Teaching for Student Learning

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Outline

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A quote

The scientist is not a person who gives the right answers, he's one who asks the right questions. – Claude Lévi-Strauss

Underlying pedagogy

TGTL = **T**opical **G**uide to **T**eaching and **L**earning

Underlying pedagogy

The idea behind TGTL begins with a student's mastery of a topic or concept via 2 key cognitive processes:

- Assimilation
- Accommodation

Assimilation

Definition (Assimilation)

A child may change or alter what he perceives in the outside world in order to fit his/her internal world.

Assimilation

Example (Physics)

The variation with time t of the upward force on the rocket during the first 3 seconds after firing is shown in Figure 2.

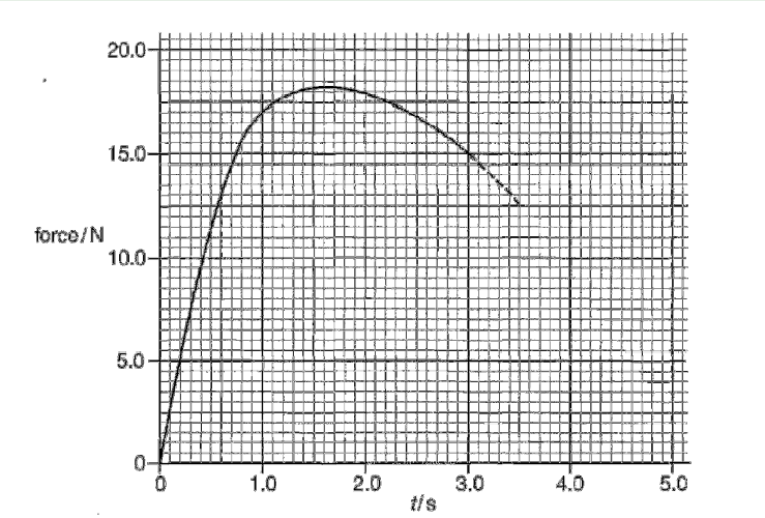


Figure : Variation of upward force with time

Assimilation

Example (Physics)

When a student sees the word *rocket* and the graph, what mental image is created?

Activity

Draw it out now!

Assimilation

Example (Physics)

A model rocket of initial mass 1.3 kg is fired vertically into the air. Its mass decreases at a constant rate of 0.23 kg s^{-1} as the fuel burns. The final mass of the rocket is 0.38 kg. The rocket rises to a height such that, during the flight, the gravitional field strength of the Earth may be considered to have the constant value of 9.8 N kg^{-1}.

(a) Calculate

(i) the initial weight of the rocket,
(ii) the final weight of the rocket,
(iii) the time taken for the fuel to be burned.

Assimilation

Example (Physics)

Does reading the given information change anything about the earlier mental image?

Assimilation

Example (Physics)

Look at the graph again:

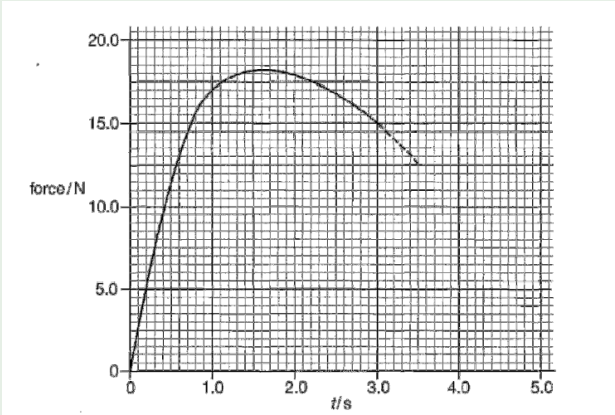


Figure : Variation of upward force with time

Can you describe in layman language (or sign language) the motion of the rocket during the first 3 seconds after firing?

Accommodation

Definition (Accommodation)

- A child perceives information that cannot fit into any existing category.
- The child must then create a new area of intelligence, perception, and thought in order to process the information gathered from the outside world.

Accommodation

Example (Economics)

A student read from a set of lecture notes on market structure:

Perfect competition

In the long run equilibrium, every competitive firm will earn *normal profit*, i.e., *zero profit*.

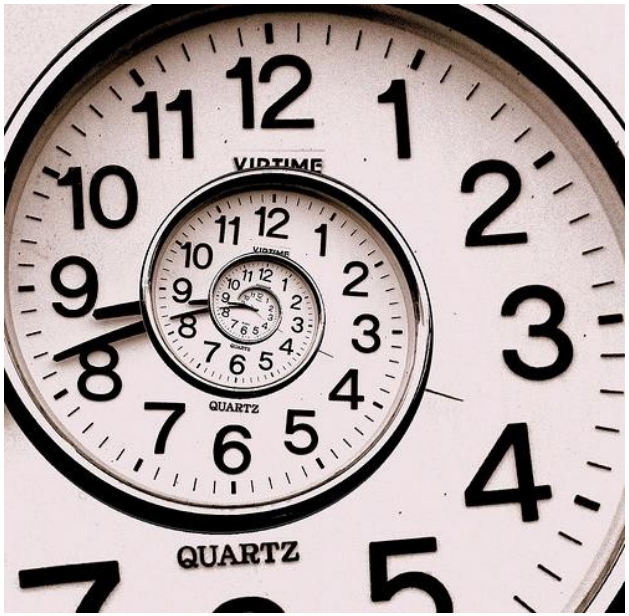
How shocking!

Learning behaviour of JC student

- Lecture delivers bulk information to JC student in a chronological order.
- Chronological order $\not\Longrightarrow$ Natural learning order.

Learning behaviour of JC student

- A student must try to fit the new concept into his/her existing knowledge to make sense of what is coming in.
- This process takes time.



Learning behaviour of JC student

- Before the new concept can "set its roots" firmly, another new concept comes in.
- Poor JC student experiences frustration because the time given for this "set-in" is too short.

Learning behaviour of JC student

When an unseen situation arises, a student is often at a loss:

Learning behaviour of JC student

- What formula can I use?
- What is the question asking me to do?
- How do I get started?
- This is too difficult! I don't know anything!
- Blank out.

Learning behaviour of JC student

- What physical strengths do I harness when I play a certain sport?
- How do I resolve the tension between self-glory and team-victory?
- I have no time to train, my academic work is chasing after me.
- This opponent is too skillful for me, I can never beat him/her.
- This particular technique is too tricky for me.
- Give up.

Learning behaviour of JC student

Example (General Paper)

Punishment is the sure way to eliminate crime. Do you agree?

Learning behaviour of JC student

Common problems include:

- Radical views, biased arguments
- Make sweeping statements
- Narrow view of what constitute of crime and punishment
- Miss out the key words: Punishment, sure, eliminate, crime, agree
- Lack of supporting case-studies and relevant facts
- Lack of personal stand
- Incoherence and lack of focus in writing

Learning behaviour of JC student

- Tutorials are supposed to reinforce learning.
- All too often it becomes a "chase after the train".

Problems

1. Time too short to assimilate and accommodation
2. Volume of new material too much
3. Time too short to teach everything
4. Little real learning

ZPD

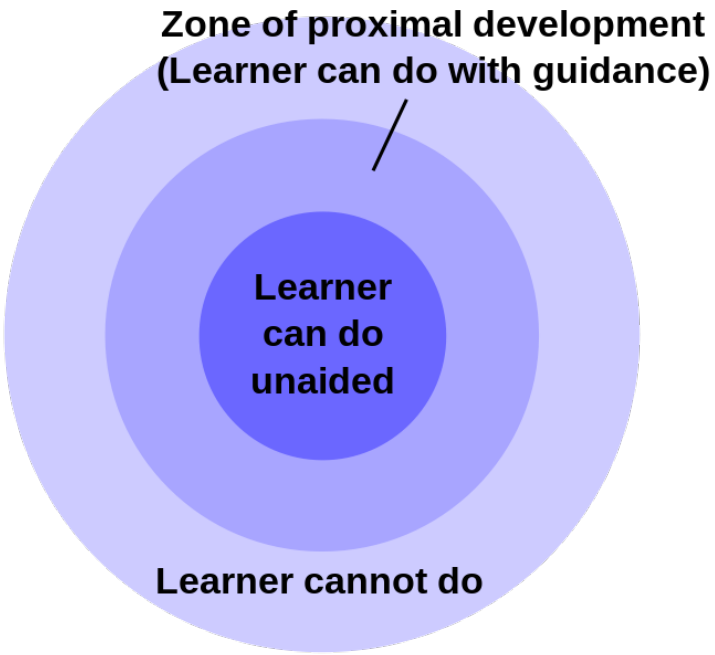


Figure : Vygotsky's Zone of Proximal Development

Features of TGTL

- Use questions to guide thinking processes
- Cut big chunks into 'bit-size' pieces
- Build scaffolds to establish 'small' essential skills

Features of TGTL

- Weave the threads of "small skills" into a fabric of "larger concept"
- Focusing on an essential skill

Features of TGTL

Example (Focus on small skill)

2	Use the normal distribution, with continuity correction, to approximate the Binomial distribution where appropriate (n is sufficiently large to ensure that $np > 5$ and $nq > 5$, approximately)	
	Guiding questions: When do we apply Binomial Approximation to Normal? When Normal approximation is used, so do you do c.c.?	Qn 3(ii),4, 7, 8(v), 9(iii)

Figure : Mathematics: Approximation of distributions

Features of TGTL

- Learn by doing
- Topics $\longrightarrow$ Subtopics
- Targeted areas: Focus
- Intentional guide through questions

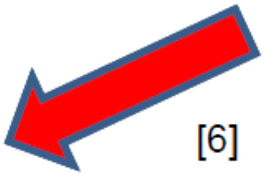
Features of TGTL

Example (Targeted areas: Focus)

F

Numbers **1** to **6** represent a sequence of events occurring in the cell.

(b) State what is occurring from **1** to **6**. [6]



T: State/ concise answer; T:Cell structure; F: Process/ function of each organelle

1 – synthesis of protein/enzymes occurs on ribosomes of rER;

2 – transport of proteins/enzymes in vesicles which bud off from rER + fuse with cis face of Golgi apparatus;

3 – chemical modification of proteins/enzymes in GA;

4 – vesicles containing mature proteins/enzymes bud off from trans face of GA, to form lysosomes;

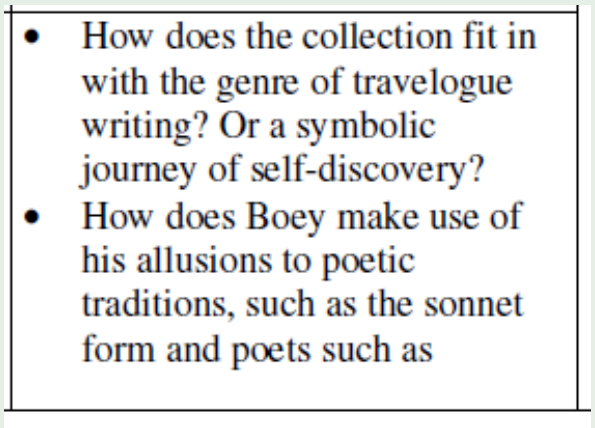
5 – lysosome fuses with endocytic vesicle;

6 – contents of endocytic vesicles are digested by enzymes in lysosome + products of digestion absorbed by cell;

Figure : Biology: Cell biology

Features of TGTL

Example (Intentional guide through questions)



- How does the collection fit in with the genre of travelogue writing? Or a symbolic journey of self-discovery?
- How does Boey make use of his allusions to poetic traditions, such as the sonnet form and poets such as

Figure : Literature: Another Place (by Boey Kim Cheng)

Features of TGTL

Example (Intentional guide through questions)

(i) On Fig. 2.1, use the same scales to draw a line to represent the variation with time t of the total weight of the rocket during the first 5 seconds after firing.

(If the mass of the rocket decreases at a constant rate, how then does its weight vary with time?)

(ii) Hence read off from Fig. 2.1 the time delay between firing the rocket and lift-off.

(At the instant when the rocket lifts off, what is the net force acting on it?)

Figure : Physics: Dynamics

Features of TGTL

- Problem Solving
- Data Response Questions

Features of TGTL

Example (Problem solving skills (Question-specific))

[Tut. 17, Q2.] Suggest reagents and conditions, and intermediate if necessary, to convert Iodoethane to propanoic acid.

Problem Solving Skill Set (PS^3) for Q2

1. **Strategy for synthesis question:** Check the difference between rxt and prdt (including change in carbon length, if any) and recall the reaction(s) required to effect the change(s).
2. **What are step-up reactions? Why are they important?**

Figure : Chemistry: Halogen derivatives

Features of TGTL

- Conceptual reinforcement using key questions
- Creating scaffolds to guide thinking

Features of TGTL

Example (Creating scaffolds to guide thinking)

Big Idea: ▪ How independence was achieved
Key Component 1: ▪ The impacts of political, social and economic impacts of colonial rule on Nationalism.
Key Question 1: ▪ What are the reasons that led to the rise of nationalist movements in pre-war Southeast Asia?
Scaffolding Questions: ▪ What is nationalism? ▪ What are the roles played by religion, culture and ideology in the development of nationalist movements? ▪ Why did nationalism develop so slowly in Malaya?

Figure : History: Nationalism

Features of TGTL

- Emphasis on meaningful repetition
- Drill with increasing order of difficulty/complexity
- Culminate with examination type question

Features of TGTL

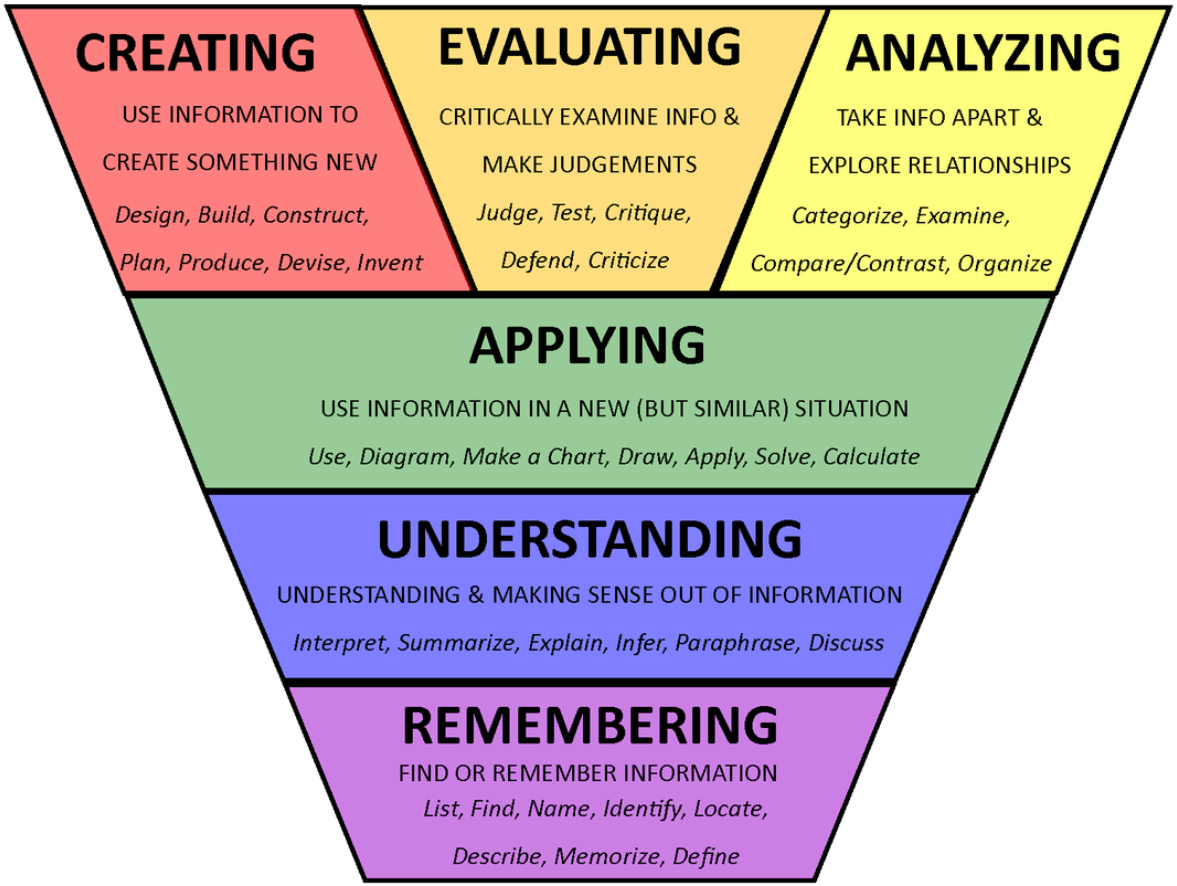
Example (Culminate with exam type question)

[JJC 2012.] Singapore experienced a quarterly growth rate of -0.7% from April to June 2012. However, during the same period, inflation rate remained high at about 5%.

(a) Explain why inflation can remain high despite a slowdown in economic growth in Singapore. [10]

(b) "Inflation is harmful to an economy and hence it should be the priority of the Singapore government to reduce inflation." Discuss. [15]

Bloom's taxonomy



Orders of thinking processes

Example (L.O. vs H.O.)

SECTION 3A: Lower-Order Skills

1. Explain why a country may experience a persistent rise in its general price level. [10]
[CJC, 2010]

SECTION 3B: Higher-Order Skills

1. In August 2000, the Chinese government was concerned that increases in AD were putting too much pressure on the economy.

   (a) Explain why a government is concerned about the excessive pressure created by rising AD. [10]

   (b) Discuss whether fiscal policy alone might be effective in reducing this pressure. [15]

Figure : Economics: Inflation

Beginning teacher

TGTL aids the beginning teacher in

- zooming into the key points of the lesson
- asking the crucial guiding questions

Experienced teacher

- TGTL serves as the vehicle for implementing the SOW.
- Reduce consultation hours, encourage independent learning.

Professional development

"The quality of education cannot exceed the quality of the teachers." – Barber . Mourshed, 2007

Success of TGTL

happens if and only if the school embraces professional development of her teachers.

Different approaches

- Mathematics: TGTL (Guiding Questions)
- Physics: Thought-Process Guide
- Chemistry: Problem Solving Skills Set
- Biology: Task $\rightarrow$ Topic $\rightarrow$ Focus
- General Paper: Thematic
- Art, Literature, Geography, History: Scaffolding questions
- Physical Education: Essential questions for General-Individual-(Team) Strategies

Critique

- Is the learning trajectory of the student mapped against the progression of the topical guide or questions?

Critique

- Do the students internalize the question stems for a given topic?

Critique

- Is this approach too question/topic-specific?

Critique

- Are there generic questioning techniques that address the meta-cognitive processes involved in problem solving?

Critique

- Is this approach too 'guided'? Are the scaffolds systematically removed?

Critique

- Has there been a formal study that confirms the effectiveness of TGTL (implemented till now) on the teaching and learning in NYJC?

Suggestions

- Take a complex final-exam type question and unfold backwards
- Progress the student from most basic, through more complex, to the most demanding

Suggestions

- Give students a chance to craft and pose questions
- Meta-cognitive and reflective stance of students
- Departing from exam-type questions, moving into deeper conceptual understanding and exploration via research
- Moving into e-platform

Asking the right questions

We watch two video snippets:

`http://www.youtube.com/watch?v=RUTbCkDRig4`

and

`http://www.youtube.com/watch?v=Z1HbFOQ201w`

Thank you


obrigado
Dank U
Merci
mahalo
Köszi
спасибо
Grazie
Thank you
mauruuru
Takk
Gracias
Dziękuję
Děkuju
danke
Kiitos