Strategies for Effective Teaching and Learning

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Why do this?

• Disclosure

• Similarity

• Caring
Evidence

PsychInfo Database
- Learning, Adult, Peer-review: >69,000 hits (1894 1st article)
- Teaching, Adult, Peer-review: >30,000 hits
ERIC Database
- Learning, Adult, Journal Articles: >7,800 hits
- Teaching, Adult, Journal Articles: >3,200 hits
PubMed
- Pedagogy, Adult, Human: >6500 hits
Amazon.com
- Teaching and learning in higher education: >4,800 hits

Learning Defined

Learning is the ability to use information after significant periods of disuse (i.e., retention) & it is the ability to use the information to solve problems that arise in a context different (if only slightly) from the context in which the information was originally taught. (i.e., transfer)

Robert Bjork, Memories and Metamemories, 1994

Rote vs Meaningful Learning

Rote Learning
- Involves verbatim memorization
  - (which is easily forgotten)
- Cannot be manipulated or applied to novel situations
  - (e.g. remembering phone numbers, dates, names, etc.)

Meaningful Learning
- Learning that is tied and related to previous knowledge and integrated with previous learning
- Can be manipulated, applied to novel situations, and used in problem solving tasks
Effect Size

<table>
<thead>
<tr>
<th>Effect Size</th>
<th>% of control group who would be below average person in experimental group</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0</td>
<td>50%</td>
</tr>
<tr>
<td>0.1</td>
<td>54%</td>
</tr>
<tr>
<td>0.2</td>
<td>58%</td>
</tr>
<tr>
<td>0.3</td>
<td>62%</td>
</tr>
<tr>
<td>0.4</td>
<td>66%</td>
</tr>
<tr>
<td>0.5</td>
<td>69%</td>
</tr>
<tr>
<td>0.6</td>
<td>73%</td>
</tr>
<tr>
<td>0.7</td>
<td>76%</td>
</tr>
<tr>
<td>0.8</td>
<td>79%</td>
</tr>
<tr>
<td>0.9</td>
<td>82%</td>
</tr>
<tr>
<td>1.0</td>
<td>84%</td>
</tr>
</tbody>
</table>

Normative Comparison Points

| Student Maturation | 0.10 |
| Teacher in front of the classroom | 0.24 |
| Innovation in school | 0.40 |

Hattie, J., Univ of Aukland

4 years of college...

| General verbal skills | 0.56 |
| Math / Quantitative  | 0.24 |
| Specific subject matter knowledge | 0.86 |

Pascarella et al, How College Affects Students, 2005

By the end of this pre-conference workshop, you will be able to

- Explain attributes of instructors, instructional climate, and how that impacts student learning
- Generalize important principles from neuroscience, cognition, etc. in terms of how we learn
- Prepare students to be more effective learners
- Align outcomes, assessment, and instructional activities
- Describe the continuum of face-to-face to complete online instruction
- Summarize of most effective instructional strategies
- Design effective pre-class material (reading, online, material)
- Inform their own teaching with the basics of motivation, attribution theory, self-theories
- Develop metacognitive skills in students to help them in the development of critical thinking skills
What Does the Instructor Bring to the Table?

Student-Instructor Interaction

- Course Organization
- Student-Instructor Interaction
- Instructor Responsiveness
- Likeability / Concern

Perceived Learning
- Pedagogical Effect
- Student Interest
- Learning Performance

Abrantes et al. 2007

0.31
0.19
0.58
0.65
0.50
0.57
0.15
0.23
0.58
0.41
**Limbic System**

- Controls emotions
  - Emotions are at the interface between sensorial perception and behavioral outcomes,

- Controls motivation
  - Selectively guide attention and filtering of the incoming sensory information

- Determines which components to be preserved in memory
  - Bergado et al., Prog Neurobio, 2011

**What does this mean?**

“...that learning and memory are mediated, conditioned or modulated by emotional and motivational factors.”

- Bergado et al., Prog Neurobio, 2011

**Physiologic Aspects of Learning**

<table>
<thead>
<tr>
<th>Condition</th>
<th>Placebo</th>
<th>Cortisol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neutral, immediate</td>
<td>50</td>
<td>55</td>
</tr>
<tr>
<td>Neutral, +1 week</td>
<td>45</td>
<td>50</td>
</tr>
<tr>
<td>Emotion</td>
<td>40</td>
<td>45</td>
</tr>
</tbody>
</table>

- Tollenaar et al., Neurbiol Learn Mem, 2009
Cognitive Performance and Stress

Positive Environment
The Broaden Effect

“Positive emotions broaden the scopes of attention, cognition, and action, widening the array of percepts, thoughts, and actions presently in mind”

Fredrickson et al., Cogn Emot, 2005

Summary

1. They know how students learn
2. When preparing to teach, they ask “What should students be able to do?”
3. They have high (but achievable) expectations
4. They have a positive classroom environment
5. They treat students with respect
6. They use assessment to help students and to be better teachers
7. They are reflective
Setting the Foundation
How Learning Works

Types of memories

<table>
<thead>
<tr>
<th>Explicit</th>
<th>Implicit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Semantic</td>
<td>Procedural</td>
</tr>
<tr>
<td>Memories of facts and concepts</td>
<td>Motor skills and habits</td>
</tr>
<tr>
<td>Memories of personally experienced events</td>
<td>Learned emotional reactions</td>
</tr>
</tbody>
</table>

Example: recalling that Raleigh is the capital of North Carolina
Example: recalling a trip to Raleigh
Example: drawing Mickey Mouse
Example: recoiling at the sight of a spider

Memory formation

- External stimulus
- Sensory register
- Attention
- Long-term memory
- Rehearsal and coding
- Retrieval
- Short-term memory
- Repetition
- Forgetting through interference or decay
Biology of Learning

Day et al, Neurobio Learn Mem, 2011

7 Principles of Good Practice

1. Encourages contact between students and ourselves
2. Develops reciprocity and cooperation among students
3. Encourages active learning
4. Gives prompt feedback
5. Emphasizes time on task
6. Communicates high but achievable expectations
7. Respect diverse talents and ways of learning

Encourages contact between students and ourselves

“Humans seem to have a strong tendency to align their behavior with their fellows during social interactions”

Lieberman, Annu Rev Psycol, 2007

Develops reciprocity and cooperation among students

<table>
<thead>
<tr>
<th></th>
<th>Effect Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cooperative vs Competitive</td>
<td>0.78</td>
</tr>
<tr>
<td>Cooperative vs individualistic</td>
<td>0.78</td>
</tr>
<tr>
<td>Group Competitive vs individualistic</td>
<td>0.50</td>
</tr>
<tr>
<td>Group Cooperative vs competitive</td>
<td>0.37</td>
</tr>
<tr>
<td>Competitive vs individualistic</td>
<td>0.03</td>
</tr>
</tbody>
</table>


Encourages active learning

Vidakovic Med Hypoth, 2011
### Active Learning: Promote Interaction with Material

<table>
<thead>
<tr>
<th>Student</th>
<th>Read Web notes before class</th>
<th>Read book before class</th>
<th>Read book in other classes</th>
</tr>
</thead>
<tbody>
<tr>
<td>A students</td>
<td>78%</td>
<td>65%</td>
<td>53%</td>
</tr>
<tr>
<td>B students</td>
<td>75%</td>
<td>72%</td>
<td>48%</td>
</tr>
<tr>
<td>C students</td>
<td>63%</td>
<td>61%</td>
<td>51%</td>
</tr>
<tr>
<td>D students</td>
<td>45%</td>
<td>40%</td>
<td>40%</td>
</tr>
<tr>
<td>F students</td>
<td>46%</td>
<td>42%</td>
<td>42%</td>
</tr>
</tbody>
</table>

*Marrs & Novak, Cell Biol Educ, 2004*

### Active Learning: Promote Interaction with Material

<table>
<thead>
<tr>
<th>Student</th>
<th>Crammed</th>
<th>Crammed for other courses</th>
</tr>
</thead>
<tbody>
<tr>
<td>A students</td>
<td>16%</td>
<td>44%</td>
</tr>
<tr>
<td>B students</td>
<td>34%</td>
<td>63%</td>
</tr>
<tr>
<td>C students</td>
<td>41%</td>
<td>65%</td>
</tr>
<tr>
<td>D students</td>
<td>64%</td>
<td>71%</td>
</tr>
<tr>
<td>F students</td>
<td>68%</td>
<td>69%</td>
</tr>
</tbody>
</table>

*Marrs & Novak, Cell Biol Educ, 2004*

### Gives prompt feedback

*Rundinger et al., Trends Cognit Sci 2011*
Emphasizes time on task

increased the number of GI endoscopies required for graduating residents to 35 upper endoscopies and 50 colonoscopies.

...but provide rest
Communicates high but achievable expectations


Respect diverse talents and ways of learning

- Task dimension
- Authority dimension
- Recognition dimension
- Grouping dimension
- Evaluation dimension
- Timing dimension

Morris et al., Ann Rev Psychol, 2006

Storage vs Retrieval

<table>
<thead>
<tr>
<th>Storage Strength</th>
<th>Retrieval Strengths</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>High</td>
<td>What is your ATM password?</td>
</tr>
<tr>
<td>Low</td>
<td></td>
</tr>
</tbody>
</table>

Slide from Andrew Butler, PhD, Duke University
What does success look like?

Jancke et al., Cogn Brain Res, 2000

Summary

• Remember the 7 Principles
• Classroom design and instructional techniques influence the biologic system
### Instructional Alignment

Instructional alignment routinely causes effect sizes exceeding **1 and 2 two sigma**, about four times what we ordinarily see in typical classrooms.

Cohen, Educ Res 1987

### Planning Instruction

1. Objectives
2. Design Assessments
3. Design activities

- Objectives
  - Lesson Plans
- Active learning
  - Cooperative learning
  - Experiential training
- Feedback
- Summative assessment
Step 1: Determine the Learning Outcomes

Step 2: Decide on how to assess student achievement of outcomes

Step 3: Select appropriate instructional strategies

Students prior cognitive ability (1.0)
This can include what the student already knows.

Peer Teaching / Cooperative Learning (0.90)
This can include think-pair-share/jigsaw to team-based learning.

Providing Feedback (0.80)
Reinforcement, corrective feedback or mastery learning are the most powerful.

Self-Directed Learning (0.65)
Students diagnose their learning goals, formulate goals, identify material and evaluate their outcomes.

Questioning (0.60)
Questions that are not simply knowledge level require thought promote the best learning and foster critical thinking.

Norm for Educational Intervention (0.40)

Instructional Media (0.30)
This includes videos, online learning, blended-learning, use of computers, and simulations.

www.teacherstoolbox.co.uk/T_effect_sizes.html

US Dept of Educ, Evaluation of Evidence-Based Practice in Online Learning, 2010

Students prior cognitive ability (1.0)

- Background knowledge probe
- Focused listing
- Misconception / Preconception check
- Empty outlines
- Minute paper
- Muddiest point

Peer Teaching / Cooperative Learning (0.90)

<table>
<thead>
<tr>
<th>Complexity</th>
<th>Simple</th>
<th>Short-Term</th>
<th>Long-Term</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duration</td>
<td>2-3</td>
<td>4-6</td>
<td>4-8</td>
</tr>
<tr>
<td>Size</td>
<td>2-3</td>
<td>4-6</td>
<td>4-8</td>
</tr>
</tbody>
</table>

- Think-Pair-Share
- Roundtable
- 3-Step interview
- Focused listing
- Send-a-problem
- Games
- Jigsaw
- Case-based learning
- Team-based learning
- Problem-based learning

Providing Feedback (0.80)

- Specific
- Immediate
- Honest
- Actionable
Self-Directed Learning (0.45)

Reason
Accountability
Interaction
Student-friendly
Efficient

Questioning (0.40)

<table>
<thead>
<tr>
<th>Category</th>
<th>Assistant Professor</th>
<th>Associate Professor</th>
<th>Full Professor</th>
</tr>
</thead>
<tbody>
<tr>
<td># of questions per class</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Expected Wait Time (sec)</td>
<td>10.0</td>
<td>10.0</td>
<td>5.0</td>
</tr>
<tr>
<td>Actual Wait time (sec)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

...waiting for 3-5 seconds after questioning increases:
- the mean length of the students' answers,
- encourages voluntary and adequate answers,
- reduces the number of failed answers,
- promotes speculative answers,
- increases the students' questions, and
- improves the students' academic performance

Cho et al., BMC Med Educ, 2012

Instructional Media (0.30)

<table>
<thead>
<tr>
<th>Learning Environment</th>
<th>Primary Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traditional Environment</td>
<td>Instructor is center of attention and students are passive receivers</td>
</tr>
<tr>
<td>Technology-Enhanced Environment</td>
<td>Traditional classroom + Technologies supplement activities</td>
</tr>
<tr>
<td>Blended (Hybrid Learning) Environment</td>
<td>Traditional classroom + Some fraction of learning occurs outside the course using various technologies</td>
</tr>
<tr>
<td>Online Learning Environment</td>
<td>Majority of the course is online with no direct face-to-face</td>
</tr>
</tbody>
</table>
Blended-Learning

...the observed advantage for blended learning conditions is not necessarily rooted in the media used per se and may reflect differences in content, pedagogy and learning time.

Kalyuga et al., Appl Cogn Psych, 1999

While Surfing
Effect size = -0.92

While Viewing Surfing
Effect size = 1.4
Desirable Difficulties

Conditions that slow learning or make it harder will produce better long-term retention and understanding.

Examples: Retrieval practice, spacing, interleaving, reducing or delaying feedback, etc.

Distribute Practice and Scaffold

Back to Alignment

Transfer Appropriate Processing

<table>
<thead>
<tr>
<th>Item-specific processing</th>
<th>Relational processing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial learning</td>
<td>Criterial Task</td>
</tr>
<tr>
<td>Item-specific</td>
<td>Relational</td>
</tr>
<tr>
<td>Item-specific</td>
<td>Item-specific</td>
</tr>
<tr>
<td>Relational</td>
<td>Item-specific</td>
</tr>
<tr>
<td>Relational</td>
<td>Relational</td>
</tr>
</tbody>
</table>

Slide from Andrew Butler, PhD, Duke University

Summary

- Align, align, align
- Have a variety of instructional methods
- (retrieval) Practice, (retrieval) practice, (retrieval) practice
- Ask “what is the challenge I am having?”

Class Preparation

“…trying to teach skills such as analysis or synthesis in the absence of factual knowledge is impossible.”

Willingham (2010). Why don’t students like School?
Acquisition of Information

<table>
<thead>
<tr>
<th>Teaching Method</th>
<th>Lecture Less Effective</th>
<th>No Difference</th>
<th>Lecture More Effective</th>
</tr>
</thead>
<tbody>
<tr>
<td>Personalized System of Instruction</td>
<td>20</td>
<td>17</td>
<td>8</td>
</tr>
<tr>
<td>Discussion</td>
<td>18</td>
<td>54</td>
<td>22</td>
</tr>
<tr>
<td>Reading / Independent Study</td>
<td>10</td>
<td>21</td>
<td>9</td>
</tr>
<tr>
<td>Inquiry</td>
<td>6</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>Other (e.g., computer assisted)</td>
<td>27</td>
<td>57</td>
<td>20</td>
</tr>
</tbody>
</table>

D.A. Bligh (2000), “What is the use of lecture?”

Keep in Mind

- **Reason**
- **Accountability**
- **Interaction**
- **Student-friendly**
- **Efficient**

**Reason**

Why do students need to prepare?
Accountability

A Case Study: CV Pharmacotherapy

- Self-paced instructional materials were viewed by:
  – 20% of students prior to the first lecture,
  – 42% prior to the second lecture
  – 78% prior to the exam.
- Attendance minimally impacted by the blended-learning approach
- 83% reported being unlikely to review materials prior to class if a conflict occurred the same day.
- 69% reported graded assignments as the best incentive for preparing for class.

Rodgers et al, unpublished data, UNC School of Pharmacy, poster at AACP

Interaction
To ask or not to ask the question

<table>
<thead>
<tr>
<th></th>
<th>Prequestion Answered Correctly</th>
<th>Prequestion Answered Incorrectly</th>
<th>Prequestion Exposed</th>
<th>Not Available as a Prequestion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prequestion Answered</td>
<td></td>
<td>***</td>
<td>53.9%</td>
<td></td>
</tr>
<tr>
<td>Read Only</td>
<td>***</td>
<td>***</td>
<td>52.6%</td>
<td></td>
</tr>
<tr>
<td>Control</td>
<td>***</td>
<td>***</td>
<td>***</td>
<td>50.9%</td>
</tr>
</tbody>
</table>

Pressley et al. Contemp Educ Psych 1990

Just-in-Time-Teaching (JiTT)

Student Friendly
### Readability of Texts

<table>
<thead>
<tr>
<th>Area Tested</th>
<th>Grade Equivalency (mean and range)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vocabulary</td>
<td>16.5 (11.6-18.9)</td>
</tr>
<tr>
<td>Comprehension</td>
<td>16.4 (9.3-18.9)</td>
</tr>
<tr>
<td>Total</td>
<td>16.5 (10.6-18.9)</td>
</tr>
</tbody>
</table>

*Fisher et al., Am J Pharm Educ, 2007*

<table>
<thead>
<tr>
<th>Text</th>
<th>Grade Equivalency (mean and range)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DiPiro</td>
<td>18.1 (16.3-19.5)</td>
</tr>
<tr>
<td>Tx Guidelines</td>
<td>19.2 (17.5-21.0)</td>
</tr>
</tbody>
</table>

*Fuller et al., Am J Pharm Educ, 2007*

### Reading

- Learning from a text requires the learner to form deep level mental representations of the text material
- Taking notes or summarize during reading is better than passive reading (increases academic performance)

*Caspi et al, Instr Sci, 2005*

### Video

- For some learning, video may facilitate understanding if tasks are difficult to explain verbally
- Preconceptions of perceived effort required by the medium influences the amount of actual effort
- A lack of integration between video and narration overburdens working memory leading to poorer learning

*Cennamo, Educ Tech Res Dev, 1993*
Case Example: Hypertension

- Pages of Text: 21
  - Word count per page: ~900
  - Total word count: ~18,900 words
- Tables: 9
- Figures: 1

Average reading speed for comprehension 140-200 words per minute

1.5 to 2.25 hours of reading

How much time…

...do you spend per week preparing for class?

3.2 hours

~1 hour preparation for every hour in class

Persky et al, Am J Pharm Educ, 2010
“Research showed decades ago that self-paced instruction has the power to improve and accelerate learning by about one-third, compared with lectures and conventional assignments on the same topic…”

http://www.tltgroup.org/resources/Visions/Outcomes.html

Summary

• Remember RAISE
• Methods of pre-class preparation are diverse – pick the best for the topic at hand
• Get students to prepare outside of class – use class time for thinking
• Environment is everything
Motivation, Attribution, & Self-Theories

“\[I \text{ want to thank my parents for giving me confidence disproportionate to my looks and abilities, which is what all parents should do}\]\n
Tina Fey  
On receiving an Emmy for Best Actress, 2008

Neurobiology of Motivation

Robbins et al., Curr Opin Neurobiol, 1996

Detrimental mechanism or event (time-on-task, distractors, drugs, sleepiness)  
Motivation activated to counter performance decline – increases intentional effort

Insufficient motivation to attenuate impairments to recover performance, to stay on task

Sarter et al., Brain Res Rev, 2006
What is motivation

- Initiation and sustaining behavior, sustained attention and focus
- Based on an individuals:
  - Can I do this? (self-efficacy)
  - Why do I want to do this? (intrinsic / extrinsic motivation)

Why is academic self-efficacy important?

- Linked to:
  - Persistence
  - High-order strategy use
  - Learning / achievement
  - Interest and value
  - Reduced anxiety/depression
- Influences choices made
  - Engage when confident (optimism)
  - Avoid when not confident

Threats to Self-Efficacy

- Good study habits
  - Get a good night’s sleep
  - Concentrate: Cut distractions
  - Take short breaks
  - Review and analyze the steps that went well
  - What’s given? What’s wanted?
  - Write main thoughts in each paragraph
  - Set realistic goals for each study session
  - Take additional information from notes or books, tables, diagrams, graphs, etc.
  - Review important ideas in your own words
  - Remember them.

Adam M. Persky, PhD
What can we do to prevent this?

1. Encourage students to attribute failure to internal, controllable, unstable causes (e.g., lack of effort, poor strategy use)
2. Foster the belief that ability is changeable
3. Use criterion (rather than normative) grading
4. Hold high but realistic expectation
5. Provide challenging assignments and tests that can be completed successfully with effort
6. Help students develop better study strategies

Self-Confidence

Comes from real feedback, NOT inflated feedback

Why do I want to do this?

Intrinsic
- Engage due to enjoyment
- Task is valuable / interesting
- Learn to improve

Extrinsic
- Engage in order to receive rewards/avoid punishment
- Impress others
- Outperform others
Supporting Intrinsic Motivation

- Meet students needs for:
  - Autonomy
  - Competence
  - Relatedness
- Create engaging educational contexts that support situational interest
  - Catch
  - Hold

Achievement Goal Orientations

<table>
<thead>
<tr>
<th>Learning Goal</th>
<th>Ego Goal</th>
</tr>
</thead>
<tbody>
<tr>
<td>• develop competence, progress judged internally</td>
<td>• demonstrate competence, progress judged externally</td>
</tr>
<tr>
<td>• Linked to increase</td>
<td>• appear smart</td>
</tr>
<tr>
<td>- Engagement / persistence</td>
<td>• avoid appearing incompetent</td>
</tr>
<tr>
<td>- Cognitive strategy use</td>
<td></td>
</tr>
<tr>
<td>- Emotional well-being</td>
<td></td>
</tr>
<tr>
<td>- Learning / achievement</td>
<td></td>
</tr>
</tbody>
</table>

- May have different goal orientation in different subject areas
- Can pursue more than one goal orientation at the same time

Supporting Learning v Ego Goals

<table>
<thead>
<tr>
<th>Learning goals supported through:</th>
<th>Ego goals supported through:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Use of varied, meaningful tasks</td>
<td>• Controlling classroom environment</td>
</tr>
<tr>
<td>• Autonomy support</td>
<td>• Normative evaluation</td>
</tr>
<tr>
<td>• Criterion-referenced evaluation</td>
<td>• Emphasis on social comparison, pointing out smart students</td>
</tr>
</tbody>
</table>
Self-Theories

The brain is like a muscle

It gets stronger with use. MF growth is in MY hands!


deficit mindset intelligence is static

leads to a desire to look smart & therefore a tendency to...

Challenges
Avoid challenges
Obstacles
Give up easily
Effort
See effort as hopeless or worse
Criticism
Ignore useful negative feedback
Success of others
Feels threatened by the success of others

growth mindset intelligence can be developed

leads to a desire to learn & therefore a tendency to...

Challenges
Embrace challenges
Obstacles
Remains in the face of obstacles
Effort
See effort as a path to mastery
Criticism
Learn from criticism
Success of others
Finds lessons & inspiration in the success of others

Attribution Theory

stable

able to control

internal

Unstable

unable to control

External
### Table: Attribution, Dimension, and Consequence

<table>
<thead>
<tr>
<th>Attribution</th>
<th>Dimension</th>
<th>Consequence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ability</td>
<td>Internal</td>
<td>Competence or incompetence; pride or shame</td>
</tr>
<tr>
<td></td>
<td>Stable</td>
<td>Pride or shame magnified</td>
</tr>
<tr>
<td></td>
<td>Uncontrollable</td>
<td>Failure resignation/apathy magnified</td>
</tr>
<tr>
<td>Effort</td>
<td>Internal</td>
<td>Pride in success</td>
</tr>
<tr>
<td></td>
<td>Unstable</td>
<td>Does not decrease success expectancy</td>
</tr>
<tr>
<td></td>
<td>Controllable</td>
<td>Magnifies pride or guilt</td>
</tr>
<tr>
<td>Luck</td>
<td>External</td>
<td>Self-image not altered</td>
</tr>
<tr>
<td></td>
<td>Unstable</td>
<td>No decrease in success expectancy</td>
</tr>
<tr>
<td></td>
<td>Uncontrollable</td>
<td>Surprise at either success or failure</td>
</tr>
<tr>
<td>Help from others</td>
<td>External</td>
<td>Self-image not altered</td>
</tr>
<tr>
<td></td>
<td>Unstable</td>
<td>No decrease in success expectancy</td>
</tr>
<tr>
<td></td>
<td>Uncontrollable</td>
<td>Gratitude for help; Anger for hindrance</td>
</tr>
<tr>
<td>Task Difficulty</td>
<td>External</td>
<td>No enhancement of self-esteem for success outcome</td>
</tr>
<tr>
<td></td>
<td>Stable</td>
<td>Same outcome expected again</td>
</tr>
<tr>
<td></td>
<td>Uncontrollable</td>
<td>Depression and frustration for failure outcomes</td>
</tr>
</tbody>
</table>

### Summary

- Motivation is about environment
- Build activities that allow
  - Choice
  - Student to demonstrate route to mastery
- Provide honest feedback
- Use attribution theory to help
Thinking Skills

"The mind is actually designed to avoid thinking. Thinking is a slow process; it's effortful and even uncertain. People naturally want to avoid that process, and instead rely on memory, the things we already know how to do and are successful at."

Willingham (2010), Why don’t students like School?

Quick thinks

If it takes 5 machines 5 minutes to make 5 widgets, how long would it take 100 machines to make 100 widgets?

A bat and a ball cost $1.10 in total. The bat costs $1.00 more than the ball. How much does the ball cost?

7 Survival Skills

1. Critical thinking and problem solving
2. Collaboration across networks & leading by influence
3. Agility & adaptability
4. Initiative & entrepreneurism
5. Effective oral & written communication
6. Accessing & analyzing information
7. Curiosity & imagination
AACP Teachers Seminar 2013

Amer. Philosoh Assoc.

“The ideal critical thinker is habitually inquisitive, well-informed, trustful of reason, open-minded, flexible, fair-minded in evaluation, honest in facing personal biases, prudent in making judgments, willing to reconsider, clear about issues, orderly in complex matters, diligent in seeking relevant information, reasonable in selection of criteria, focused on inquiry, and persistent in seeking results which are the precise as the subject and the circumstances of inquiry permit”

Promoting Thinking

<table>
<thead>
<tr>
<th>Method</th>
<th>Lecture Less Effective</th>
<th>No Difference</th>
<th>Lecture More Effective</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discussion</td>
<td>29</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Reading / Independent Study</td>
<td>1</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Inquiry</td>
<td>5</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Other</td>
<td>12</td>
<td>17</td>
<td>0</td>
</tr>
</tbody>
</table>

D.A. Bligh (2000), “What is the use of lecture?”

Conditions that encourage student thinking

• Classroom Arrangement
• Modeling skills
• Minimize negative risks
• Attending to what is going on
• Providing time to think
• Using language of thinking
• Opportunities to engage in thinking

Beyer, BK, Improving Student Thinking
Critical Thinking: What Works

<table>
<thead>
<tr>
<th>Well Supported by Research</th>
<th>Impedes</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Step-by-step guided practice</td>
<td>• Rote Learning</td>
</tr>
<tr>
<td>• Authentic Problem Solving</td>
<td>• Is not assessed or assigned</td>
</tr>
<tr>
<td>• Structured Collaboration</td>
<td>• Meaningless assignments</td>
</tr>
<tr>
<td>• Focused Communication</td>
<td>• Norm Referenced grading</td>
</tr>
<tr>
<td>• Formative Feedback</td>
<td>• Assessment Overload</td>
</tr>
</tbody>
</table>

Pascarella & Terenzini (2005), *How College Affects Students*

Types of Interventions

<table>
<thead>
<tr>
<th></th>
<th>Effect size</th>
</tr>
</thead>
<tbody>
<tr>
<td>General</td>
<td>0.38</td>
</tr>
<tr>
<td>Infusion</td>
<td>0.54</td>
</tr>
<tr>
<td>Immersion</td>
<td>0.09</td>
</tr>
<tr>
<td>Mixed</td>
<td>0.94</td>
</tr>
<tr>
<td>Instructor training</td>
<td>1.00</td>
</tr>
</tbody>
</table>


general: CT abilities and dispositions taught separately from the presentation of the content of existing subject matter offerings

Infusion: students immersed in the subject and general principles of CT skills and dispositions are made explicit

Immersion: students immersed in the subject but general CT principles are not made explicit

Mixed: combination of the general approach with either the infusion or immersion approach.

Metacognition Defined
3 steps

Planning

3 steps

Planning

Monitoring

Monitoring – Note Taking

Cornell Note Taking Method
3 steps

- Planning
- Monitoring
- Evaluating

Guiding Principles

- Practice at retrieval strengthens memory traces
- Spaced practice enhances long-term retention (cramming only works for short retrieval intervals)
- The curse of expertise
  - Need to reduce cognitive overload — group items, visually separate them, reduce extraneous "noise"
- Dual coding of information in visuospatial and verbal formats will enhance learning and memory

Medication schedule for an actual patient. It is written in list format, exactly as written by his physician.

**List**
- Inderal – 1 tablet 3 times a day
- Lomoxin – 1 tablet every a.m.
- Carofate – 1 tablet before meals and at bedtime
- Zantac – 1 tablet every 12 hours (twice a day)
- Quinaglude – 1 tablet 4 times a day
- Courmadle – 1 tablet a day
Matrix representation for the same medication schedule.

<table>
<thead>
<tr>
<th>Medication</th>
<th>Breakfast</th>
<th>Lunch</th>
<th>Dinner</th>
<th>Bedtime</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laxin</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inderal</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Grinaglutte</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Ranolite</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Zantac</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Coumadin</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
</tr>
</tbody>
</table>

Summary

1. Explicitly teach/learn the skills of critical thinking
2. Encourage/develop the disposition of effortful thinking and learning
3. Direct learning activities in ways that increase the probability of transfer
4. Make metacognitive monitoring explicit and overt

Summary

Lesson 1: Research is important

Lesson 1A: Research is important

...but the rules for engagement for SOTL are different

- Funding is limited
- Impact on authentic learning situations
- Our subjects are exceptional
- Statistics vs learning
- Rarely is there ever a single intervention
How Special

<table>
<thead>
<tr>
<th>Category</th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>11.4 Million Full Time Undergraduates</td>
<td>11.4%</td>
<td></td>
</tr>
<tr>
<td>1.6 Million Full Time Post-Bac</td>
<td>1.6%</td>
<td></td>
</tr>
<tr>
<td>158,000 Doctoral Level</td>
<td>158,000</td>
<td>1.4%</td>
</tr>
<tr>
<td>57,000 Health Professions</td>
<td>57,000</td>
<td>0.5%</td>
</tr>
<tr>
<td>~10,000 Pharmacy</td>
<td>~10,000</td>
<td>0.09%</td>
</tr>
</tbody>
</table>

National Center on Education Statistics, 2010

Lesson 2: Students have brains too

Lesson 3: Good teaching is a complex mosaic
Lesson 4: Teaching is a team sport

Lesson 5: Active Learning Works

Lesson 6: Make learning meaningful

Does it have MEANING?

Probability of Learning

Does it make SENSE?

D.A. Sousa (2006), "How the Brain Learns"
Lesson 7: There is no magic formula

Lesson 8: Retrieve, Retrieve, Retrieve

The single most important variable in promoting long-term retention and transfer is practice at retrieval.

Lesson 9: Less is More

The general notion underlying this concept is that 80 percent of your results come from 20 percent of your efforts.
...so why change?

“Motivation for grades is so great that students try to compensate for ineffective teaching by increased effort. When this motivation is coupled with a criterion measure based on a textbook that the student can study regardless of the teaching method used, the result is a washing out of teaching-produced differences in learning.”

McKeachie et al. Teaching and Learning in the College Classroom

When you stop hearing “Is this going to be on the test?” you’ll know you have achieved the goal

Jensen (2000), Brain-based learning
Adam M. Persky
apersky@unc.edu