Basic Principles of Learning

David Therriault, Ph.D.
Associate Professor
School of Human Development and Organizational Studies
(SHDOSE)
E-mail: therriault@coe.ufl.edu
Webpage: http://education.ufl.edu/dtherriault/
Organization of This Presentation

• Two sources of thinking about learning will be reviewed Developmental and Cognitive approaches.
• Throughout the class, I will present (10) Teaching Tips (including research that supports them).
• Fielding questions about teaching at UF.
Therriault’s 10 Teaching Tips

General:
1. Dr. Therriault’s three tense approach. Tell your students what you are going to be saying, say it, then tell them what you said.
2. Do not focus on what a student cannot do.
3. Help students acquire an experiential knowledge base.
4. Scaffolding is a particularly effective method of instruction.

Specific:
5. Capacity: Provide opportunities for recoding in your teaching materials (e.g., use students current knowledge when presenting new material)... they will be more likely to remember it.
6. Timing: Students are more likely to remember the beginning and end of a lecture (and information presented out of lecture format). Plan your materials accordingly.
7. Clarity: Don’t let your teaching become like the “fruit” lists, always make meaningful distinctions. It will aid in keeping away interference effects (i.e., student confusion).
8. Content: Highlight meaningful associations and study practices: Why? Because LTM is organized by meaning (information is connected by meaning).
9. Process: Forgetting curve shows that most forgetting occurs within a short time after learning. Repetition and over-learning improve our student’s memories.
10. Testing: Provide multiple assessments to promote distributed learning.
Introduction to the Principles of Learning (useful for teachers)

• What do we mean by useful
  – Two Views on Learning (paradigms)
    • Developmental
    • Cognitive
What do we mean by useful?

• Two Views on Learning (paradigms)
  – Developmental
  – Cognitive
Developmental: Piaget and Vygotsky

• Piaget
  – Mechanisms of Cognitive Development
    • Equilibration Versus Disequilibrium
    • How does a child achieve equilibration?
      – Changing schemes
      – Assimilation
      – Accommodation
Assimilation and Accommodation
Piaget’s Stage Theory of Cognitive Development

• Stages of Cognitive Development
  – Sensorimotor
  – Preoperational
  – Concrete Operational
  – Formal Operational
Sensorimotor Stage

- Learning primarily through senses, rudimentary ability to represent things mentally
- Birth - Age 2
- Object Permanence
- Representational Thought
Preoperational Stage

• Builds upon sensorimotor: further development in the ability to think and reason
• Age 2 - 7
• Language Development
• Egoctrism
Concrete Operational Stage

- Children are becoming more adult like but tend to reasoning tasks based in the concrete world.
- Age 7 - 11
- Representational Thought
- Conservation
- Reversible Thinking
Formal Operational Thinking

- Highest stage: individuals are able to reason in a fully abstract manner
- Age 11 - 12
- Abstract Thought
- Second-order Relations
Evaluating Piaget’s Work

• The validity of Piaget’s theory has been questioned for several reasons:
  – limitations of stages
  – accuracy of ages
  – truth regarding the reasons behind skill limitations
  – question regarding how many adults actually reach Formal Operations
  – limited cross-cultural generalizability
Neo-Piagetian Views

• Neo-Piagetian - Current theorists that have built upon Piaget’s initial work, addressing many of the concerns.
• Optimal Versus Typical Development
• Post Formal Thinking
• Problem Finding
• Dialectical Thinking
Vygotsky’s Sociocultural Theory of Cognitive Development

- Placed importance on the social and cultural aspects of development.
- Developed three main developmental ideas:
  - Internalization
  - Zone of Proximal Development
  - Scaffolding
Vygotsky’s Sociocultural Theory of Cognitive Development

• Internalization - taking in knowledge observed in a social context.
• Language is key to the internalization of complex ideas.
Vygotsky’s Sociocultural Theory of Cognitive Development

• Zone of Proximal Development - the range between a child’s level of independent performance and the level of performance a child can reach with assistance.

• Scaffolding
Teaching Tips

1. Dr. Therriault’s three tense approach. Tell your students what you are going to be saying, say it, then tell them what you said.

2. Do not focus on what a student cannot do.

3. Help students acquire an experiential knowledge base.

4. Scaffolding is a particularly effective method of instruction.
Cognition and Information Processing
Relevant Questions

• How is information entered or encoded into memory? How do we go from seeing or hearing information, to learning the information, to putting it into memory?
• How is information stored in memory? What are the different kinds of memory storage that people use?
• What models have been proposed to account for how information is stored in memory?
• How do we retrieve information from memory? What factors influence remembering and forgetting?
Relevant Questions Cont.

• What can people do to improve their memories? What specific techniques can students and teachers use to enhance their memories?
• How do the conditions under which we learn something influence our likelihood of remembering and using the information.
Basic Memory Terminology

• Encoding: how you transform a sensory input into some kind of representation that can be placed in memory

• Storage: how you retain encoded information in memory

• Retrieval: how you access information stored in memory
Information Processing Paradigm

• Sensory Memory: encodes information duration is very short.

• Attention or Short Term Memory or Working Memory: (Processing and Storage component) Storage area that holds information for a short period of time.
  – e.g., Loading dock or Analogy to mental workbench

• Long-term Memory: Storage area in which information can be held for longer periods of time, possibly permanently.
  – e.g., Warehouse or analogy to file cabinet.
The Standard Memory Model

Environmental input

Sensory registers
- Visual
- Auditory
- Haptic

Short-term memory (STM)
Temporary working memory
Control processes:
- Rehearsal
- Retrieval strategies

Response output

Long-term memory (LTM)
Permanent memory store
Short Term Memory

- **Short Term Memory**: The limited-capacity memory component for temporary information storage. How much you can store.

- **Memory Span**: # of items that can be recalled immediately after a presentation (in order).

- **Capacity**: Magic # 7 ± 2 ‘bytes’ or Chunks: The limit of information that can be encoded, held, and reported from immediate memory (memory span).

- **Duration**: approximately 1 - 2 minutes
Short Term Memory Terminology

- **Chunk**: A group of information, unit of memory.
- **The Bottleneck of STM**: How can we function at such a high level cognitively with such a small STM capacity?
Short Term Memory Terminology

• **Chunk**: A group of information, unit of memory.

• **The Bottleneck of STM**: How can we function at such a high level cognitively with such a small STM capacity?

• **Recoding**: Process of grouping objects together (forming larger chunks).
  – e.g., recall the following:
Chunking Example

PLDNQSRUEF
Chunking Example

IBMPBSUSANFL
Chunking Example

PLDVNQSRBUEF
Or…
IBMPBSUSANFL

• We can chunk the second into units of three letters rather than units containing one letter each
Teaching Tip

5. Capacity: Provide opportunities for recoding in your teaching materials (e.g., use students current knowledge when presenting new material)… they will be more likely to remember it.
Memory Retrieval: The Serial Position Curve

![Graph showing the serial position curve, with percentage of words recalled on the y-axis and serial position on the x-axis.]
Primacy & Recency

- **Primacy effect**: The tendency for items at the beginning of a list to be more accurately recalled than items in the middle of the list. This is due to the fact that the first few items “make it” into LTM.

- **Recency effect**: The tendency for items at the end of a list to be more accurately recalled than items in the middle of the list. This is due to the fact that the last few items are still in STM.
- Evidence
Teaching Tip

6. Timing: Students are more likely to remember beginning/end of a lecture (and information presented out of lecture format). Plan your materials accordingly.
Forgetting...?

- **Decay**: The fading or forgetting of information over time.
- **Interference**: Forgetting due to the introduction of new material.
Decay

• Brown and Peterson & Peterson and Peterson’s (1959) Task
• Investigated decay from STM. Three-letter stimulus (trigram) was presented to Ss, followed by a three-digit number. Ss were instructed to count backwards (by threes) from the presented number. After a specified time, Ss were required to recall the original letter stimulus.
• Results: Ss were less accurate in recall as their counting time increased.
• Conclusion: This provides evidence for decay in STM.
Decay vs. Interference?

- Waugh & Norman’s task (1965) Investigated decay/ interference from STM.
- Probe digit task: A task in which Ss hear a list of digits. The final digit (probe) is a repeat of a digit presented earlier. The Ss task is to produce the digit that followed the probe in the original list.
Example:

- (A) 195293804637602-tone- respond “9”
- (B) 195293804637607-tone- respond “6”
- In A there are 10 items interfering in B only 2.

**Manipulations:**

- Varied the amount of interference (1-13 digits)
- Varied presentation rate (decay) (1 or 4 digits per second)
- Measured ability to recall # following the target.
Waugh & Norman Cont.

- **Results**: Amount of interference had a large effect. Presentation rate had no effect.

- **Conclude**: Interference is the primary cause of forgetting from STM.
Interference

• **Proactive interference** (Wickens, 1972): Another challenge to Peterson and Peterson’s experiment. Wickens suggested that: Older material interferes forward in time with remembering the current stimulus.

• **Retroactive interference**: Newer material interferes backward in time with memory for older items.
Release from PI: Proactive interference is reduced or eliminated due to a change in the nature of the stimuli.

Figure 4.5
Recall accuracy in a release-from-PI experiment reported in Wickens (1972). All subjects received word triads from the fruit category on trial 4. On trials 1 to 3, different groups received triads from the categories fruits, vegetables, flowers, and professions. (From Wickens, 1972.)

![Graph showing recall accuracy over trials with different switches in category.](image)
Teaching Tip

7. Clarity: Don’t let your teaching become like the fruit lists, always make meaningful distinctions. It will aid in keeping away interference effects (i.e., student confusion).
Studying and The Rehearsal Buffer

• **Rehearsal**: The deliberate mental repetition or practicing of to-be-learned material.

• **Two functions of Rehearsal**:  
  – Maintain information in STM by simple repetition or recycling  
  – Transferring information to LTM
Two types of rehearsal

• **Maintenance Rehearsal**: Focus on the to-be-remembered items, but no focus on what the items “mean” or how they are related to what you already know.

• **Elaborative Rehearsal**: Focus on what the to-be-remembered items “mean” and how they are related to things that you already know.
  - What’s active then? The to-be-remembered items AND information already in LTM (This will help form a connection, and will aid storage and retrieval)
  - **Example**: Learning someone’s phone # (312) 935-1482
Teaching Tip

8. Content: Highlight meaningful associations and study practices: Why? Because LTM is organized by meaning (information is connected by meaning).
How is information represented in STM (representation)?

Four Types:

1. Verbal (acoustic-articulatory): evidence that we do this is the fact that we make mistakes on the sounds of letters (e.g., D for E).

2. Semantic: evidence STM is sensitive to meaning information.

3. Visual: evidence mental rotation tasks, (Shepard’s work)

4. Movement based codes: evidence congenitally deaf will confuse like hand movements but not show difficulty reading similar sounding words
Baddeley’s Working-Memory Model

- So we have all of these various codes in STM.
- But STM is simply thought of as storage of information.
- We need a more flexible system to explain these codes.
- He proposed Working Memory (WM).
Baddeley’s Model

**WORKING MEMORY**

**CENTRAL EXECUTIVE**
(Central pool of mental resources)

*Activities:*
- Initiate control and decision processes
- Reasoning, language comprehension
- Transfer information to long-term memory via rehearsal, recoding
- Recency effects

**ARTICULATORY REHEARSAL LOOP**
("Short-term buffer")

*Activities:*
- Recycling items for immediate recall
- Articulatory processes
  - Executive’s resources are drained if articulation task is difficult.

**VISUO-SPATIAL SKETCH PAD**

*Activities:*
- Visual imagery tasks
- Spatial, visual search tasks
  - Executive’s resources are drained if visuo-spatial task is difficult.
Working Memory Components

• **Central Executive**: overall controller of the system. Responsible for decision making, retrieval from LTM, and rehearsal for transfer of info into LTM. Also where reasoning and language comprehension take place.

• **Articulatory Loop**: Holds and recycle small amounts of sound information. You can think of this as older STM rehearsal buffer we discussed earlier.

• **Visuo-spatial Sketchpad**: Holds spatial and visual information for a short time. This component would be engaged in a spatial rotation task.
Working Memory cont.

• **Resources**: Work is done by allocating resources to a task. All the components have resources but the CE can also send more resources to the slave systems if a task is difficult. Resources only flow down in the system.
The Forgetting Curve: Ebbinghaus

• **Ebbinghaus**: was the first researcher to explicitly study memory. Invented the relearning task (used nonsense syllables).

• **Relearning task**: learn a list up to a set level of recall, put the list aside for a period of time, then learn the list again to the same level of recall.
The Forgetting Curve: Ebbinghaus

• How many fewer trials were needed was referred to as your **savings score**
• Example:
• you learn a list it originally takes you 10 attempts,
• set the list aside for a week, then relearn the list
• this time it takes you 6 attempts.
• The four trials that were “saved” is your savings score (roughly 40% of the information did not need to be relearned)
The classic forgetting curve from Ebbinghaus (1885/1913/1964). The figure shows the reduction in savings across increasing retention intervals, time between original learning and relearning. (Data from Ebbinghaus, 1885/1913/1964.)
What can we conclude about studying from Ebbinghaus:

- **Distributed Learning** - learning spaced out over several learning sessions.

Is generally more effective than

- **Massed Learning** - learning that is crammed into a single session.
Teaching Tip

9. Process: Forgetting curve shows that most forgetting occurs within a short time after learning. Repetition and over-learning improve our student’s memories.

10. Testing: Provide multiple assessments to promote distributed learning.
Therriault’s 10 Teaching Tips

General:
1. Dr. Therriault’s three tense approach. Tell your students what you are going to be saying, say it, then tell them what you said.
2. Do not focus on what a student cannot do.
3. Help students acquire an experiential knowledge base.
4. Scaffolding is a particularly effective method of instruction.

Specific
5. Capacity: Provide opportunities for recoding in your teaching materials (e.g., use students current knowledge when presenting new material)... they will be more likely to remember it.
6. Timing: Students are more likely to remember the beginning and end of a lecture (and information presented out of lecture format). Plan your materials accordingly.
7. Clarity: Don’t let your teaching become like the fruit lists, always make meaningful distinctions. It will aid in keeping away interference effects (i.e., student confusion).
8. Content: Highlight meaningful associations and study practices: Why? Because LTM is organized by meaning (information is connected by meaning).
9. Process: Forgetting curve shows that most forgetting occurs within a short time after learning. Repetition and over-learning improve our student’s memories.
10. Testing: Provide multiple assessments to promote distributed learning