Basic Principles of Learning

Ira Fischler, Prof. [of Interesting Stuff] Emeritus
Psychology Department & Office of Research

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My Background (And Yours)

Who am I to say what the principles are?

- Trained as a cognitive psychologist in the “information-processing” tradition
  - The “computer” metaphor: *Encoding, Storage, & Retrieval*

- Research since 1970 (my first pub!) on attention, rehearsal, short- and long-term memory, and language (*and emotion, creativity, aging, brain activity, deafness, . . .*)

- Teaching courses on these topics
  - And applying (a) little of what I’d learned
Basic Principles of Learning

Plan for the session:

- Teachers as “learning specialists”
- “Folk” theories and principles of learning
  - As a student, what have you learned about learning?
  - Do you practice it?
- Science-based principles of learning and retention
- Defining and implementing your goals for learning
“Folk” Theories of learning

* Jot down three basic *principles of learning* that you’ve learned. What matters most?
* Draw “Venn Diagram” indicating the relative impact of:
  - The instructor
  - The student
  - The interaction (overlap) between them (and how much you can control/change their strategies)
Principles from the Educators

“The principles state that students learn best when:

- the learning environment is supportive and productive
- the learning environment promotes independence, interdependence and self-motivation
- students’ needs, backgrounds, perspectives and interests are reflected in the learning program
- students are challenged and supported to develop deep levels of thinking and application
- assessment practices are an integral part of teaching and learning
- learning connects strongly with communities and practice beyond the classroom.”

Principles from the Educators (2)

“Research-based Principles of Learning”

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

[http://www.crlt.umich.edu/gsis/p4_7]
Behavioral Principles of Learning

- Associative learning, conditioning and contiguity ("what fires together, wires together")
- Operant learning and reinforcement
- Focus on identifying the “behaviors” to be learned, and reinforcing their occurrence
- Useful “in principle” but underspecified in practice, and applied largely to
  - Animal learning
  - Limited-capacity individuals
  - “Cognitive-behavioral therapy”
Cognitive Principles of Learning

- Focus on the processes, not the products
  - Cognescere: *To know*
- The “sweet spot” for pragmatic strategies?
- Development of this research from limits of behavioral research to specify “what matters”
Principle 1: Attention

“On average, we can attend to about one thing at a time” (Norman, 1980)
- Without active attention, learning may be zero (Cherry 1953)
- “multitasking” amounts to task-switching
- Some tasks can be “time-shared” but one or both must be “automatic” and highly practiced

We can see/hear material but not “pay attention” (Even when studying, driving)

Lots of competition for attention
- Texting, daydreaming, planning. . . . Or your next lecture point?
Ensuring Attention

In the classroom:

- Be interesting! Be funny! Be surprising!
- Ban smartphones, be suspicious of laptops
- Use frequent interactions to maintain attention
- Your strategies? “Flipped” classrooms?

And elsewhere:

- Encourage self-monitoring during study
- Finding a place with the right amount of distraction
Principle 2: Practice

- Duh. . . (But effectiveness a function of many things)
- The classic “learning curve”
  - Not linear, but monotonic
  - Steeper is better!
- Learning versus performance
  - “Overlearning” and the assessment of achievement
  - Is learning ever “perfect?”
Principle 2a: Spaced Practice

For X amount of practice, it’s better to “space” sessions or presentations than to “mass” them together.

- Sometimes stunningly better
- The longer the “retention interval” (from last exposure) the bigger the advantage
- Holds over many time scales, types of materials, and kinds of tests
- Explanations?
Spaced practice: across sessions

Learning Spanish vocabulary

- Two sessions, two hours each
- 0, 1, or 30 days between sessions
- Immediate test: no differences
- 8 years (!) later: 30-day shows 250% (!) better retention (Bahrick & Phelps, 1987)
Spaced Practice: “Within session”

- Recalling lists of words
  - 42 nouns, one/sec, for later “free recall”
  - 1 to 4 repetitions, massed or spaced
  - Explanations?

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<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
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<tbody>
<tr>
<td>Massed</td>
<td>15%</td>
<td>17%</td>
<td>17%</td>
<td>19%</td>
</tr>
<tr>
<td>Spaced</td>
<td>16%</td>
<td>31%</td>
<td>42%</td>
<td>47%</td>
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(Underwood 1970)
Orchestrating Spaced Practice

In the classroom:
- Today’s lesson is tomorrow’s context
- Revisiting material already covered (trade-off?)
- “Delayed” exams? Finals? (gasp)

And elsewhere:
- Teach students about the benefits of spaced practice
- Remind them that cramming may do for now, but long-term retention will be poor
  - (“And your point is . . . ?”)

[And your point is . . . ?]
The sweet spot: Expanding practice intervals

- If initial interval is too long, all will be lost
- Begin with short intervals between exposures
- As learning is “consolidated,” it can withstand longer and longer intervals between tests
  - My learning of 150 student names
Principle 2B: Retrieval practice

- Echo of a behavioral principle: make study as much like the ultimate "test" as possible
  - "Probe tests" and cued recall better than "mere study" and recognition
- One reason that massed practice is inefficient
  - Example: "Programmed Learning"
    Question follows answer, in effect
Principle 3: Build knowledge structures

- All memory is associative
- The more that gets “connected” with the information, the more robust the learning
- “Understanding” means learning:
  - Interrelationships among elements ("coherence")
  - Connections to our larger body of knowledge
- May be the most important principle, and the most difficult to orchestrate
Comprehension and “mental models”
Principle 3a: Quality of Practice

Learning “narrative” versus “expository” text:

- Study strategy: write down questions about the text, or construct an outline
- Which is better “elaborative practice” for learning?

<table>
<thead>
<tr>
<th>Type of text</th>
<th>Questions</th>
<th>Outline</th>
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<tbody>
<tr>
<td>Narrative</td>
<td>+31%*</td>
<td>+13%</td>
</tr>
<tr>
<td>Expository</td>
<td>+28%</td>
<td>+64%</td>
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</tbody>
</table>

*gain over no elaboration

Why the difference?
Principle 3b: “Depth” of processing

- Does motivation (or intent-to-learn) matter?
- List of 24 words spoken at 2-sec rate

Instructions about recall:

“Encoding” task:    none    intentional

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<tbody>
<tr>
<td>Rate pleasantness</td>
<td>16.3</td>
<td>16.6</td>
</tr>
<tr>
<td>Detect # of e’s</td>
<td>9.4</td>
<td>10.2</td>
</tr>
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 Hyde & Jenkins, 1969
Principle 3c: “Mnemonics”
Use and Limits to Mnemonics

Can make material “memorable” by assuring:
- Attention to material (names at a party?)
- Rehearsal of material
- Elaborative encoding for distinctive “structures”
- Effective use of prior knowledge

But:
- Almost always specific to a certain kind of material
- May require extensive practice and training itself
- May become irrelevant with practice and familiarity
Other Strategies and Tips

Note-taking in class. Good idea?

- May assure attention to the material
- May help organize and elaborate material
- “Generation” effect: better to generate information than just “receive” or repeat it
- May distract attention from material (multitasking?)
- May be superficial, incomplete, or, well, wrong

Solutions?
Enhancing value of note-taking

- Let them know when it’s a good/bad idea
- Provide PowerPoint outlines of lecture
  - Before or after?
- Allow students to record the lecture?
- Encourage note-swapping
- Encourage reading material BEFORE lecture (!)
- Encourage “putting things in their own words”
- Hand notes or laptop?
The Social Context of Learning: Random Thoughts

- Students are already “motivated” to learn
- Will “mastery” be reinforcing?
- Will they want to please you by learning?
- Communication of each other’s goals
- Respect for your students
Monitor your learning environment
Probe test and retrieval practice

- What are the three principles of learning?

- What are you taking away from all this?