Teaching and Learning Principles
(notes from 3 sources)

Framing Quotes:
Learning results from what the student does and thinks and only from what the student does and thinks. The teacher can advance learning only by influencing what the student does to learn.
—Herbert A. Simon

Expertise does not happen by chance. It requires deliberate practice. —Robert J. Marzano

Ambrose, Susan A., eds. *How Learning Works: Seven Research-based Principles for Smart Teaching*. San Francisco, CA: Jossey-Bass, 2010. Print.

The seven principles discussed in the book:

1. Students' prior knowledge can help or hinder learning.
2. How student organize knowledge influences how they learn and apply what they know.
3. Students' motivation determines, directs, and sustains what they do to learn.
4. To develop mastery, students must acquire component skills, practice integrating them, and know when to apply what they have learned.
5. Goal-directed practice coupled with targeted feedback enhances the quality of students' learning.
6. Students' current level of development interacts with the social, emotional, and intellectual climate of the course to impact learning.
7. To become self-directed learners, students must learn to monitor and adjust their approaches to learning.

Principle 1 Summary: If students' prior knowledge has gaps and insufficiencies, it may not adequately support new knowledge. If prior knowledge is applied in the wrong context, it may lead students to make faulty assumptions or draw inappropriate parallels. Inaccurate prior knowledge can both distort students' understanding and interfere with incoming information (and be difficult to correct). Consequently, a critical task for instructors is to assess what students know and believe so we can build on knowledge that is accurate and relevant, and fill in gaps and insufficiencies where they exist.

Principle 1 Strategies
Methods to gauge the extent and nature of students' prior knowledge

1. Talk to colleagues who teach prerequisite classes or examine their syllabi and assignments. [Hold discussions about curriculum maps]
2. Administer a diagnostic assessment like a short quiz or concept inventory.
3. Have students assess their own prior knowledge with a knowledge survey.
4. Use brainstorming to reveal prior knowledge, beliefs, associations, assumptions.
5. Assign a concept map activity: circles for concepts, lines with labels for connections.
6. Look for patterns of error in student work (use clickers).

Methods to activate accurate prior knowledge

1. Use exercises to generate students' prior knowledge. Begin a lesson by asking students what they already know about a topic or create a concept map.
2. Explicitly link new material to knowledge from previous courses.
3. Explicitly link new material to prior knowledge from your own course.
4. Use analogies and examples that connect to students' everyday knowledge.

5. Ask students to reason on the basis of relevant prior knowledge.

Methods to address insufficient prior knowledge

1. Identify the prior knowledge you expect students to have.
2. Remediate insufficient prerequisite knowledge.

Methods to help students recognize inappropriate prior knowledge

1. Highlight conditions of applicability.
2. Provide heuristics to help students avoid inappropriate application of knowledge.
3. Explicitly identify discipline-specific conventions.
4. Show where analogies break down.

Methods to correct inaccurate knowledge

1. Ask students to make and test predictions.
2. Ask students to justify their reasoning.
3. Provide multiple opportunities for students to use accurate knowledge.
4. Allow sufficient time.

Principle 2 Summary: Knowledge organizations that include more interconnections and that are based on deep and meaningful features are more effective in supporting learning and performance.

Principle 2 Strategies

1. Create a concept map to analyze your own knowledge organization (see examples)
2. Analyze tasks to identify the most appropriate knowledge organization.
3. Provide students with the organizational structure of the class, and use clear transitions when communicating the structure verbally.
4. Share the organization of each lecture, lab, or discussion. Pg 61
5. Use contrasting and boundary cases to highlight organizing structures.
6. Explicitly highlight deep structures.
7. Make connections among concepts explicit.
8. Encourage students to work with multiple organizing structures.
9. Ask students to draw a concept map to expose their knowledge organizations.
10. Use a sorting task to expose students' knowledge organizations.
11. Monitor students' work for problems in their knowledge organizations.

Principle 3 Summary: Students have multiple and diverse goals, many of which may not align with ours. Subjective values and expectancies influence motivation.

Principle 3 Strategies

Strategies to Establish Value

1. Connect the material to students' interests; find out about their interests
2. Provide authentic, real-world tasks
    a. Link new learning to current events, real-world problems
    b. Assign service-learning projects, field work, internships
3. Show relevance to students' current academic lives by linking concepts to other courses, disciplines, and future courses
4. Demonstrate the relevance of higher-level skills to students' future professional lives
5. Identify and reward what you value in the syllabus, through feedback and modeling
6. Show your own passion and enthusiasm for the discipline

Strategies that help students build positive expectancies

1. Ensure alignment of objectives, assessments, and instructional strategies
2. Identify an appropriate level of challenge
    a. Know their prior knowledge
    b. Rely on curriculum mapping
3. Create assignments that provide the appropriate level of challenge
4. Provide early success opportunities, especially for high-risk courses
5. Articulate your expectations
6. Provide rubrics (developing, competent, exemplary, etc.)
7. Provide targeted feedback
8. Be fair
9. Educate students about the ways we explain success and failure (focus on controllable factors)
10. Describe effective study strategies

Strategies that address value and expectancies

1. Provide flexibility and control: allow students to choose options consistent with their goals
2. Give students an opportunity to reflect

Principle 4 Summary: In order to develop mastery, students must 1) develop component skills, 2) practice combining and integrating these components to develop fluency and automaticity, and then 3) understand the conditions and contexts in which they can apply what they have learned.

Principle 4 Strategies

1. Push past your own expert blind spot by analyzing and isolating the component skills necessary for a task and then teach those skills.
2. Enlist a TA or Grad student to help with task decomposition. Experts operate in the "unconscious competence" state; grad students are often still in the "conscious competence" state.
3. Talk with colleagues and share assignments, rubrics, etc.
4. Enlist the help of someone outside the discipline.
5. Explore available educational materials.
6. Focus students' attention on key aspects of the task.
7. Diagnose weak or missing component skills.
8. Provide isolated practice of weak or missing skills.
9. Give students practice to increase fluency.
10. Temporarily constrain the scope of the task.
11. Explicitly include integration in your performance criteria.
12. Discuss conditions of applicability.
13. Give students opportunities to apply skills or knowledge in diverse contexts.
14. Ask students to generalize to larger principles.
15. Use comparisons to help students identify deep features.
16. Specify context and ask students to identify relevant skills or knowledge.
17. Specify skills or knowledge and ask students to identify contexts in which they apply.
18. Provide prompts to relevant knowledge.

Principle 5 Summary: Focus on a specific goal or criterion for performance; target an appropriate level of challenge relative to students' current performance; schedule sufficient quantity and frequency of feedback; communicate where students are relative to stated goals and what they need to do to improve; and provide the feedback when students can make the best use of it.

Principle 5 Strategies

Strategies addressing the need for goal-directed practice.

1. Conduct a prior knowledge assessment to target the appropriate level of challenge. Performance diagnostics are generally superior to knowledge surveys.
2. Be more explicit about your goals in your course materials.
3. Use a rubric to specify and communicate performance criteria.
4. Build in multiple opportunities for practice.
5. Build scaffolding into assignments. Give students multiple supports for the learning early in practice and gradually remove them as students gain mastery. For instance, divide complex tasks into discrete parts for practice and feedback.
6. Set expectations about practice. Students will underestimate the time needed to master complex material or tasks. Collect data from students about their use of time in reflection surveys for setting future expectations in the syllabus.
7. Give examples or models of target performance, such as a model design, and effective paper, a good solution set to a problem. Give examples of past student work with highlights on successful aspects of a complex performance.
8. Show students some common misinterpretations of assignments or what typically doesn't work.
9. Build in enough flexibility in the course design to allow refinement of goals and performance criteria as the course progresses.

Strategies addressing the need for targeted feedback

1. Look for patterns of errors in student work, using item analysis techniques.
2. Prioritize your feedback. It is not necessary or even good to give feedback on all aspects of performance. Focus on key aspects of the assignment and what the student can most likely use to improve.
3. Balance strengths and weaknesses. Students are often unaware of the progress they are making, especially early in practice. Begin with targeted feedback that is positive to enhance students' sense of efficacy and motivation.
4. Design frequent opportunities to give feedback, which means more tasks of shorter length and smaller scope.
5. Provide feedback at the group level; it doesn't always need to be individualized.
6. Use paper-based (colored index cards) or interactive technology (clickers, et al.) to provide real-time feedback at the group level.
7. Incorporate peer feedback using guidelines, criteria sheets, or rubrics. Giving feedback is a complex skill that needs practice. Build in the necessary time early in the practice for students to become effective at giving peer feedback. Schedule in-class norming sessions using clickers or small group reports.
8. Require students to specify how they used feedback in subsequent work. Students often do not see the connection between or among assignments, projects, exams, etc.

Principle 6 Summary: College students are still developing as intellectual, social, and emotional beings. Course climate interacts with student development to impact learning and performance. Instructors can be more intentional about shaping course climate and student learning.

Principle 6 Strategies

1. Make uncertainty safe; validate different viewpoints; embrace complexity and ambiguity; model the enrichment of thinking rather than simplification or just consensus.
2. Resist a single right answer. Textbooks present information linearly, but knowledge is generated and contested over time. Create a structure that supports dialogue. Use assignments with multiple correct answers.
3. Incorporate evidence into performance and grading criteria to focus students on learning rather than grade-grubbing activities.
4. Examine your assumptions about students' backgrounds and prior knowledge.
5. Be mindful of low-ability cues.
6. Never ask individuals to speak for an entire group.
7. Reduce anonymity by learning students' names and interests.
8. Model inclusive language, behavior, and attitudes.
9. Use multiple and diverse examples.
10. Establish and reinforce ground rules for interaction.
11. Make sure course content does not lend itself to marginalizing students.
12. Use the syllabus and first day of class to establish the course climate.
13. Set up processes to get feedback on the climate.
14. Anticipate and prepare for potentially sensitive issues.
15. Address tensions early.
16. Turn discord and tension into a learning opportunity.
17. Facilitate active listening.

Principle 7 Summary: faculty members may both overestimate their students' metacognitive abilities and underestimate the extent to which these skills and habits must be taught and reinforced through instruction.

Principle 7 Strategies

1. Be more explicit than you may think necessary when explaining the assignment.
2. Tell students what you do not want.
3. Check students understanding of the task.
4. Provide performance criteria with the assignment.
5. Give early, performance-based assessments.
6. Provide opportunities for self-assessment.
7. Have students implement a plan that you provide.
8. Have students create their own plan.
9. Make planning the central goal of the assignment.
10. Provide simple heuristics for self-correction.
11. Have students do guided self-assessments.
12. Require students to reflect on and annotate their own work.
13. Use peer review/reader response.
14. Provide activities that require students to reflect on their performances.
15. Prompt students to analyze the effectiveness of their study skills.
16. Present multiple strategies.

17. Create assignments that focus on strategizing rather than implementation.
18. Address students' beliefs about learning directly.
19. Broaden students' understanding of learning.
20. Help students set realistic expectations.
21. Model your metacognitive processes.
22. Scaffold students in their metacognitive processes.

Nilson, Linda B. Teaching at its Best: A Research-Based Resource for College Instructors. 3rd ed. San Francisco: Jossey-Bass Pub., 2010.

Learning Principles

1. People are born learners, beginning from infancy with an insatiable curiosity and an increasing awareness of their learning. They absorb and remember untold billions of details about objects, other people, their language, and things they know how to do (Bransford, Brown, & Cocking, 1999; Spence, 2001).
2. People learn through elaborative rehearsal, which means connecting new knowledge to what they already know and believe (Bransford et al., 1999; Tigner, 1999).
3. People learn what they regard as relevant to their lives (Svinicki, 2004).
4. People learn socially by constructing knowledge in a group (Stage, Kinzie, Muller, & Simmons, 1999), but they otherwise learn one-on-one and on their own (Spence, 2001).
5. People learn when they are motivated to do so by the inspiration and enthusiasm of other people in their lives (Feldman, 1998b).
6. People don't learn well when their major learning context is teacher centered—that is, when they passively listen to a teacher talk. Rather, they learn when they are actively engaged in an activity, a life experience. The human brain can't focus for long when it is in a passive state (Bligh, 2000; Bonwell & Eison, 1991; Hake, 1998; Jones-Wilson, 2005; McKeachie, 2002; Spence, 2001; Svinicki, 2004).
7. People learn best when they receive the new material multiple times but in different ways—that is, through multiple senses and modes that use different parts of their brain (Kress, Jewitt, Ogborn, & Charalampos, 2006; Tulving, 1985; Vekiri, 2002).
8. People learn when they actively monitor their learning and reflect on their performance—a mental operation called *metacognition* or *self-regulated learning* (Bransford et al., 1999).
9. Relatedly, people learn less by reviewing material and more from being tested or testing themselves on it, as the latter involves greater cognitive processing and practice retrieving (Dempster, 1996, 1997; Roediger & Karpicke, 2006).
10. People learn better when the material evokes emotional and not just intellectual or physical involvement. In other words, a lasting learning experience must be moving enough to make the material memorable or to motivate people to want to learn it. This learning pattern mirrors the biological basis of learning, which is the close communication between the frontal lobes of the brain and the limbic system. From a biological point of view, learning entails a change in the brain: the establishment of desirable new synapses (Leamnson, 1999, 2000; Mangurian, 2005).

Teaching Principles that Complement the Learning Principles

1. Hold your students to high expectations. But be reasonable, and don't use yourself as the standard. Very few students will learn your field as quickly as you did or choose the life of the mind as you have.
2. Start where your students are. Find out what they already know and don't know and what they believe to be true, and become familiar with their lifestyles. Then relate the new content, skills, and abilities you are helping them learn to what is familiar to them, both cognitively and experientially. Use examples and analogies out of their lives and their gen rational experience.
3. Make the material relevant to the students' lives, which for today's concrete learners means connecting your material to their day-to-day experience, future careers, or real-world problems.
4. Demonstrate enthusiasm and passion for your subject and for teaching it, as these are contagious emotions. If these don't come naturally to you, learn how to use your voice and body to convey them.
5. Assign creative, inventive, and challenging tasks to small groups and more routine learning tasks, such as first-exposure reading and standard problem sets, as individual homework. Some students will need tutoring after their individual attempts at learning, which you, a teaching assistant (TA), or group members can provide. Reflection and writing are also individual learning activities, even though they can be very challenging and creative.
6. Use active learning techniques, and when you do lecture, do so interactively—that is, with frequent breaks for student activities.
7. When possible, use experiential methods: those that place students in real-life problem-solving situations, simulated or genuine.
8. Teach in multiple modalities. Give students the opportunities to read, hear, talk, write, see, draw, think, act, and feel new material into their system. In other words, involve as many senses and parts of the brain as possible in your teaching and their learning. If, as is commonplace, the students are reading or listening to the material, have them take notes on it, discuss it in pairs or groups, concept- or mind-map it, freewrite about it, solve problems with it, complete a classroom assessment exercise on it, or take a quiz on it.
9. Teach your students how to learn your material, and build in assignments that make them observe, analyze, and assess how well they are learning.
10. Build into your course plenty of assessment opportunities, including low-stakes quizzes, practice tests, in-class exercises, and homework assignments that can tell students how much they are really learning, as well as provide them with retrieval practice.
11. Motivate and reinforce learning with emotions. Make a learning experience dramatic, humorous, surprising, joyous, maddening, exciting, or heart- wrenching. Integrate engaging cases and problems to solve, simulations and games, role plays, service-learning, and other experiential learning opportunities into your courses. Let students reflect, debate, consider multiple points of view, write down their reactions to the material, and work cooperatively in groups. Any emotion will aid learning by inducing more enduring changes—that is, the generation of new, lasting synapses in the brain.

The Role that Structure Plays in Learning

1. Very early in the term, give students activities and assignments that make them retrieve, articulate, and organize what they already know (or think they know) about your course material. Then identify any evident misconceptions and address in class how and why they are wrong.
2. Again, very early, give students the big picture—the overall organization of your course content. The clearest way to show this is in a graphic syllabus. Carry through by presenting your content as an integrated whole, that is, as a cohesive system of interpreting phenomena—not as an aggregate of small, discrete facts and terms. Keep referring back to how and where specific topics fit into that big picture.
3. Give students the big picture of their learning process for the term—that is, the logical sequencing of your learning outcomes for them. A flowchart of the student learning process for a course is called an *outcomes map*.
4. Help students see the difference between information [as discreet facts] and knowledge [organized sets or domains of concepts, generalizations, inferences, strongly backed theories, well-tested principles, etc.]
5. Teach students the critical thinking structures that your discipline uses—for example, the scientific method, the diagnostic process, the rules of rhetoric, basic logic (the nature of fact, opinion, interpretation, and theory), and logical fallacies. Where applicable, acquaint them with the competing paradigms (metatheories) in your field, such as the rational versus the symbolic interpretive versus the postmodern perspectives in English literature, pluralism versus elitism in political science, functionalism versus conflict theory in sociology, and positivism (or empiricism) versus phenomenology in social science epistemology.
6. Design exercises for your students in pattern recognition and categorical chunking to help them process and manage the landslide of new material. These thinking processes will help them identify conceptual similarities, differences, and interrelationships while reducing the material to fewer, more manageable pieces. The fewer independent pieces of knowledge the mind has to learn, the more knowledge it can process and retain. Cognitively speaking, less is more.
7. In addition to showing your students a graphic syllabus and outcome map of your course, furnish them with graphic representations of theories, conceptual interrelationships, and knowledge schemata—such as concept maps, mind maps, diagrams, flowcharts, comparison-and-contrast matrices, and the like—and then have them develop their own to clarify their understanding of the material. Such visuals are powerful learning aids because they provide a ready-made, easy- to-process structure for knowledge. In addition, the very structures of graphics themselves supply retrieval cues (Svinicki, 2004; Vekiri, 2002).

Willingham, Daniel T. *Why Don't Students Like School? A Cognitive Scientist Answers Questions about How the Mind Works and What it Means for the Classroom*. Wiley, 2009.

Chpt	Cognitive Principle	Req. Knowledge about Students	Classroom Implication
1	People are naturally curious, but they are not naturally good thinkers.	What is just beyond what my students know and can do?	Think of to-be-leaned material as *answers*, and take the time necessary to explain to students the questions.
2	Factual knowledge precedes skill.	What do my students know?	It is not possible to think well on a topic in the absence of factual knowledge about the topic.
3	Memory is the residue of thought.	What will students think during this lesson?	The best barometer for every lesson plan is "Of what will it make the students think?"
4	We understand new things in the context of things we already know.	What do students already know that will be a toehold on understanding the new material?	Always make deep knowledge your goal, spoken and unspoken, but recognize that shallow knowledge will come first.
5	Proficiency requires practice.	How can I get students to practice without boredom?	Think carefully about which material students need at their fingertips, and practice it over time.
6	Cognition is fundamentally different early and late in training.	What is the difference between my students and an expert?	Strive for deep understanding in your students, not the creation of new knowledge.
7	[Students] are more alike than different in terms of learning.	Knowledge of students' learning styles is not necessary.	Think of lesson content, not student differences, driving decisions about how to teach.
8	Intelligence can be changed through sustained hard work.	What do my students believe about intelligence?	Always talk about successes and failures in terms of effort, not ability.
9	Teaching, like any complex cognitive skill, must be practiced to be improved.	What aspects of my teaching work well for my students, and what parts need improvement?	Improvement requires more than experience; it also requires conscious effort and feedback.