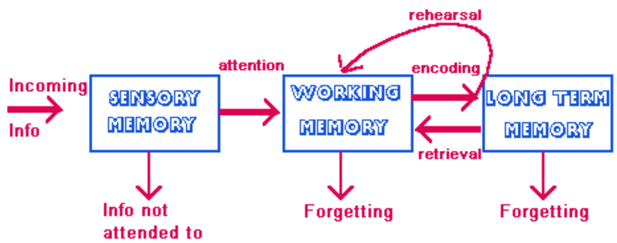
CHAPTER 14
APPLYING COGNITIVE LEARNING THEORY IN THE CLASSROOM



This chapter will help you understand cognitive learning theory and its various applications to teaching and learning.

LEARNING ABOUT KNOWLEDGE AND KNOWING ABOUT LEARNING – KNOWING ABOUT KNOWLEDGE

Learning involves the acquisition of knowledge. But is remembering the same as learning? Put another way: Are knowledge and memory the same? Also, is knowledge the same as information? Let's see if we can add some clarity here.

Learning

According to cognitive learning theory, learning involves a change in one's cognitive structure. This change occurs when new information or experiences are combined with existing knowledge stored in long term memory (LTM). In this sense, new knowledge is constructed by learners (constructivist learning theory will be described in the next chapter).

Learning becomes meaningful when it is connected to what you already know. That is, when new information is connected to old knowledge. This is called *meaningful learning*. Knowledge without meaning is merely information. Effective teachers try to create learning experiences that result in this kind of learning (see below). The opposite of meaningful learning is *rote learning*. This is when information is presented out of any knowledge context or when it is not connect with anything already known. For example, if you were to memorize a list of facts in order to pass an exam but made no conscious effort to understand, connect, or apply these facts, you would have engaged in rote learning, a pretty useless endeavor. It would be very hard to use or apply that information in the future (see transfer below).

Below are described five strategies for making learning new information more meaningful.

1. Activate relevant schemata. Help students identify things they might already know about a subject. For example, 3rd grade teacher Molly Sanchez was teaching her students about reptiles. She began the lesson by showing students a picture of a snake and asking them to name characteristics or things they knew about snakes. She listed those facts on the board as students named them. She then showed a picture of lizard and does the same thing.

2. Use analogies. Compare new things to known things using analogies. In the last chapter I used the analogy of a storage locker to help you understand storage and retrieval in LTM with the assumption that this was familiar to most. Showing how the essential elements of a new concept are related to a familiar concept enhances students' ability to process and encode new information.

3. Present information in an authentic context. Present instruction within the context of real life situations. A common way to do this is to use problem-based or project-based learning. Here students are presented with real life situations or tasks that require them to use information or skills to solve a problem or

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create a project. Presenting new information in isolation or outside of any sort of meaningful context makes it more difficult to understand and encode new information.

4. Make personal connections. Connect new information to students' lives or personal experiences. Look for ways in which new learning affects or is exemplified in the context of their lives. Create assignments and activities that invite students to connect new learning to what they have experienced or are experiencing.

5. Use kid language, simple it up, and keep it concrete. Keep it simple when introducing new information. Too many words can be just as damaging as too few words when trying to introduce new information. Use words and concepts to explain things with which students are familiar.

Knowledge Enhances Learning

We use the knowledge we already have to help understand and interpret new information and construct new knowledge. Knowledge improves the ability to assimilate new information because there are more things to connect it to or associate it with in LTM. Put another way, the more you know the easier it is to know more. This is known as the Matthew's effects where the rich get richer and the poor get poorer (Bruer, 1993). Thus, an important part of the job of a teacher is to present bodies of knowledge to students in an organized fashion in order to enable them to construct and expand their knowledge bases.

Current learning enhances future learning. Less knowledge means less learning. One of the reasons undergraduate students sometimes struggle with concepts in educational psychology is that they have little background knowledge with which to make sense of this new information. Without significant classroom experience, the knowledge they do have related to theories of learning and educational procedures are very shallow and disjointed. As more knowledge and experience are gained, these theories and other concepts make more sense. Students find that these theories of learning make much more sense after they have been teacher for two or three years because they have significant experiential knowledge to connect them to.

Types of Knowledge

There are three different types of knowledge: declarative, procedural, and practical. All are important in any endeavor, especially teaching.

Declarative knowledge. *Declarative knowledge* is "knowing what" or knowing about something. It's information that can be declared or stated. It includes knowledge about the world, theories, ideas, or concepts. For example, you understand what operant conditioning is. This is declarative knowledge. Declarative knowledge, sometimes called propositional knowledge, is stored in LTM in the form of a series of propositions. A proposition (this is an abstract concept, not a physiological construct) is the smallest unit of knowledge or meaning that can be said to be true or false. For example, the sentence in Figure 14.1 contains four propositions or bits of knowledge (more on propositions and propositional networks below).

Figure 14.1. Examples of propositions within a sentence.

Sentence: Bill likes sour apples.

Proposition #1: *There is a person named Bill.*
Proposition #2: *He likes something.*
Proposition #3: *It is an apple.*
Proposition #4: *The apple must be sour.*

Sentence: Sally took the dirty towel.

Proposition #1: *There is a person named Sally*
Proposition #2: *She took something.*
Proposition #3: *It was a towel.*
Proposition #4: *The towel was dirty.*

Declarative knowledge is stored in LTM in the form of propositions. A series of related propositions is

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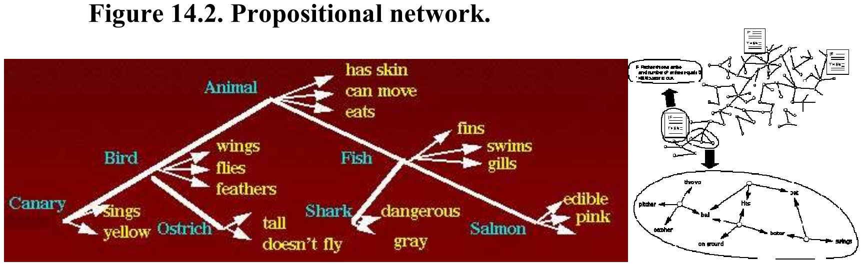
called a propositional network. A propositional network is an abstract representation of how knowledge is stored in LTM (Figure 14.2). Propositions are connected like a big spider web, often referred to as a cognitive web. The more strands in our cognitive web, the easier it is to catch new information and add additional knowledge. Again, knowledge begets more knowledge.

Figure 14.2. Propositional network.



Schemas (schemata), a term learned in the last chapter, are used to store and organize propositions. Related propositions are stored next to each other. When we encode information or retrieve knowledge we wiggle or activate that part of the spider web and related strands. This is called spreading activation. Activating one propositional strand can trigger related propositions. Metaphorically, wiggling a strand on the spider web jiggles the strands around it. Thus, when I say the word 'duck' all related duck propositions around it are activated and brought to consciousness.

Procedural knowledge. *Procedural knowledge* is "knowing how" or knowing how to do something. For example, you know how to use a contingency contract. This is knowledge that is tied to specific steps; a skill, strategy, or technique. You are able to perform a specific task. In education, examples of procedural knowledge are knowing how to plan a lesson, use cooperative learning, write an IEP, construct a Power Point presentation, or use specific questioning techniques.

Practical knowledge. Declarative and procedural knowledge are important for classroom teachers; however, without practical knowledge are of little use. The third type of knowledge, ***practical or conditional knowledge,*** is knowing how and when to us declarative and procedural knowledge. That is, you are able to make practical applications. For example, you know when to use a contingency contract in your classroom and are able to adopt and adapt it to meet the needs of a specific situation. Practical knowledge in education is having both an understanding the theories, concepts, and various pedagogical strategies and knowing when and how to apply them in real life settings.

In Chapter two, knowledge in four areas were identified as being necessary to become an expert teacher: (a) content knowledge, (b) pedagogical knowledge, (c) pedagogical content knowledge, and (d) knowledge of learners and the learning process. Content knowledge and knowledge of learners and the learning process are examples of declarative knowledge. Pedagogical knowledge is an example of procedural knowledge. Pedagogical content knowledge would be an example of practical knowledge.

MEMORIES

Learning involves both memory and knowledge, but is memory the same as knowledge? No. Knowledge has to be meaningful, memory does not. Memory is simply a storage tank for knowledge and experience.

Three Types of Memory

Within LTM there are three other types of memories: Episodic, semantic, and procedural. *Episodic memory* is the ability to recall the various episodes or events in your life. The word semantic refers to meaning; thus, the second type of memory, *semantic memory,* refers to our ability to recall meaningful data or knowledge (declarative knowledge). This type of memory is very important for school-related learning. *Procedural memory*, often called "how to" memory is the ability to recall procedures, skills, or how to do things (procedural knowledge). Data related to each of these three types of memory are all stored differently in LTM. That is, how we store and retrieve semantic memory is different from how we store and retrieve the other types of memories. Learning is enhanced when all three types of memory are used in the learning process.

Levels of Memory: Explicit and Implicit

There are two levels of memory: *Explicit memory* is the knowledge in LTM that can be recalled and consciously considered. This most often refers to semantic and episodic memories where you are able to bring knowledge or specific events to conscious awareness upon demand. Example: What did you have for breakfast today (episodic)? What is the state capital of Wisconsin (semantic)? However, procedural memory can also be explicit. Examples: What are the steps used in double-digit addition? How do I create and streaming video so that my students can access it? How do I hit a golf ball so that it doesn't slice?

Implicit memory, are those that are out of awareness but can still influence our thoughts or behaviors. These are sometimes called unconscious memories (memories of which we are not conscious but can be brought into awareness under the right circumstances) or subconscious memories (memories below our consciousness awareness that we are not able to access). There are three types of implicit memories: procedural, classical conditioning, priming effects (Woolfolk, 2007). *Implicit procedural memories* involve those skills that have become automatic (automaticity). For example, you know how to drive a car or ride a bike so you don't have to think about it. Implicit procedural memories also include habits you may have formed (you turn on TV first thing in the morning without thinking about it), or ways of doing things (you always put on our right sock and shoe and then we put on the left sock and shoe).

The second type of implicit memories, *implicit conditioned memories*, is related to classical condition. Here you unconsciously associate episodic memories to current environmental stimuli. For example, you become anxious when you're asked to bat in a baseball game because you remember getting hit in the head by a pitch in 7th grade. Or you respond positively to a commercial with a dog in it because of your own pleasurable experiences with dogs.

The third type of implicit memories involves priming or activating related information in LTM. *Primed implicit memories* are those that are directly related or closely related to something else you are retrieving. For example, in an education class that's studying lesson planning your instructor uses a particular social studies lesson plan as an example. You suddenly remember a particular social studies lesson or a social studies class you had in middle school. The example triggers something that was paired with it in LTM. A similar thing triggered an associated memory. This is an example of a primed implicit memory.

ENHANCING THE ENCODING OF KNOWLEDGE

From a cognitive perspective learning is a change in the cognitive web where new nodes and strands are added. How can we enhance this process? How can we make it easier and more likely that students are able to add strands to their cognitive webs? Four strategies are provided here.

Massed vs. Distributed Practice

The theory of massed and distributed practice was developed originally from research in behavioral psychology (Hergenhan & Olson, 2005). From a behavioral perspective, massed practice is learning a skill in a very short amount of instructional time. Distributed practice is learning a skill with the instructional time spread out. From a cognitive perspective, massed practice is trying to encode new information in one large session or in a series of encoding sessions bunched together. Distributed practice is trying to encode the same amount of information in the same amount of encoding sessions in shorter bits but with larger spaces between them. To show this visually, each of the asterisks in Figure 14.3 represents an instructional bit or an encoding session of similar duration.

Figure 14.3. Massed vs. distributed practice.

massed practice	distributed practice
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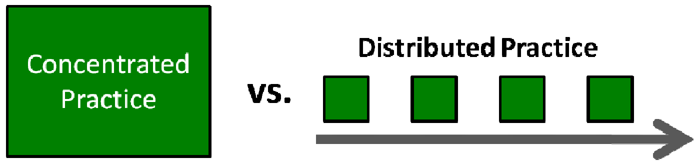

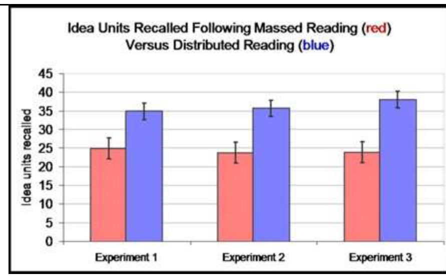

In experiments in both behavioral and cognitive psychology, subjects are able to learn more and retrieve more information from LTM when instruction, practice, or encoding sessions are spread out over time versus when they are bunched together.

Cramming for exams. The concept of massed versus distributed practice has direct a relationship to your and you study habits. The common practice of cramming for an exam is an example of massed practice. Here students wait until the night before an exam to do all the required reading and studying. However, if you wanted to learn more and study less you would keep up with the assigned reading every week (distributed practice). However, many students insist that they study better under pressure. You may feel an increased level of motivation when you wait until the last minute to study; however, learning is not enhanced or increased. I recommend that you find a consistent time every week in which to do your studying.

Cramming information in students' heads. In the classroom the theory of massed vs. distributed practice can also be applied to the teaching. More does not mean more learning. Trying to teach too much too quickly can inhibit learning (as well as frustrate students). Students do not learn best by simply having a big blob of information pour over their heads in one sitting. Instead, students learn best if you provide a bits of input (lecture) followed by an activity to reinforce or manipulate the information or to use the new skill.

> *"Attempts to cover too many topics too quickly may hinder learning and subsequent transfer because students (a) learn only isolated sets of facts that are not organized and connected or (b) are introduced to organizing principles that they cannot grasp because the lack enough specific knowledge to make them meaningful"* (National Research Council, 2000, page 56).

Mnemonic Devices

Mnemonic devices link new information to familiar words or letter patterns for easier retrieval from LTM. For example, when first learning about the six levels of thinking described in Blooms taxonomy, I looked at the first letters of each word: knowledge, comprehension, application, analysis, synthesis, evaluation (KCAASE) and used the following sentence to help me remember: King Cole always ate stale eels. This helped me remember the six levels and the order in which they came, which in turn helped me encode this and related information more easily. There are a variety of other mnemonic devices that can be used; however, keep in mind that while memory is part of learning it is not the same as learning.

Imagery

In using imagery students are asked to picture in their minds what is to be learned, what is learned, or what was learned. Generating mental images of what is to be learned is a form of elaborative encoding (Snowman & Biehler, 2006). It also is a form of dual encoding as students are encoding both semantic information and visual information. An example: Molly Sanchez ends her frog lesson by asking students to imagine that they were a frog. She then guides them as to what the sights and sounds might be if they were living in a pond.

RETRIEVAL AND ENCODING FAILURE

Do memories decay? Not according to cognitive learning theory. We don't actually forget anything. That is, memories don't fade away; however, we do have retrieval failures. This is when we are unable to access knowledge stored in LTM.

Interference Theory

Retrieval failure is caused by neural pathways that get cluttered up with other information. This is called *interference*. Interference is when old knowledge impedes or obstructs both our encoding (learning new information) and our retrieval (remembering). Put simply, learning new stuff is hampered by the presence of old stuff and remembering old stuff is hampered by the presence of new stuff.

There are two types of interference: retroactive interference and proactive interference. *Retroactive interference* is retrieval failure that's caused by something that occurred ***after*** the initial learning or encoding. For example, I have an acquaintance named Jim Peterson. I could recall his last name fairly easily. However, I attended a funeral where I met Jim Meyer, a friend I hadn't seen in many years. Seeing this old friend in the context of the funeral triggered all sorts of memories and emotions. A day later, as I was trying to retrieve Jim Peterson's last name I found I couldn't do it. Jim Meyer continued to come up instead.

As another example of retroactive interference, this time involving a skill: I played tennis as I was growing up. In my early 20s I started playing racquetball. Both sports involve using racquets hitting balls where your opponents cannot return them. After play racquetball exclusively for about 25 years, tried to play a game of tennis. I found this exceedingly difficult to do as my racquetball-playing information got in the way of my tennis-playing information. My mind was telling my body to react and swing the racquet in racquetball ways instead of tennis ways. It took a full two weeks of playing before I could once again play tennis.

Proactive interference is retrieval failure that's caused by something that occurred ***before*** the initial learning or encoding. Old knowledge get's in the way of new knowledge. I had a student in one of my classes who's name was Beth Swedenberg. Growing up, I had a neighbor who's name was Becky Swedenberg. It was the first time since childhood that I had encountered that last name. Thus, the old Swedenborg knowledge interfered with the accurate processing and encoding of new Swedenborg data. For the first half of the semester I kept calling Beth, Becky.

Implications for Teaching

Memory is an important part of learning, but is different from learning. Memory enables us to retrieve past knowledge (activate relevant schemata) in order to interpret new information and construct new knowledge. But, as described above, sometimes old and new knowledge interferes with encoding and retrieval. Retrieval of knowledge from LTM can be enhanced by active learning, meaningful instruction (see above), the use of authentic contexts, and frequent review and practice.

Summary of Key Ideas

• Learning involves a change in the learner's cognitive structure that occurs when new information or experiences are combined with existing knowledge stored in LTM.
• Learners construction new knowledge by combining new information with knowledge already held in LTM.
• Meaningful learning is when new information is connected to knowledge currently held in LTM.

• Rote learning is when information taken is not connected to anything known or stored in LTM.
• Having a body of knowledge enhances one's ability to learn.
• There are three types of knowledge: declarative knowledge or propositional knowledge, procedural knowledge, and practical knowledge.
• A proposition is the smallest unit of meaning stored in LTM.
• Declarative knowledge is stored in LTM in the form of semantic networks.
• There are three types of memories: episodic, semantic, and procedural memory.
• Having short learning sessions spread out over time (distributed learning) is more effective than having the same learning sessions bunched together or back-to-back (massed learning).
• Interference is when old knowledge impedes or obstructs encoding of information or retrieval of knowledge.
• Retroactive interference is retrieval failure caused by something that happened after the initial encoding.
• Proactive interference is retrieval failure caused by something that occurred before the initial encoding.

References

Breuer, J. T. (1993). *Schools for thought*. Cambridge, Massachusetts: MIT Press.

Eggen P. & Kauchak, D. *Educational psychology: Windows on classrooms* (7th ed.). Upper Saddle River, NJ: Pearson

Hergenhahn, B. R., & Olson, M. H. (2005). *An introduction to theories of learning* (7th ed.). Upper Saddle River, NJ: Pearson/Prentice Hall.

Johnson, A. (1998). Word class: Using thinking skills to enhance spelling instruction. *Reading Horizons, 38,* 257-265.

Snowman, J. & Biehler, R. (2006). Psychology applied to teaching *(11th ed.).* Boston, MA: Houghton Mifflin Company.

Woolfolk, A. (2007). *Educational psychology* (10th ed.). Boston, MA: Pearson.