Research-based Principles of Learning & Teaching Strategies

Eberly Center for Teaching Excellence
Carnegie Mellon University

The following list presents the basic principles and teaching strategies that underlie effective learning. These principles are distilled from research from a variety in disciplines.

1. Students' prior knowledge can help or hinder learning.

Students come into our courses with knowledge, beliefs, and attitudes gained in other courses and through daily life. As students bring this knowledge to bear in our classrooms, it influences how they filter and interpret what they are learning. If students' prior knowledge is robust and accurate *and activated at the appropriate time*, it provides a strong foundation for building new knowledge. However, when knowledge is inert, insufficient for the task, activated inappropriately, or inaccurate, it can interfere with or impede new learning. To apply this principle, consider the following teaching techniques:

- Administer a diagnostic assessment or have students assess their own prior knowledge (See "Selected Classroom Assessment Techniques (CATs) for Getting Feedback on Student Learning," pg 85).
- Use brainstorming to reveal prior knowledge.
- Identify discipline-specific conventions explicitly.
- Ask students to make and test predictions (See "Teaching for Retention in Science, Engineering & Mathematics," p. 53).

2. Students' motivation determines, directs, and sustains what they do to learn.

As students enter college and gain greater autonomy over what, when, and how they study and learn, motivation plays a critical role in guiding the direction, intensity, persistence, and quality of the learning behaviors in which they engage. When students find positive value in a learning goal or activity, expect to successfully achieve a desired learning outcome, and perceive support from their environment, they are likely to be strongly motivated to learn. To apply this principle, consider the following teaching techniques:

- Connect the material to students' interests.
- Provide authentic, real-world tasks (See "Teaching for Retention in Science, Engineering & Mathematics," p. 53).
- Show relevance to students' current academic lives.
- Provide rubrics (See "Best Practices for Designing & Grading Exams," p. 132, and "Sample Laboratory Report Rubrics," p. 121).

3. How students organize knowledge influences how they learn and apply what they know.

Students naturally make connections between pieces of knowledge. When those connections form knowledge structures that are accurately and meaningfully organized, students are better able to retrieve and apply their knowledge effectively and efficiently. In contrast, when knowledge is connected in inaccurate or random ways, students can fail to retrieve or apply it appropriately. To apply this principle, consider the following teaching techniques:

- Provide students with the organizational structure of the course.
- Share the organization of each lecture, lab, or discussion explicitly (See "How to Make Lectures More Effective," p. 124).
- Make connections among concepts explicit.
- Ask students to draw a concept map to expose their understanding of how course material is organized.

4. To develop mastery, students must acquire component skills, practice integrating them, and know when to apply what they have learned.

Students must develop not only the component skills (i.e., fundamental skills) and knowledge necessary to perform complex tasks, they must also practice combining and integrating them to develop greater fluency and automaticity. Finally, students must learn when and how to apply the skills and knowledge they learn. As instructors, it is important that we develop conscious awareness of these elements of mastery so as to help our students learn more effectively. To apply this principle, consider the following teaching techniques:

- Provide isolated practice of weak or missing skills.
- Give students opportunities to practice skills including low-stakes, ungraded assignments See "Selected Classroom Assessment Techniques (CATs) for Getting Feedback on Student Learning," p. 88).
- Give students opportunities to apply skills or knowledge in diverse contexts.
- Specify skills or knowledge and ask students to identify contexts in which they apply.

5. Goal-directed practice coupled with targeted feedback enhances the quality of students' learning.

Learning and performance are best fostered when students engage in practice that focuses on a specific goal or criterion, targets an appropriate level of challenge, and is of sufficient quantity and frequency to meet the performance criteria. Practice must be coupled with feedback that explicitly com-

municates about some aspect(s) of students' performance relative to specific target criteria, provides information to help students progress in meeting those criteria, and is given at a time and frequency that allows it to be useful. To apply this principle, consider the following teaching techniques:

- Be explicit about your goals in your course materials (See "Strategies for Effective Lesson Planning," p. 37).
- Stage assignments by breaking tasks into smaller assignments.
- Look for patterns of errors in student work.
- Prioritize your feedback (See "Responding to Student Writing – A Sample Commenting Protocol," p. 137).
- Incorporate peer feedback.

6. Students' current level of development interacts with the social, emotional, and intellectual climate of the course to impact learning.

Students are not only intellectual but also social and emotional beings, and they are still developing the full range of intellectual, social, and emotional skills. While we cannot control the developmental process, we can shape the classroom climate in developmentally appropriate ways. In fact, many studies have shown that the climate we create has implications for our students. A negative climate may impede learning and performance, but a positive climate can energize students' learning. To apply this principle, consider the following teaching techniques:

- Make uncertainty safe.
- Examine your assumptions about students.
- Model inclusive language, behavior, and attitudes (See p. 50 for guideance).
- Establish and reinforce ground rules for interaction (See "Guidelines for Class Participation," p. 58).
- Use the syllabus and first day of class to establish the course climate (See "Creating your Syllabus," p. 18).

7. To become self-directed learners, students must learn to monitor and adjust their approaches to learning.

Learners may engage in a variety of metacognitive processes to monitor and control their learning—assessing the task at hand, evaluating their own strengths and weaknesses, planning their approach, applying and monitoring various strategies, and reflecting on the degree to which their current approach is working. Unfortunately, students tend not to engage in these processes naturally. When students develop the skills to engage these processes, they gain intellectual habits that not only improve their performance but also their effectiveness as learners. To apply this principle, consider the following teaching techniques:

- Check students' understanding of the task.
- Have students do guided self-assessments.
- Require students to reflect on and annotate their own work.
- Prompt students to analyze the effectiveness of their study skills.
- Have students engage in peer feedback.

References

Ambrose, S., Bridges, M., DiPietro, M., Lovett, M., Norman, M. (2010) *How learning works*. San Francisco: Jossey Bass

Adapted with permission from Eberly Center for Teaching Excellence, Carnegie Mellon University, Pittsburgh, Pennsylvania.

Eberly Center for Teaching Excellence, Carnegie Mellon University (n.d.) *Theory and Research-based Principles of Learning*. Retrieved from http://www.cmu.edu/teaching/principles/learning.html