

Gradteach Certificate Notes

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The Science of Learning

1. Describe how learning works in terms of cognitive attention, working memory, prior knowledge, and retrieval;
2. Identify key levers for student self-regulation of learning, through the prompting of metacognitive processes and motivation to learn;
3. Explain, by way of well-defined key concepts and terms, the value of adopting a learner-centered teaching mindset.

How Learning Works

1. Describe the basics of how learning works, using key terms like *attention*, *working memory*, *prior knowledge*, and *retrieval*;
 2. Identify points in the learning process where you, as a TA or instructor, are able to impact whether and how much learning occurs.
- The landscape of learning
 - After we complete a learning activity, e.g., listening to lectures or doing homework, the brain does some stuff, and then we learn something.
 - Metacognitive awareness is an individual's awareness of their learning and of the things that impact their learning. Knowing what you do or don't understand and when you need to take a break or review something again.
 - Motivation to learn is a major contributor to learning. Combined with metacognitive awareness, this leads to self-regulating behaviors.
 - Self-regulating behaviors: things like goal-setting and decision making, which can have a positive impact on the degree of learning.
 - High levels of stress or distraction, along with other barriers, can negatively impact learning.

- The context of learning almost always involves a sociocultural aspect of interacting with other learners. Interactions with other learners can be both positive and negative.
- Most of learning is *not* about baseline intelligence, but rather about how these different factors interact.
- Cognitive process for learning
 - Learning begins when we sense something, and take it into our **sensory memory**. The sensory memory has a large capacity to process a lot of information at the same time. However, the duration of the sensory memory is very short. So we need to focus our senses on the right sensory information for long enough (**attention**) for sensory memories to be moved into the working memory.
 - The **working memory** is where thinking happens and information is processed. We begin to understand things in the working memory. The working memory has a relatively small capacity, which means we can't work with that much new information at one time. It is important to avoid overloading the working memory.
 - The **long-term memory** is accessed during learning (**retrieval**), including concepts, facts, and connections between ideas. We work with our sensory information and retrieve long-term memories at the same time, so it is important to ensure that learners can connect these two.
 - We say that learning occurs when the results of working memory processing are **encoded** into our long-term memory, and we can retrieve them later.
 - We take information into our senses, play around with it in the working memory, and hopefully encode it in the long-term memory. This is the part of the learning landscape where the “brain does some stuff”.
- Memory encoding
 - **Encoding** refers to the process where short-term working information is converted into long-term storage in the brain. Once information is encoded, it can be recalled from either the short or long-term memory.
 - The process of encoding begins with perceiving sensory information. Stimuli from the environment are perceived by sense organs, and information is transferred to the **thalamus**, where they are synthesized. The **hippocampus** then analyses the experience and decides if it should be committed to long-term memory.
 - Encoding is achieved when neural pathways are formed or strengthened through the process of **long-term potentiation**, which alters the flow of information within the brain. As a person consolidates their sensory and long-term information together in the working memory, the brain “rewires” itself to store new experiences in memory.
 - Encoding can be optimized through organization of information. If information is improperly coded, recall will be more challenging later on. Several mechanisms can be used to improve encoding, but three common ones are: *mnemonics*, an organization technique that can be used to aid in memory; *chunking*, organizing parts of learning into meaningful wholes; or *state-dependent learning*, when a person

remembers information based on the state of mind they are in when they learn in. Smells, sounds, and place of learning are all part of state-dependent learning.

- **Memory consolidation** is a category of processes that stabilize a memory after initial encoding, and influences the ease of recall. While encoding is influenced by attention and conscious effort, processes involved in consolidation occur at the cellular level and are unconscious. Consolidation happens when we sleep.
 - Providing clear and well-organized information is the easiest way for instructors to help students with memory encoding. For example, providing a course outline with delineated chunks can encourage learning. Explicitly making connections with other material the students already know is also beneficial.
- The Role of attention in memory
 - *attentional capture* is the process of paying attention to a particular piece of information. Attentional capture is the necessary first step for information to be encoded into a long term memory.
 - **Explicit attentional capture** is when a stimulus that a person has not been paying attention to becomes salient enough that an individual begins to pay attention to it and becomes cognizant of its existence. Simply, it's when something catches your attention and you actively choose to focus on it. For example, if you are doing your homework and someone calls your name, your attention is redirected to the person calling your name.
 - **Implicit attentional capture** is when a stimulus that a person is not attending to has an impact on their behavior, regardless of whether they are cognizant of the stimulus. For example, if you do your homework while quiet but annoying music is playing in the background, the music can disrupt your ability to focus on the homework even if you don't choose to pay attention to it.
 - The working memory has limited capacity and has to take in thousands of pieces of information every second. Based on past experiences, current thoughts, or long-term recall information, the working memory decides if any particular piece of information is important or relevant.
 - Attentional capture encodes a stimulus into working memory, at which point the memory is manipulated to associate it with other concepts and stimuli. The memory will then be encoded into long-term memory or forgotten.
 - Instructional words or cues to direct attentional capture can play an important role in teaching and allow learners to focus on the important concepts to encode into long-term memory.
 - Explicitly mentioning transitions and connections can improve attentional capture and encoding into long-term memory.
 - Recognizing the smaller capacity of the working memory is very important for teaching – if we overload students with facts, they will prevent the earlier facts before encoding them into memory.
 - Memory storage and retrieval

- Memories are not stored as exact replicas but are instead modified and reconstructed during retrieval and recall.
- Memory storage is achieved through the process of encoding, through either short or long-term memory.
- Information in short-term memory deteriorates constantly; however, if the information is deemed important or useful, it is transferred to LTM for extended storage. These long-term memories must be consolidated to optimize storage.
- LTMs still decay over time, and as the retention interval between encoding and retrieval of the memory lengthens, the accuracy of the memory decreases.
- The two main types of memory retrieval are **recall**, retrieving information from long-term memories; and **recognition**, where an outside stimulus provides a clue that the information has been seen before.
- Recall can be assisted when the retrieval cues are presented that enable the subject to quickly access the information in memory, which is why it is valuable to provide students with instructional cues to help activate their prior knowledge.
- By providing cues and regularly asking students to retrieve the same memories, we can improve encoding into long-term memory and additionally increase the ability of learners to recall the same information. This practice increases the likelihood of recall of the right things at the right time.