I.B. The Learning Process

References: Aviation Instructor's Handbook (FAA-H-8083-9)

Objectives	The learner should develop knowledge of the elements related to the learning process as required in the CFI PTS.

Elements
1. Learning Theory
2. Perceptions and Insight
3. Acquiring Knowledge
4. The Laws of Learning
5. Domains of Learning
6. Characteristics of Learning
7. Acquiring Skill Knowledge
8. Types of Practice
9. Scenario Based Training
10. Errors
11. Memory and Forgetting
12. Retention of Learning
13. Transfer of Learning

Schedule
1. Discuss Objectives
2. Review material
3. Development
4. Conclusion

Equipment
1. White board and markers
2. References

IP's Actions
1. Discuss lesson objectives
2. Present Lecture
3. Ask and Answer Questions
4. Assign homework

SP's Actions
1. Participate in discussion
2. Take notes
3. Ask and respond to questions

Completion Standards	The learner understands the learning process and can integrate the knowledge when instructing learners.

Instructor Notes:

Introduction:
   Attention
   Interesting fact or attention-grabbing story
   This will explain why you will or will not remember this lesson.

   Overview
   Review Objectives and Elements/Key ideas

   What
   Understanding how people learn, and applying that knowledge to the learning environment.

   Why
   As a flight instructor, the ability to effectively teach learners is imperative. Understanding how people learn and how to apply that knowledge is the basis for effective teaching.

How:
1. **Learning Theory**
   A. Definition – A body of principles used to explain how people acquire skills, knowledge, and attitudes
   B. How people learn is explained by 2 basic concepts: Behaviorism and Cognitive Theory
   C. Behaviorism (Positive Reinforcement, rather than no reinforcement or punishment)
      i. Stresses the importance of having particular behavior reinforced, to shape or control what is learned
         a. The instructor provides the reinforcement
      ii. Frequent positive reinforcement and rewards accelerate learning
      iii. The theory provides ways to encourage the learner's progress and learning with rewards
      iv. Today, behaviorism is used more to break unwanted behaviors, such as smoking, than in teaching
         a. The popularity of behaviorism has waned – learning has been shown to be a much more complex process than a response to a stimuli
   D. Cognitive Theory (Focuses on what is going on inside the learner's mind)
      i. Learning isn't just a change in behavior; it is a change in the way a learner thinks/understands/feels
      ii. Two Major Branches of the Cognitive Theory
         a. The Information Processing Theory
            • The learner's brain has internal structures which select and process incoming material, store/retrieve it, use it to produce behavior, and receive/process feedback on the results
               a This involves a number of cognitive processes: gathering and representing information (encoding), retaining of information, and retrieving the information when needed
               b The brain gets input from the senses (sight, hearing, touch, taste, smell); the amount of sensory input the brain receives per second is incredibly high, so the brain will let many of the habitual and routine things go unnoticed
                  1. For example, a pilot using rudder when entering a turn is often unaware of pressing the pedal
                  2. The human unconscious takes charge, leaving the conscious thought processes free
         b. Constructivism
            • Learning is the result of the learner matching new information against preexisting information and integrating it into meaningful connections

        a   Learners do not acquire knowledge and skills passively, but actively build or construct them based on their experiences

        b   Humans construct a unique mental image by combining preexisting information with the information received from sense organs

- High Order Thinking Skills (HOTS) - also referred to as aeronautical decision making (ADM)
  a. Training based on problems or scenarios
  b. Teaching the higher-level thinking skills which are essential to judgment, decision making, and critical thinking is important to aviation because a common thread in aviation accidents is the absence of higher order thinking skills
  c. Teaching HOTS
     1. Taught like other cognitive skills: from simple to complex and from concrete to abstract
     2. To teach effectively involves strategies and methods that include:
        a. Problem-based learning instruction
        b. Authentic problems
        c. Real world problems
        d. Learner-centered learning
        e. Active learning
        f. Cooperative learning
        g. Customized instruction to meet the individual learner's needs
        h. These strategies engage the learner in some form of mental activity, have the learner examine that mental activity and select the best solution, and challenge the learner to explore other ways to accomplish the task or the problem
     3. HOTS must be emphasized throughout a program of study for best results
        a. It should be taught in the initial pilot training program and in every subsequent pilot training program
     4. Cognitive research has shown the learning of HOTS is not a change in observable behavior but the construction of meaning from experience
  d. Scenario-Based Training (SBT)
     1. The heart of HOTS, and an example of Problem Based Learning
     2. SBT is a training system that uses a structured script of "real world" scenarios to address flight-training objectives in an operational environment
        a. The instructor should adapt scenarios to the aircraft, its specific flight characteristics and the likely flight environment, and should always require the learner make real-time decisions in a realistic setting
           i. Other than the first flight or two, the scenario should be planned and led by the learner
        b. It causes the learner to consider whether the decision led to the best possible outcome and challenges the learner to consider other possible solutions
     3. The strength of SBT lies in helping the learner gain a deeper understanding of the information and in the learner improving his or her ability to recall the information. The goal is reached when the material is presented as an authentic problem in an environment that allows the learner to "make meaning" of the information based on past experience and personal interpretation

E. Behavioral + Cognitive
   i. Plan, manage, and conduct aviation training with the best features of each theory
   ii. Provides a way to measure the behavioral outcomes and promote cognitive learning

2. Perceptions and Insight
   A. Initially all learning comes from perceptions which come from the senses; the learner then gives meaning to the senses
      i. New learners are overwhelmed and often focus on meaningless things, thus missing key info
         a. It is important to direct perceptions so that the learner obtains relevant information
   B. Factors affecting perceptions
      i. Physical Organism
         a. Provides the perceptual apparatus (the body) for sensing the world around them
      ii. Goals and Values
         a. Every experience is affected by the individual's values and beliefs
            • Understand the learner's values and tailor teaching to those values
         b. Goals are more highly valued and therefore sought after than other less important ideas
      iii. Self-Concept
         a. Self-image (confident or insecure) has a great influence on perception
            • A positive self-image allows the learner to remain open to new experiences
            • A negative self-image has a negative effect on learning
      iv. Time and Opportunity
         a. Proper sequence and time are necessary for learning
      v. Element of Threat
         a. Threat does not promote effective learning
            • Attention is limited to threatening object/idea
         b. Frightening or threatening learners is not effective
   C. Insight
      i. An insight is the 'aha!' moment (when the information (perceptions) 'clicks' and the learner gains a more complete understanding of the concept or subject)
         a. As a result, learning becomes more meaningful and more permanent
         b. Insight is one of the instructor's primary responsibilities
      ii. Help the learner understand how each piece of information relates to the others

3. Acquiring Knowledge
   A. Memorization
      i. First attempt to acquire knowledge
         a. Not good for problem solving
   B. Understanding
      i. Stage 2 of acquiring knowledge
      ii. The learner begins to organize knowledge in useful ways and a collection of memorized facts gives way to understanding (insight)
   C. Concept Learning
      i. Based on the assumption that humans tend to group objects, events, ideas, people, etc., that share one or more major attributes that set them apart
         a. By grouping information into concepts, we create manageable categories

4. The Laws of Learning (REEPIR)
   A. Laws of learning provide additional insight into what makes people learn most effectively
   B. **R**eadiness
      i. The basic needs of the learner need to be met before they're ready or capable of learning
         a. The instructor can do little to motivate the learner if these needs haven't been met
         b. If outside responsibilities, interests, worries, etc. weigh heavily, they may have little interest
      ii. Learners best acquire new knowledge when they see a clear reason for doing so
   a. Provide useful, applicable, information tailored to a specific learner's experience level

        iii. Two steps to keep learners in a state or readiness:
- a. Communicate a clear set of objectives and relate each new topic to the objectives
- b. Introduce topics in a logical order and leave learners with a need to learn the next topic

        iv. Be alert to, and capitalize on, teachable moments
- a. Moments of educational opportunity when a person is particularly responsive to being taught something

C. **E**xercise
- i. Connections are strengthened with practice and weakened without it
  - a. "Use it or lose it"
- ii. Exercise is most meaningful/effective when a skill is learned in the context of real-world applications
- iii. The instructor must provide opportunities for learners to practice and, at the same time, make sure that this process is directed toward a goal and performed properly
  - a. Don't let the learner practice bad habits, fix them early

D. **E**ffect
- i. Behaviors the lead to satisfying outcomes are likely to be repeated, whereas behaviors that lead to undesired outcomes are less likely to recur
- ii. Whatever the learning situation, it should contain elements that affect the learner positively and give them a feeling of satisfaction (encourage!)
  - a. Create situations designed to promote success

E. **P**rimacy
- i. What is learned first, often creates a strong, almost unshakable impression
  - a. Un-teaching is much more difficult than teaching. Teach it right the first time
- ii. The first experience should be positive, functional, and lay the foundation for all that is to follow

F. **I**ntensity
- i. A vivid, dramatic, or exciting learning experience teaches more than a routine or boring experience
- ii. The instructor should use imagination in approaching reality as closely as possible
  - a. Instruction can benefit from a wide variety of instructional aides to improve realism, motivate learning and challenge learners

G. **R**ecency
- i. Things most recently learned are best remembered
  - a. The further removed in time from a new fact/understanding, the more difficult to remember
- ii. Repeat, restate, or reemphasize important points at the end of a lesson to help in remembering

5. Domains of Learning (What is to be learned: Knowledge, Change in Attitude, Physical Skill, or combo)
  A. Besides the 4 basic levels of learning, several additional levels have been developed, and classified into 3 large groups called the domains of learning:
  B. **C**ognitive Domain (Knowledge); often referred to as Bloom's Taxonomy of Educational Objectives
     i. Educational objectives refer to knowledge which might be gained as the result of attending a ground school, reading about aircraft systems, listening to a preflight briefing, etc.
     ii. The highest objective level may be shown by learning to properly evaluate a maneuver
     iii. There are 6 major categories, or levels, starting from the simplest to the most complex
  C. **A**ffective Domain (Attitudes, Beliefs, and Values)
     i. This hierarchy addresses a learner's emotions toward the educational experience
        a. Includes feelings, values, enthusiasms, motivations, and attitudes
        b. Measuring educational objectives in this domain is not easy
     ii. Most techniques for evaluation of achievement rely on indirect inferences
        a. For example, evaluating a positive attitude toward safety
     iii. Provides a framework for teaching in 5 levels (shown below)
  D. **P**sychomotor Domain (Physical Skills)
     i. Skill based and includes physical movement, coordination, and use of the motor-skill areas
        a. Typical activities include learning to fly a precision approach, programming a GPS receiver
     ii. As physical tasks and equipment become more complex, the requirement for integration of cognitive and physical skills increases
   iii. The practical instructional levels are shown below

Objective Level	Action Verbs for Each Level
COGNITIVE DOMAIN	
Evaluation	Assess, evaluate, interpret, judge, rate, score, or write
Synthesis	Compile, compose, design, reconstruct, or formulate
Analysis	Compare, discriminate, distinguish, or separate
Application	Compute, demonstrate, employ, operate, or solve
Comprehension	Convert, explain, locate, report, restate, or select
Knowledge	Describe, identify, name, point to, recognize, or recall
AFFECTIVE DOMAIN	
Characterization	Assess, delegate, practice, influence, revise, and maintain
Organization	Accept responsibility, adhere, defend, and formulate
Valuing	Appreciate, follow, join, justify, show concern, or share
Responding	Conform, greet, help, perform, recite, or write
Receiving	Ask, choose, give, locate, select, rely, or use
PSYCHOMOTOR DOMAIN	
Origination	Combine, compose, construct, design, or originate
Adaptation	Adapt, alter, change, rearrange, reorganize, or revise
Complex Overt Response	Same as guided response except more highly coordinated
Mechanism	Same as guided response except with greater proficiency
Guided Response	Assemble, build, calibrate, fix, grind, or mend
Set	Begin, move, react, respond, start, or select
Perception	Choose, detect, identify, isolate, or compare

Affective Domain

Psychomotor Domain
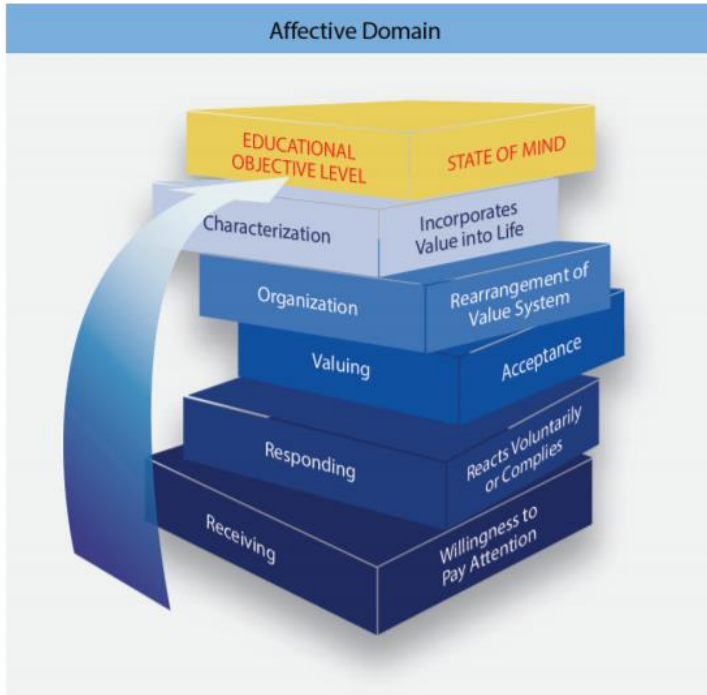
E. Levels of Learning (Not in PTS)
   i. Four Basic Levels
      a. Rote Learning – The ability to repeat something which one has been taught, without understanding or being able to apply what has been learned
      b. Understanding – Insight into what has been taught
         • The learner consolidates old and new perceptions into an insight on a subject/maneuver
      c. Application – The skill for applying what has been learned
         • Understands, has had demonstrations, and has practiced until consistent
         • Don't stop here!
      d. Correlation – Correlation of what has been learned with things previously learned and subsequently encountered
         • The objective in aviation instruction
         • Ex: Can correlate the elements of turn entries with performing lazy eights and chandelles

Basic Levels of Learning
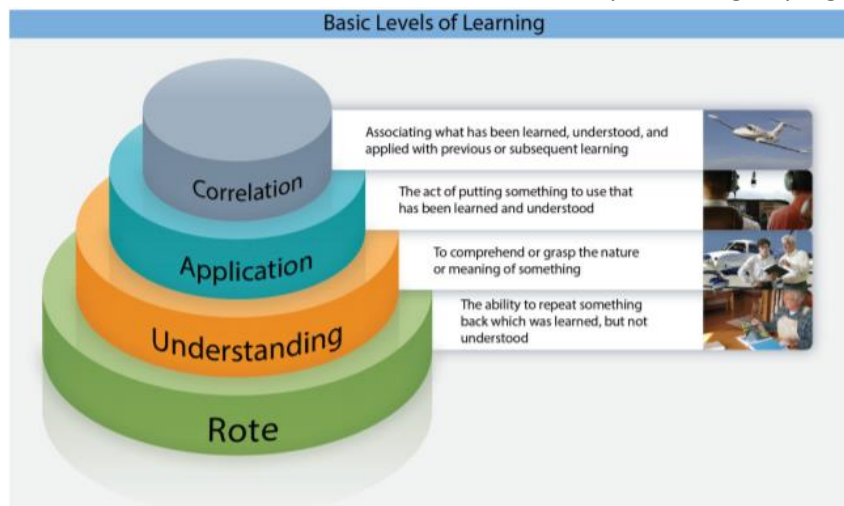
6. Characteristics of Learning (PRMA)
   A. To be effective, the learning situation should be purposeful, based on experience, multifaceted, and involve an active process
   B. **P**urposeful
      i. In the process of learning, the learner's goals are the most important factor
         a. Most people have fairly definite ideas about what they want to do and achieve (goals)
         b. Learners learn from any activity that tends to further their goals
         c. Individual needs and attitudes may determine what they learn just as much as what the instructor is trying to get them to learn
      ii. To be effective, instructors need to find ways to relate new learning to the learner's goals
   C. **R**esult of Experience (Learn by Doing)
      i. Learning is an individual process and the learner can learn only from personal experiences
         a. Previous experiences condition a person to respond to some things and to ignore others
         b. Instructors are faced with the problem of providing learning experiences that are meaningful, varied, and appropriate to individual learners
      ii. If an experience challenges the learner, requires involvement with feelings, thoughts, memory of past experiences, and physical activity, it is more effective than to commit something to memory
      iii. If learners are to use sound judgment and develop decision making skills, they need learning experiences that involve the use of judgment in solving realistic problems
   D. **M**ultifaceted
      i. Individuals learn much more than expected if they fully exercise their minds and feelings
         a. A flight instructor is not just training memory and muscles
         b. The learning process may include verbal elements, conceptual elements, perceptual elements, emotional elements, and problem-solving elements all taking place at once
      ii. While learning the subject at hand, learners may be learning other things as well
         a. They may be developing attitudes about aviation, they may learn self-reliance, etc.
   E. **A**ctive Process (Constantly Engage the Learner)
      i. The instructor cannot assume that learners remember something just because they were there when the material was presented
      ii. For effective knowledge transfer, learners need to react/respond, perhaps outwardly, perhaps only inwardly, emotionally, or intellectually

7. Acquiring Skill Knowledge
   A. Skill knowledge: knowledge reflected in motor or manual skills and in cognitive or mental skills, that manifests itself in the doing of something (for example, riding a bike)
   B. Stages of Acquiring a Skill
      i. Cognitive Stage
         a. Memorizing the steps to a skill
         b. Provide clear, step by step examples
      ii. Associative Stage
         a. Practice begins to store the skill
         b. The learner can assess progress and make adjustments instead of simply repeating steps
      iii. Automatic Response Stage
         a. Through practice, the skill becomes automatic allowing increased focus on other aspects as well
   C. Knowledge of Results
      i. The learner must be informed of their progress
         a. Both good and bad
      ii. Flying is foreign; a learner may know something is wrong but may not know how to correct it
   D. How to Develop Skills

        i.   Consistent practice

   E. Learning Plateaus

        i.   They're normal and temporary, ensure the learner understands this and is prepared for them

        ii. Over-practice can bring on a learning plateau

            a. If necessary, move away from a certain task and return to it at a later time

8. Types of Practice

   A. General

        i.   3 types of practice which yield results in acquiring skills

   B. Deliberate Practice

        i.   Learner practices specific areas for improvement and receives specific feedback after practice

            a. Feedback shows differences between performance and desired goal

               • Focus is on eliminating differences

   C. Blocked Practice

        i.   Practicing the same drill until it becomes automatic

        ii. Enhances current (short-term) performance, but does not improve either concept learning or retrieval from long-term memory

   D. Random Practice

        i.   Mixes up the skills to be acquired throughout the practice session

        ii. Performing a series of separate skills in a random order leads to better retention

            a. Learner starts to recognize the similarities/differences of each skill making it more meaningful

9. Scenario Based Training

   A. Scenarios that resemble the environment in which knowledge and skills are used are helpful to learning

   B. Good Scenario:

        i.   Clear set of objectives

        ii. Tailored to the needs of the learner

        iii. Capitalizes on the nuances of the local environment

10. Errors

   A. To believe people can eliminate errors from their performance is to commit the biggest error of all

        i.   Be prepared for occasional errors

   B. Two Kind of Errors

        i.   Slip

            a. A person plans to do one thing but inadvertently does something else

            b. Forms of Slips

                • Neglect to do something

               • Confuse two similar things

                • Asked to perform a routine in a slightly different way

               • Time pressure

        ii. Mistake

            a. A person plans to do the wrong thing and succeeds

                • Error of thought. Sometimes caused by a gap or misconception in learner's understanding

            b. Forms of Mistakes

                • Incorrect understanding

                • Incorrectly categorizing a specific situation

   C. Reducing Error

        i.   Learning and practicing

   a. Chair flying when away from the aircraft can be a huge help (as long as it is practiced properly)

        ii. Taking Time

a. Work at a comfortable pace

b. Slow is steady, steady is fast

- Don't rush, make mistakes, and have to repeat/start over

iii. Checking for Errors

a. Actively look for evidence of errors

iv. Using Reminders

a. Checklists, bugs, notebook, etc.

v. Developing Routines

a. Standardized procedures are widely known to reduce errors

vi. Raising Awareness

a. Raise awareness when operating in conditions under which errors are known to happen, or in conditions which defenses against errors have been compromised (fatigue, lack of practice, etc.)

D. Error Recovery

i. Error is inevitable, learners must learn to recover from situations

a. Do not let the error "snowball" and cause additional problems, or grow bigger than it is

- Solve the problem, and focus on the tasks at hand/ahead

E. Learning from Error

i. Great learning tool

ii. When an error is made ask the learner why it happened/what could be done different

a. Great debrief topics include a discussion of what went well, followed by a discussion of what could have gone better

11. **Memory and Forgetting**

A. Memory General

i. Memory includes 3 parts: Sensory, Short-Term, and Long-Term Memory

ii. The total system operates like a computer

a. Accepts input, information is processed, storage capability, and an output function
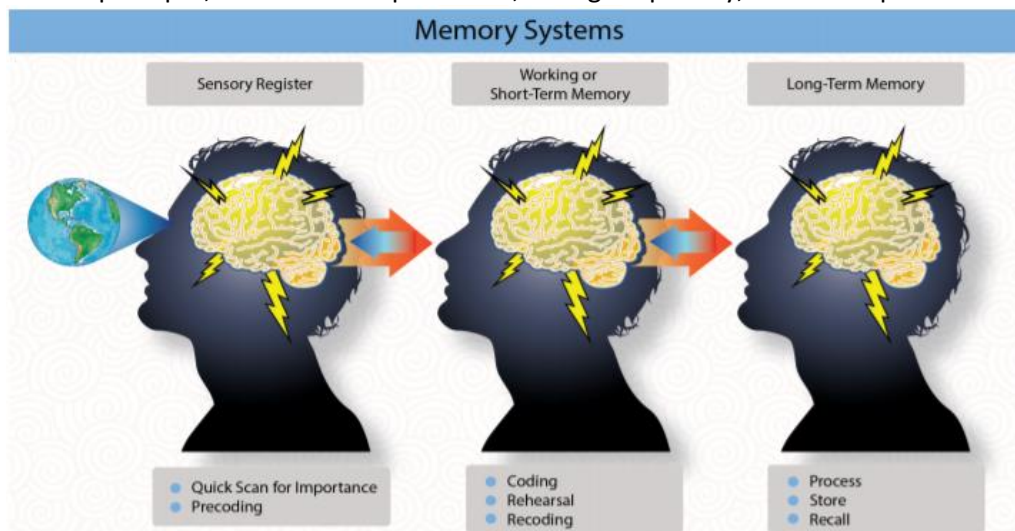
B. Sensory Memory (Quick Scan, Precoding)

i. Receives stimuli from the environment and quickly processes it according to a preconceived concept of what is important

a. Other factors can influence reception of info

- If it is dramatic or impacts more than one sense it is more likely to make an impression

b. It recognizes certain stimuli and immediately transmits them to short-term memory for action

- This is called precoding (ex. Fire Alarm – working memory is immediately made aware of the alarm and preset responses begin to take place)
 ii. Capable of retaining information for only a very short period of time and within seconds the relevant information is passed to the short-term memory

C. Short-Term Memory (Coding, Rehearsal, Recoding)
 i. Short-term memory resembles the control tower of a major airport and is responsible for coordinating all incoming and outgoing flights
  a. Information is stored for roughly 30 seconds, after which it may rapidly fade or be consolidated into long-term memory, depending on the individual's priorities
 ii. Rehearsal or repetition of the info and sorting or categorization into chucks help with retention
  a. The sorting process is called Coding or Chunking
  b. Usually takes 5 - 10 sec; if interrupted, the information is easily lost since it is only stored for 30 seconds
 iii. Time limited and Capacity limited (time limitation can be overcome by repetition)
 iv. The coding process may involve recoding to adjust information to individual experiences
  a. This is when actual learning begins to take place
  b. Recoding: relating incoming information to concepts or knowledge already in memory
 v. Three basic operations of Short-term memory
  a. Iconic Memory: Brief sensory memory of visual images
  b. Acoustic Memory: Encoded memory of a brief sound memory or the ability to hold sounds in short-term memory
  c. Working Memory: Active process to keep information until it is put to use
   - The goal of working memory is not to move information from short-term to long-term memory, but merely to put the information to use
 vi. Developing a logical strategy for coding information is a significant step in the learning process

D. Long-Term Memory (Process, Store, Recall)
 i. Relatively permanent storage of unlimited information
  a. For it to be useful, special effort must have been expended during the coding process
   - The more effective the coding process, the easier the recall
   - What is stored in long-term memory affects a person's perceptions of the world and what information in the environment is noticed
    a Information that makes it to long-term memory typically has some significance attached to it
 ii. One of the major responsibilities of the instructor is to help learners use their memories effectively
  a. Look for ways to make training relevant and meaningful enough for the learner to transfer new information to long-term memory

E. Memory and Usage
 i. The ability to retrieve knowledge or skills is primarily related to two things:
  a. How often the knowledge has been used
  b. How recently the knowledge has been used
 ii. The more frequent and recent knowledge is used, the more likely it is retained

F. Forgetting
 i. There are many theories regarding why people forget (FIIRS)
  a. Fading: Suggests that information that is not used for a period of time is forgotten
  b. Interference: We forget things because an experience has overshadowed it, or the learning of similar things has intervened
   - Two conclusions from interference:
    a Similar material seems to interfere with memory more than dissimilar material

             b   Material not well learned suffers most from interference

     c.   **R**etrieval Failure: Inability to retrieve the information

     d.   **R**epression or **S**uppression: A memory is pushed out because the individual does not want to remember the feelings associated with it

12. Retention of Learning

A. The instructor needs to make certain that the learner's learning is readily available for recall
    i.   Teach thoroughly and with meaning

B. Praise Stimulates Remembering
    i.   Responses that give a pleasurable return tend to be repeated

C. Recall is Promoted by Association
    i.   Each bit of information or action, which is associated with something to be learned, tends to facilitate its later recall by the learner

D. Favorable Attitudes Aid Retention
    i.   Without motivation there is little chance for recall; the most effective motivation is based on positive or rewarding objectives

E. Learning with all our Senses is most Effective
    i.   When several senses respond together, a fuller understanding and greater chance of recall is achieved

F. Meaningful Repetition Aids Recall (mere repetition does not guarantee retention)
    i.   Each repetition provides an opportunity to gain a clearer perception of the subject to be learned
    ii. 3-4 repetitions provide the maximum effect

13. Transfer of Learning

A. Primary Objective is to promote Positive Transfer
    i.   Positive Transfer - Learning skill A helps to learn skill B (slow flight and short field landings)
    ii. Negative Transfer - Learning skill A hinders learning of skill B (landing an airplane vs a helicopter)
    iii. A degree of transfer is involved in all learning since all learning is based on prior learned experience
        a.   People interpret new things in terms of what they already know
    iv. Achieving Positive Transfer
        a.   Plan for transfer as a primary objective
        b.   Ensure that learners understand that information can be applied in other situations
        c.   Maintain high-order learning standards
        d.   Avoid unnecessary rote learning, since it does not foster transfer
        e.   Provide meaningful learning experiences that build confidence in their ability to transfer knowledge
        f.   Use material that helps form valid concepts and generalizations (make relationships clear)

B. Habit Formation
    i.   It's the instructor's task to insist on correct techniques/procedures to provide proper habit patterns

C. Training traditionally has followed a building block concept
    i.   Start with the basics and build from there

Conclusion

Brief review of the main points

PTS Requirements:

To determine that the applicant exhibits instructional knowledge of the learning process by describing:

1. Learning theory.
2. Perceptions and insight.
3. Acquiring knowledge.
4. The laws of learning.
5. Domains of learning.
6. Characteristics of learning.
7. Acquiring skill knowledge.
8. Types of practice.
9. Scenario-based training.
10. Errors.
11. Memory and forgetting.
12. Retention of learning.
13. Transfer of learning.

I.B. The Learning Process