UCD TEACHING AND LEARNING/ RESOURCES

Teaching Toolkit

How Students Learn 3

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Cognitivism

Cognitive learning theories focus on how information is attained, structured, and recalled. They go "inside the head of the learner" in that they make mental processes of the learner the primary object of study.

Major Assumptions of Cognitivism

- Learning is a process of relating new info to previously learned

- Learning involves the formation of mental representations that are not always reflected in behaviours

- Inferences about unobservable mental process can be drawn from behaviour

- Cognitive processes (information processing) are the focus of study

- Individuals are actively involved in the learning process through processing, assimilating and accommodating

There are numerous components within cognitivism that explain elements of learning. This briefly introduces one of the most popular, Cognitive Information Processing Theory, and outlines how this impacts on teaching and learning.

Cognitive Information Processing Theory

This learning theory uses a computer metaphor to explain the mechanisms whereby we control information processing (Barsalou, 1992). The model considers how information progresses from input sensors and through encoding procedures to be stored and recalled from memory when necessary.

In 1968 Atkinson and Shiffrin proposed a model of human memory which posited two distinct memory stores: short-term memory, and long-term memory, which was latter followed by the addition of a third memory store, sensory memory.

NB. Learning vs. Memory: Learning is the acquisition of new information. Memory is related to the ability to recall information that has previously been learned.

"Good memory. Now turn around and let's try it again. I've put the chart on the opposite wall since your last visit."

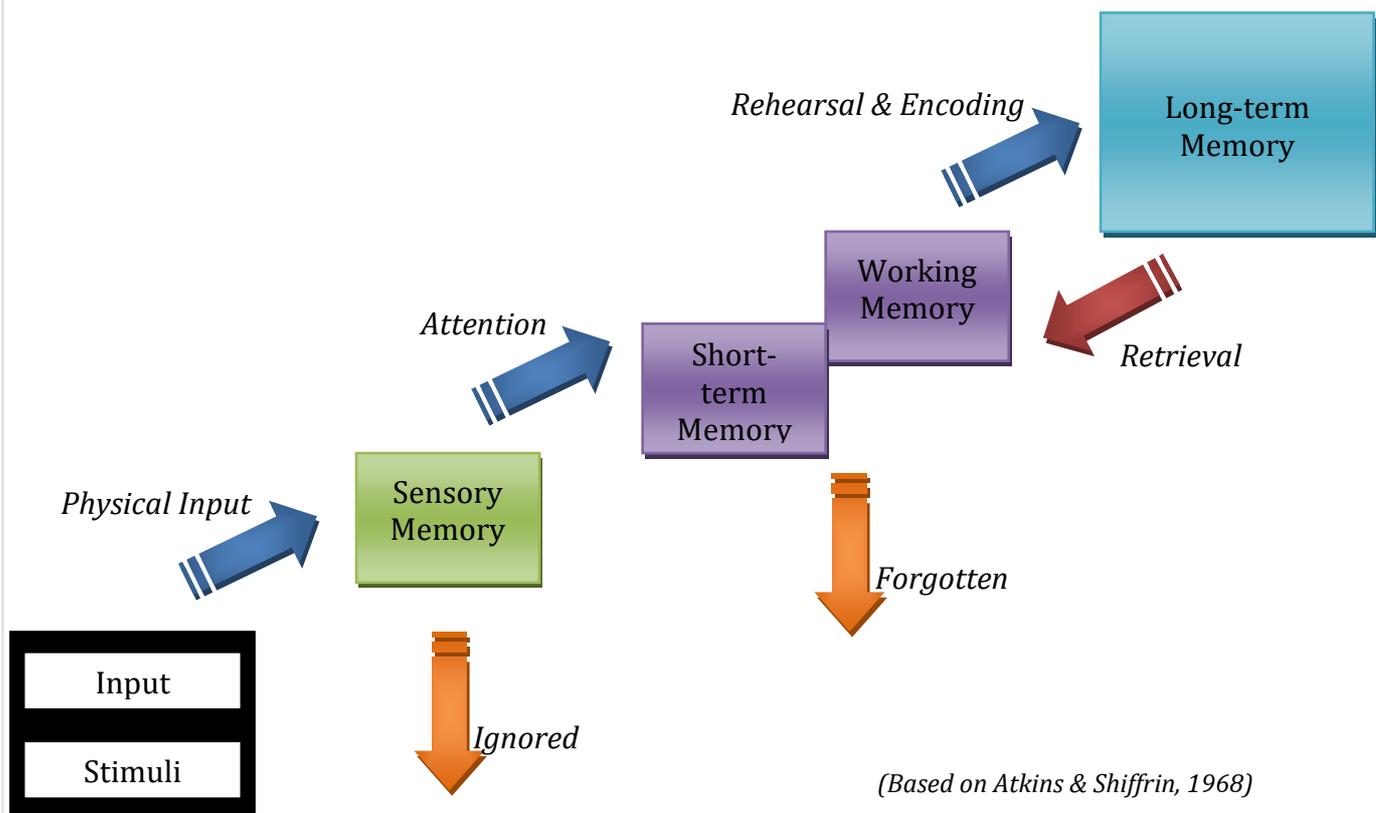The theorized process from stimuli input to storage and recall is illustrated in Figure 1.

(Based on Atkins & Shiffrin, 1968)

Figure 1: *Basic Overview of Cognitive Information Process Theory*
The key components of this process include:

Sensory Memory holds all sensory information (visual, auditory, olfactory, & haptic) for a very brief time period in its raw sensory form

Through **selective attention** information is moved into consciousness, and into the **short term** memory. This allows us to retain information long enough to use it (either 15 and 30 seconds (Peterson and Peterson, 1959) or 7±2 'chunks' of information (Miller, 1956)). The relationship between short term memory and **working memory** is unclear, though it has been suggested that if short term memory is conscious memory, then working memory is the equivalent of a post-it note. Working memory was later developed by Baddeley and Hitch (1974) who suggested that working memory comprised of the central executive, the phonological loop, and the visuo-spatial scratchpad.

Material is considered learned when it passes into the **long term memory**, where information and skills are stored for either minutes or a lifetime.
Storing information in LTM is equivalent to a computer writing information out to its hard drive, or to a tape recorder writing patterns of magnetization onto tape to record music. The 'writing' of information to the long term memory is called **storage** and the 'playback' called **retrieval**.

Forgetting occurs due to either decay (information isn't attended to and fades away) or interference (where new or old information 'blocks' access to the information in question).

Cognitivism in the Classroom

Based on this learning theory there are a large number of techniques that can be used to facilitate more effective learning. Several of these are outlined below.

Making the most of memory in class

Craik & Lockhart (1972) developed the idea that the strength of encoding information will affect level and duration of understanding. Information that is encoded by simple repetition results in surface learning and poorer recall over time. Encoding that has involved making connections with existing knowledge is associated with a deeper understanding of the material and more durable memories.
Activities involved in the promotion of each memory store are outlined in Figure 2.

Short-term Memory	Working Memory	Long-term Memory
Limit the number of lists to be committed to memory at one time	Begin with an overview of the material to be learned	Link materials to cues that can be used to recall them
Be aware that learners remember first and last items on a list rather than central ones	State the objectives for a learning session	Remind learners that cues are sufficient to recall material
Group items into chunks, with less than ten items to be memorised at one time	Encourage reflection and meta-cognition	Encourage learners to create their own cues
Be conscious of interference between different types of information to be learned	Link different-to-remember items to more meaningful ones	Teach revision techniques
Use repetition or rehearsal to retain information for a short period	Use image representations and mind-mapping techniques	Encourage learners to discover and use their strengths
	Use verbal memory aids (such as mnemonics)	
	Present content in increasing order of complexity	
	Revisit topics to strengthen retention	

(From information in Jordan, Carlile, & Stack, 2008)

Figure 2: *Methods to Increase Short, Working, and Long Term Memory*

Gagne's Nine events of instruction (Gagne, 1985) extends cognitive learning theories to instructional designs. He stated that information undergoes a series of processes as it passes through the stages of memory, including attention, pattern recognition, retrieval, rehearsal, encoding, and retention etc., and that learning occurs when these processes are activated.

 The goal of instruction therefore should be to facilitate this activation. He proposed nine events of instruction that should be completed sequentially (see Figure 3), though acknowledged that the order and manner of implementation may vary (Gagne & Driscoll, 1988)

Internal Process	Instructional Event	Action
Reception	Gaining attention	Use abrupt stimulus change
Expectancy	Informing learners of objectives	Tell learners what they will be able to do after learning
Retrieval to working memory	Stimulating recall of prior learning	Ask for recall of previously learned knowledge/skills
Selective perception	Presenting the content	Display the content with distinctive features
Semantic encoding	Providing learning guidance	Suggest a meaningful organisation
Responding	Eliciting performance	Ask learner to perform
Reinforcement	Providing feedback	Give information feedback
Retrieval and reinforcement	Assessing performance	Require additional learner performance with feedback
Retrieval and generalisation	Enhancing retention and transfer	Provide varied practice and spaced reviews

(Based on Driscoll, 2005)

Figure 3: *Gagne's Nine Events of Instruction*

Role of instructor

Driscoll (2005) suggested that there were numerous ways for instructors to incorporate CIP into lesson design and implementation to facilitate greater learning. Four are outlined below:

Providing organised instruction	Organisation is important because when learning any new information students will try to apply some meaningful structure to help make sense of it. If students are required to learn information in a particular way then the way the information is presented to them is going to help or hinder them in this task. Tactics such as signalling important information, drawing attention to specific aspects, using images, and representing information in multiple ways can focus attention and help with encoding and retrieval. Beissner, Jonassen, & Grabowski (1994) advocated the use of graphic techniques such as mind mapping (see http://www.thethinkingbusiness.co.uk/mindmappingbenefits.htm for more information) to enhance the learner's structural knowledge

Arranging extensive and variable practice	Rehearsing information, or practicing until a skill until it becomes habitual, helps with information encoding and retrieval. In addition to frequency, the type of practice is important. Driscoll recounts the adage that 'perfect practice makes perfect'. To avoid context-specific learning (the ability to recall or perform a skill at a single location or under specific circumstances) the learner should have the opportunity to practice the skill in a variety of contexts

Enhancing learners' encoding and memory	To help students to perform at the high cognitive level expected in university strategies can be taught to enhance learners' encoding and memory. These strategies have their basis in information processing theory

Enhancing learners self-control of information processing	Shifting the focus of learning from instructor to learner involves different aspects of cognition. This involves enabling the learner to control and modify information flow within the information processing model. This awareness and control over thinking and self-regulatory behaviour is called 'metacognition' (Brown, 1980; Duell, 1986)