How students process information
- Perception, attention and pattern recognition
- The limitation of working memory
- The implication on mathematics learning
SELECTING LEARNING PROCESS: organise information, build connections among information and integration with prior knowledge, and eventually construct knowledge, encode knowledge to LTM.

FORGOTTEN PATTERN RECOGNITION

- What is in your mind now?
  - Limited in capacity
    - Miller’s research: the magic number of seven (7±2 chunks of new meaningful information)
    - Cowan’s research: 4±1 chunks of new information to be processed
  - Limited in duration
    - Recalls decay over time unless actively rehearsal occurs
    - Information lost very rapidly when people are distracted from rehearsing
    - Forgetting occurs due to interference (of new information) rather than time
  - Dual-coding theory – expert attempts to extend student’s ability to process more bits of information by providing both audio and visual information simultaneously

Working memory?

What is in your mind now?

Consciousness

Working Memory

- Limited in capacity
  - Miller’s research: the magic number of seven (7±2 chunks of new meaningful information)
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- Dual-coding theory – expert attempts to extend student’s ability to process more bits of information by providing both audio and visual information simultaneously
Executive Control System
(Control the operations of WM)

Phonological loop
(Auditory rehearsal)

Visual-spatial sketch pad
(Visual rehearsal)

Verbal coding system is where linguistically based information is coded (words, sentences, stories, the content of information)

Imaginal coding system is where non-verbal information is coded (pictures, sounds, sensations)

Coding words and pictures are independent

Information that can be coded into both systems is more easily recalled

Images (concrete information, e.g., birds, graph) are easier to recall than words (abstract information, e.g., Soar, value)

Pictures are more memorable than words

**Dual-coding theory (Paivio)** – the use of both channels

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Pictures are more memorable than words
Working memory can be
Processing “unlimited” amount of information that is already familiar.

Give example!

Think...
Implication of limited working memory when dealing with novel information for learning new mathematics problem?
Long term memory

Unconscious component of our memory
Unlimited capacity and duration
Where cognitive structures are organised

Explicit memory
- Conscious recall, recognition of previous knowledge/information/experience

Implicit memory
- No record of previously remembering events
- Retention without remembering

Read this....

“...and the young men went ashore from his house and made a fire. And he told everybody and said 'Behold, I accompanied the ghost, and we went to a fight. Many of our fellows were killed. And they said I was hit and I did not feel sick'. He told it all and they became quiet. When the sun rose he fell down. Something black came out of his mouth. His face became contorted. The people jumped up and cried. He was dead.” (Bartlett, 1932)

Different types of knowledge

Declarative knowledge
- Domain specific
- Knowing what

Procedural knowledge
- Knowing how

Conditional knowledge
- Knowing when and why

Classify the following:
- Using a computer
- Writing formula
- Finding area
- Solving an algebraic equation
Sub-components of declarative memory*

Semantic memory
- A mental thesaurus, organised knowledge a person possesses about words and other verbal symbols, their meanings and referents, about relations among them, about formulas, and algorithms for the manipulation of these symbols, concepts and relations (Endel Tulving, 1972)

Episodic memory
- Stores information about ‘episodes’ or ‘events’ in our lives
- The learning order in the classroom
- Makes mistakes
- ...
- Unique to student

*it is still on debate

Flushbulb memory
Brown and Kulik (1977) defined flashbulb memory as a vividly detailed memory of the circumstances under which first learned of a surprising, consequential, emotionally involving event

Categories:
- Informant
- Place where the news was heard
- Ongoing event
- Individual’s own emotional state
- Consequences of the event for the individual
Prospective memory
A lot of everyday thinking involves remembering to carry out intended actions
Time based memory involves remembering to perform an action at a particular time
Event based memory involves remembering to perform a task in the appropriate circumstances

Think...
What is the implication of having various types of knowledge (memory) stored in LTM on mathematics learning?

LTM instructional implications
Recognise that what students already know influences what they will learn
Help students activate current knowledge
Help students organised knowledge into meaningful ‘chunks’
‘proceduralise’ declarative knowledge
Present information both verbally and non verbally

(more detail on next lecture)
How we store and build knowledge
How can we best conceptualise the information stored in LTM
Various theories are proposed
Each helps us think about LTM in a different way

Those representing declarative knowledge are:
- Concepts
- Propositions
- Schemata

Those representing procedural knowledge are:
- Productions
- Scripts

CONCEPTS (Declarative knowledge)
Concepts represent ‘meaningful categories’
- Green, cat, lecture, man, classroom
- Area, square, addition, multiplier
Features essential to defining a concept are defining attributes
- Wings are defining attributes of bird
- Sides are defining attributes of rectangle
Rectangle
- What are the ‘defining attributes’
- What are the ‘non-defining attributes’

Cognitive Building Blocks
Those representing declarative knowledge are:
- Concepts
- Propositions
- Schemata

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PROPOSITIONS (Declarative knowledge)
A proposition is the smallest unit of meaning able to be judged true or false
- ‘Anna held the white cat’ has two propositions: Anna held the cat and the cat is white
- ‘The area formula of a rectangle is the length times the width’ has how many propositions?

The number of the propositions shows how much information stored in LTM
More complex than the concepts they include
Propositions that share information are linked in propositional networks

"Anna held the cat" ↔ "The cat is white"

Create the proposition networks:

"The area formula of a rectangle is the length times the width"

Cognitive Building Blocks

Those representing declarative knowledge are:
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Schemata

Are networks of generalised information about a topic

“organised structures that capture knowledge and expectations of some aspect of the world” (Bartlett, 1932)

“abstract knowledge structures that organised a vast amount of information” (Woolfolk & Margetts, 2007)

Terminology:
- Schema = singular
- Schemata = plural
- Instantiation = provide a specific instance, representing a concept/event

Schemata are instantiated when a particular situation occurs in which enough values are met that the schema is activated
- More instances can then be accessed

Schema theory is more comprehensive than concept or proposition theory
Most commonly used framework for understanding knowledge in LTM
Schemata contro encoding, storage and retrieval of LTM
Think of the following story:

The student sat looking at his *****. “old friend” he thought, “this hurts me”. A tear rolled down his cheek. He hesitated, then picked up his tap shoe and raised his arm. “Tick tick tick”... He did what he had to do....

Could you have understood it without activation of your “calculator” schema?

Schemata example: calculator

Object

Calculator

- Has button
- rectangle
- Has screen

Purpose

- Count
- Work assistance
- Graph

Access

- Not always permitted to use
- Need license
- Can be broken

TODAY’S MAIN DISCUSSION:

HOW SCHEMA IS CONSTRUCTED
HOW SCHEMA IS AUTOMATED

- Metacognition task:
  Why we need to discuss these?
LTM is actively constructed using schemata.
Activated schemata determine what incoming information is relevant.
Schemata are continually reconstructed through learning.

What do you remember from the story excerpt you saw earlier in the lecture?
The war of the ghosts

Bartlett (1932) aimed to investigate recall stories from different cultures

- Schemata include expectations, stereotypes, etc
- If schemata are drawn on, participants’ story recall should reflect these
- Recall of stories was not entirely accurate
  - Unfamiliar data was omitted (because cannot link with own schemata)
  - Other material was altered (using own schemata)

Provides evidence schema theory: that knowledge in LTM is actively constructed using schemata

Think...

What is the implication on mathematics learning?

Characteristic of schemata

LTM is actively constructed using schemata
Activated schemata determine what incoming information is relevant
Schemata are continually reconstructed through learning
The area of a paddy field is 1000 metres square and is divided into three smaller areas. What could it be the area of the smaller areas?

Activated schemata? What students will attempt?

Characteristics of schemata

LTM is actively constructed using schemata
Activated schemata determine what incoming information is relevant
Schemata are continually reconstructed through learning

PIAGET’S THEORY

ASSIMILATION
- New information that fits into an existing schema is added

ACCOMODATION
- Existing schemata are modified in the face of new, conflicting information
Discuss an example of assimilation and accommodation?

Use mathematics learning context

THIS IS YOUR ASSIGNMENT TODAY

PAUSE ...... REHEARSE

NEXT LECTURE.....
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- Schemata

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