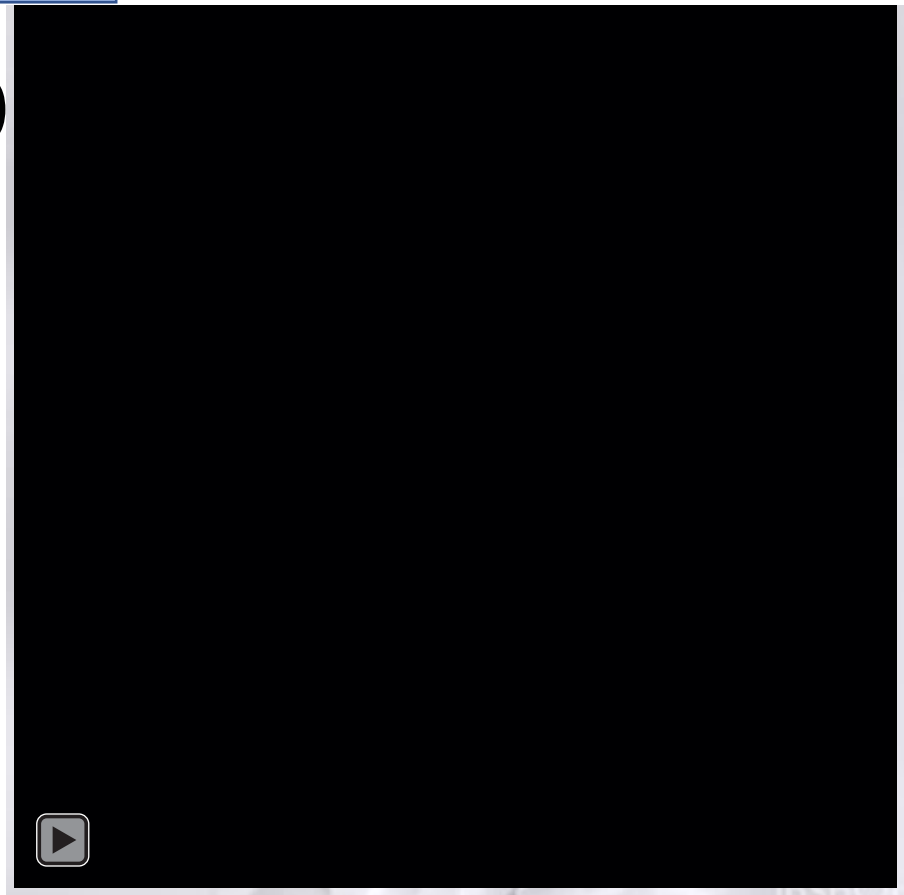
Seesaw

Fertilization sto







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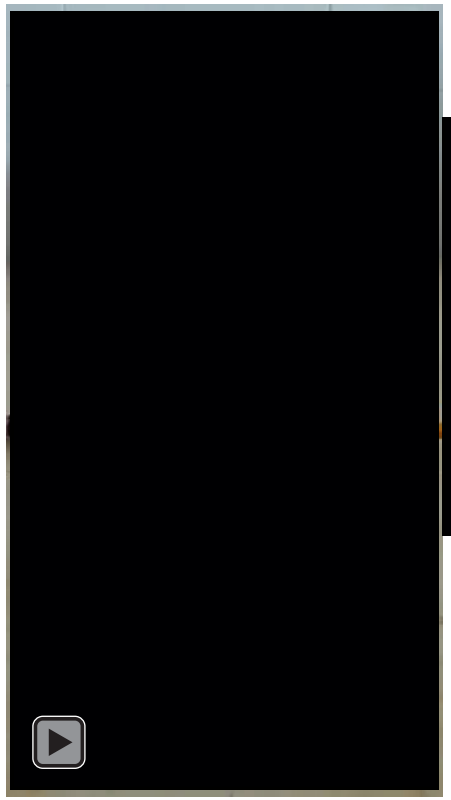
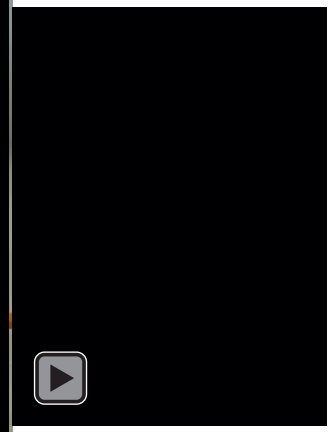
padlet

主題:能量





評估學習表現的工具

以中一科學科為例

基本教學重點 → 實時互動 → 學習筆記 → 傳統操練(功課) → 創意功課/回饋 → 線上/傳統測試

LOiLONOTE SCHOOL

Seesaw

Google Classroom

schoology learn. together.

schoology learn. together.

Kahoot!

socrative 2.0

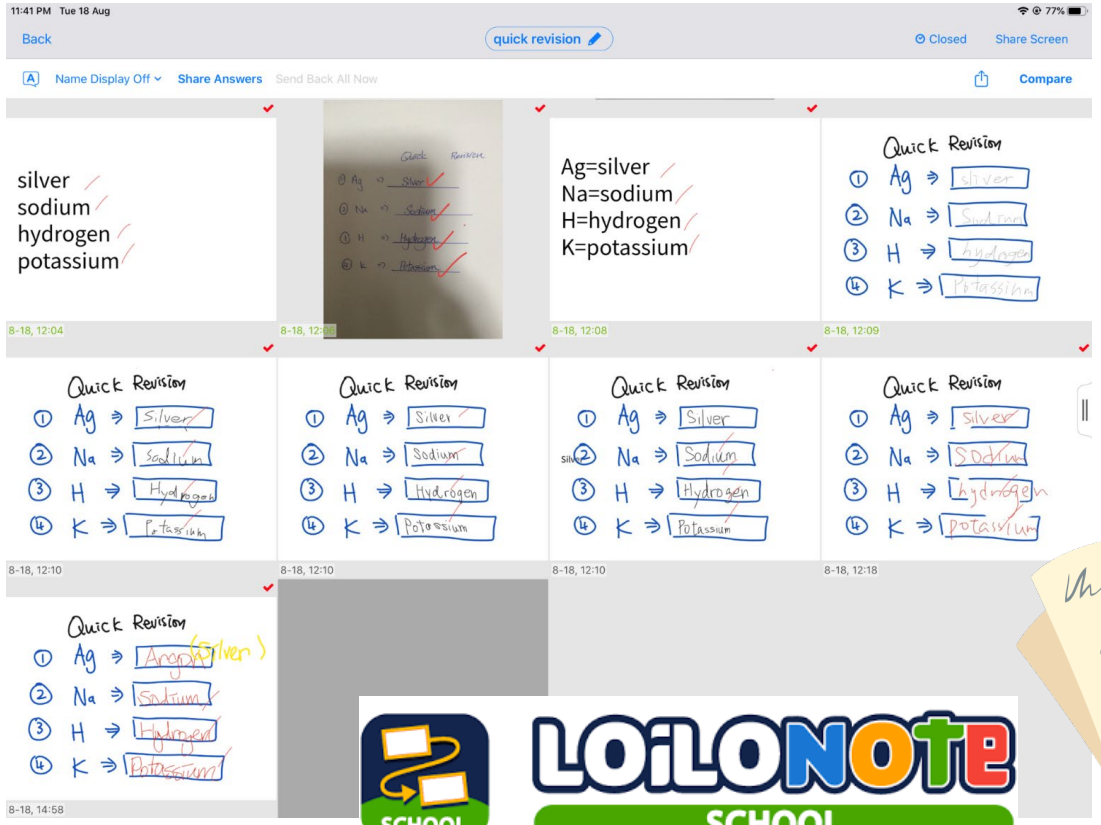
Google Forms

QUIZIZZ

線上持續性評估設計

以中一科學科為例

基本教學重點 → 實時互動 → 學習筆記 → 傳統操練(功課) → 創意功課/回饋 → 線上/傳統測試



Submissions/ Attempts	Latest Attempt	Final Score Gradebook Grade	
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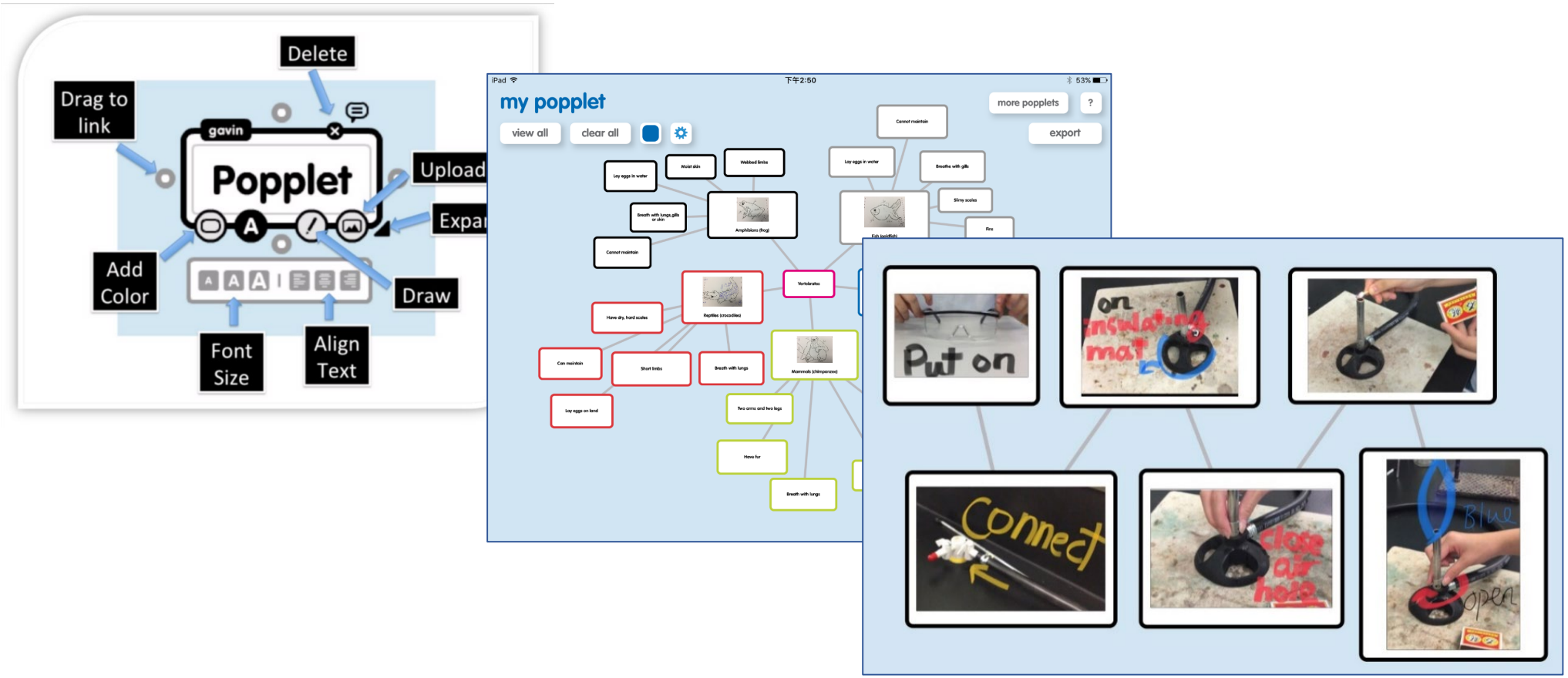
1/1	8/18/20 12:35pm	19/20 19/20	View Attempts
1/1	8/18/20 12:35pm	20/20 20/20	View Attempts
1/1	8/18/20 12:33pm	20/20 20/20	View Attempts
1/1	8/18/20 12:37pm	19/20 19/20	View Attempts
2/2	8/18/20 1:08pm	18/20 18/20	View Attempts
1/1	8/18/20 12:56pm	18/20 18/20	View Attempts
	8/18/20 1:25pm	18/20 18/20	View Attempts
	8/18/20 12:59pm	20/20 20/20	View Attempts
	8/18/20 12:35pm	18/20 18/20	View Attempts
	8/18/20 1:09pm	19/20	View Attempts

線上持續性評估設計

以中一科學科為例

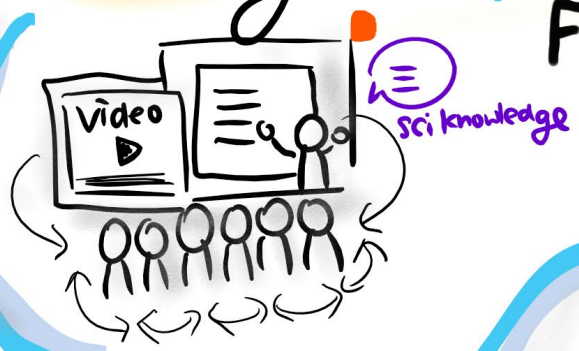
基本教學重點 → 實時互動 → **學習筆記** → 傳統操練(功課) → **創意功課/回饋** → 線上/傳統測試

-學習反思
-閱書分享
-實驗報告

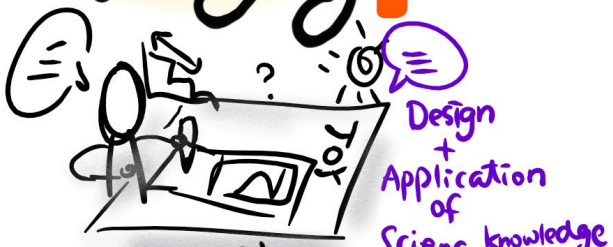


能量的種類
Forms of Energy
F1 science Maker Lesson
科學創客

短片學習
① Learning



② Designing



運用知識 設計玩具

③ Making Toy

堂上 動手做

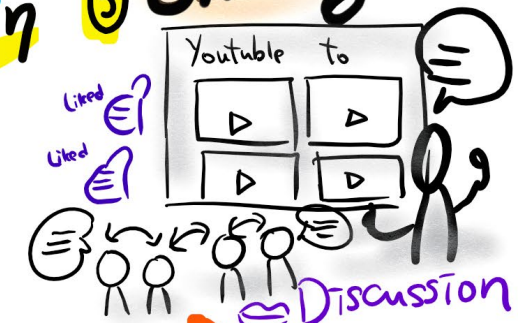
Maker

④ Making Video

Presentation + making video

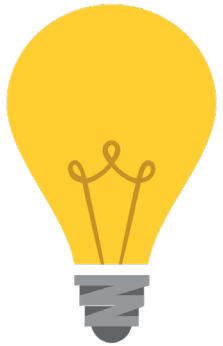
錄影匯報

成果分享
⑤ Sharing



Discussion

反思



- **掌握**學生的學習進度，並提供**適切的回饋**，以**提升教學互動**，
- **量性vs質性評估vs多元化**
- **串連和緊扣**

基本教學重點 → 實時互動 → 學習筆記 → 傳統操練(功課) → 創意功課/回饋 → 線上/傳統測試

工具選擇與設計

-沒有一定的方式 → 引發自主學習，激發學生創意。

選擇合適電子資源/工具
設計+配合課題活動
評估學習表現的工具

–Pasi Silander (Finland)

Vian Siu
viansiu@hotmail.com