Development of thinking skills in higher education: Are we helping students learn how to think?

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Agenda

- The role of universities
- Current environment in HE
- Cognitive skills
- How to facilitate the development of cognitive skills

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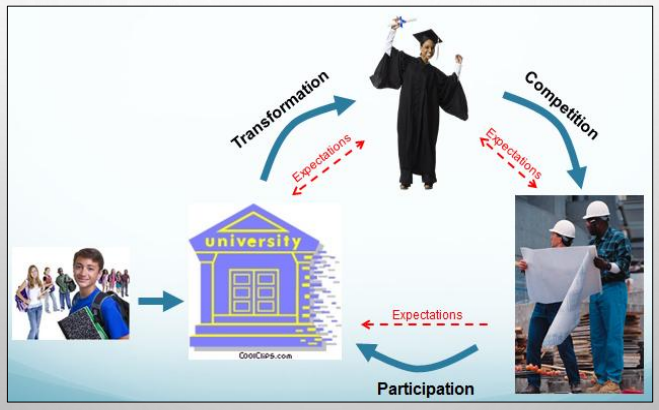
The role of universities

"Education is the process of transforming individuals' behaviour through learning"



The role of universities

Middle ages to 20th century – Repository of information

- Information was not readily available. Lecturer was the "sage on the stage" who explained the information contained in books.
- The "chalk and talk" format widely used.
- Student role reduced to listen during lectures and apply information in homework and practicals.
- Education finished on graduation.

The role of universities

Late 20th century to present – Use of information

- Information readily available. Lecturer becomes facilitator of learning, a designer of learning experiences.
- The "chalk and talk" format almost dead.
- Students take an active role. Learning depends on what they do, not on what the lecturer does.
- Education does not finish on graduation. Need for long-life learning skills.

We are in the middle of this transition.
Nobody knows what a successful university will look like by the end of the 21st century.

The social role of universities

Create individuals who are:

- Knowledgeable
- Job ready
- Long-life learners
- Socially aware
- Environmentally responsible
- Ethical in their decisions
- Informed about current affairs
- Good communicators
- Agents of change
- Interested in more than just their discipline

How?

Current environment in HE

- Competing internal and external drivers
- Quality compliance
- Student retention
- Exploring new markets nationally and internationally
- Accreditation bodies
- Industry expectations
- Student expectations
- Online delivery

The Great Wave off Kanagawa
By Katsushika Hokusai

Current environment in HE

Generational gap

- Millennials and other strange creatures
- Use of technology
- Ways to obtain and use information
- Expectations about learning
- Expectations about the future
- Multiple interests

Current environment in HE

Other gaps

Democratisation of HE: Wider spectrum of students

- More international students
- More mature students
- More working students
- Gender unbalance
- The weak are weaker, the strong are stronger.

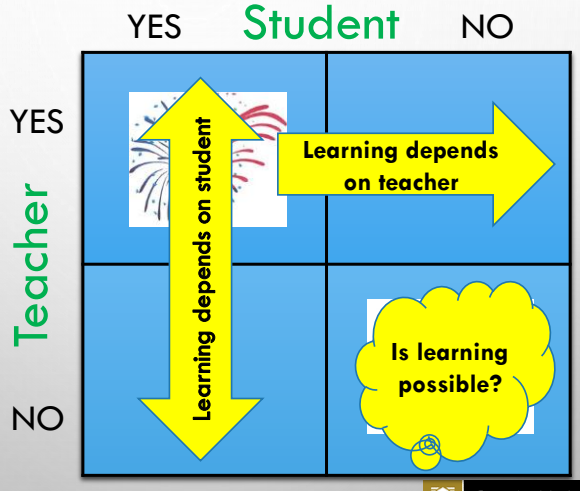
https://www.roberthalf.com/blog/management-tips/3-tips-for-managing-generational-differences

How?

Understanding the solution

What model are we assuming?

- Engaged
- Enthused
- Prepared
- Committed
- Happy
- Focused
- Ready
- Respectful



Back to basics

The attributes of a good graduate

- Intelligent
- Problem-solver
- Empathic
- Long-term vision
- Knowledgeable
- Curious
- Organised

All these are cognitive skills

What do we know about them?

Cognitive skills

epistemology
/ɪˌpɪstɪˈmɒlədʒi,ɛˌpɪstɪˈmɒlədʒi/

noun PHILOSOPHY

the theory of knowledge, especially with regard to its methods, validity, and scope, and the distinction between justified belief and opinion.

Consider the following questions:

- How do we learn?
- What are the main activities involved in the intellectual endeavour?
- In solving a problem, what are the differences between the solution advanced by an expert and that of a novice?

What the literature say

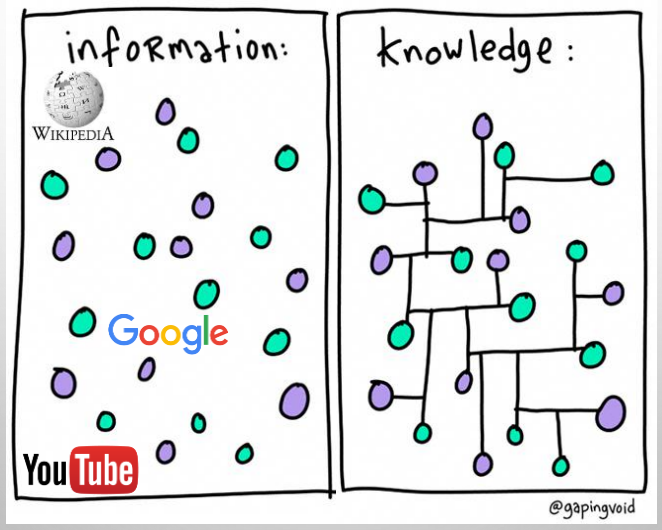
- Exactly how we learn and recall information is still a source of intense debate among neuroscientists and psychologists.
- Fortunately for us, we do not need to have the ultimate answer to these questions to facilitate learning. Having an answer that works for you would be sufficient.

Some ideas

- We cannot measure learning directly. We can indirectly estimate learning as it manifests when knowledge is used. (Have this in mind when designing assessment items)
- The intellectual endeavour can be reduced to two simple activities:

Identify and Connect

Information vs Knowledge



Activity

Make a list of all the things you can recall when you see the following pieces of information

Activity

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Make a list of all the things you can recall when you see the following pieces of information

$$A = \int_0^b f(x)\,\mathrm{d}x$$

Activity

Make a list of all the things you can recall when you see the following pieces of information

$$dU = TdS - PdV \quad \Longrightarrow \left(\frac{\partial T}{\partial V}\right)_S = -\left(\frac{\partial P}{\partial S}\right)_V$$

$$dA = -SdT - PdV \quad \Longrightarrow \left(\frac{\partial S}{\partial V}\right)_T = \left(\frac{\partial P}{\partial T}\right)_V$$

$$dH = TdS + VdP \quad \Longrightarrow \left(\frac{\partial T}{\partial P}\right)_S = \left(\frac{\partial V}{\partial S}\right)_P$$

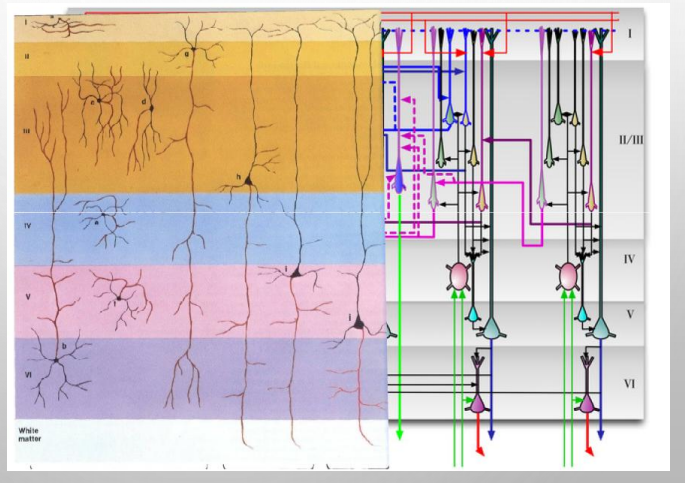
$$dG = -SdT + VdP \quad \Longrightarrow -\left(\frac{\partial S}{\partial P}\right)_T = \left(\frac{\partial V}{\partial T}\right)_P$$

Identify and Connect

We all do it. We can't help it. It is the way the brain works.

The Memory-Prediction Framework (MPF) to model of the neocortex

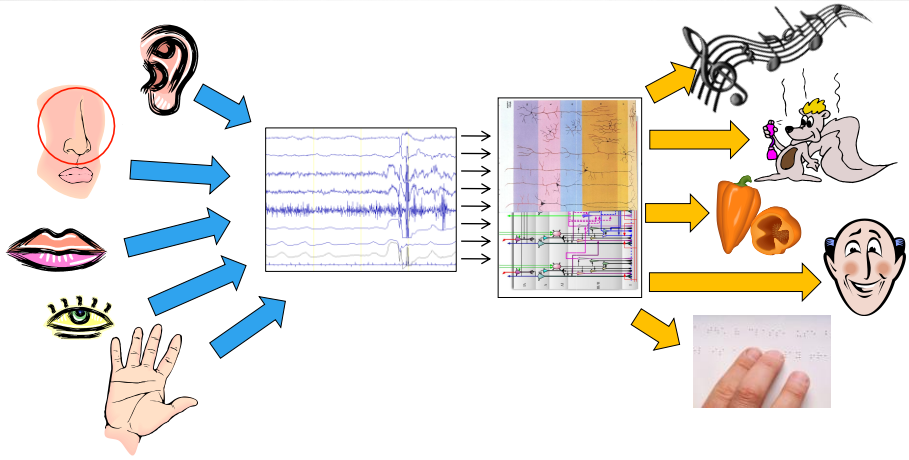
- Proposed by Jeff Hawkins in his book *On Intelligence*.
- High-level cognitive functions happen in the neocortex.
- Six-layer structure
- Complex interconnectivity



Memory-Prediction Framework

Neo-cortex main function:

1. Learn sequences of patterns
2. Recognise those sequences
3. Predict what comes next in the sequence



Identify and Connect

- The difference between an expert and a novice is the number of things (knowledge, ideas, concepts, pictures, equations, consequences, challenges, opportunities, etc.) they can recall and connect when faced with a given situation.
- Being aware that we are doing it, bringing it to the conscious level, improves the way we learn (and we teach!).

Recommendations

1. Talk with your students about these topics. It will help them reflect about their own learning (how to think).
2. Without fundamentally changing anything, include items in your assessments that will explicitly challenge students to identify and connect the main concepts in your units. E.g.
   - List the fundamentals concepts you will apply to solve this problem.
   - Explain in plain English how problems like this are solved.
3. Make explicit the connections you make when solving a problem in class, tutorial, workshop, lab, …

Further reading

- "*How We Think"* by John Dewey.
- "*Thinking: Lessons from John Dewey's How We Think*" by Moeketsi Letseka & Davison Zireva
- "*Critical Thinking: What it is an Why it Counts*" by Peter Facione.
- "*Skewered on the Unicorn's Horn: The Illusion of Tragic Tradeoff Between Content and Critical Thinking in the Teaching of Science*" by Craig Nelson.
- "*Critical Thinking Assessment*" by Robert Ennis.

Thank You