Cognitive Science: Improve your Teaching, Learning, and Jump Shot

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Cognitive Science
- Learning: Act of acquiring new information or skills
- Modifying/reinforcing prior knowledge
- Available for future use
- Cognitive Science: The study of learning, and development of practices to optimize learning
  - Psychology
  - Neuroscience
  - Education

Make it Stick, 2014

Which is the Real Penny?

A. 10%
B. 10%
C. 10%
D. 10%
E. 10%
F. 10%
G. 10%
H. 10%
I. 10%
J. 10%

The real penny
Study Smarter

Study skills: Practice tests

- Students read a passage and are tested on how much they remember 5 minutes later
- Three groups of students
  A. Read four times, then real test
  B. Read three times, practice test, real test
  C. Read once, three practice tests, real test
- No feedback after practice tests
- All students took another test 1 week later

Reading vs Testing

Which strategy was most successful at one week?

A. Read four times, then real test 33%
B. Read three times, practice test, real test 33%
C. Read once, three practice tests, real test 33%

Reading vs Testing

- Retrieval strengthens memory
  - Once you try to remember something once, it is easier to bring back the next time
  - Repeated recall strengthens and multiplies the neural connections
  - Delays forgetting
  - To cement knowledge, test yourself
  - While reading: ask yourself to rephrase the key points
  - Guess what the points will be before you start, and then check yourself
  - Make up questions to use after you read
Surgical Skills

- Microsurgical Simulation for Residents
- Typical session: Half day instruction and practice
- Spaced Sessions: One session per week over a month
- Test: Rat simulation
- Immediate Test: Both groups performed similarly
- Post Training Test: one month after last session
- Spaced Group outperformed Typical group
  - Time to complete surgery, hand movements, successful reattachment
  - 16% of Usual group could not complete the surgery

Spacing

- Taking breaks from a topic solidifies knowledge
- Consolidation to long term memory takes at least hours or days
- Longer spacing results in longer term retention
- If a little forgetting has happened, all the better

Paul Cézanne

Henri Matisse
Henri Matisse

Which group did better?

A. Studied paintings group by artist 50%
B. Studied paintings in random order 50%

Massed vs Interleaved studying

- Students who studied the artists and paintings in random order (INTERLEAVED) performed better
- 80% better
- Crossover design
  - everyone studied both ways
- 80% of students THOUGHT they did better with massed practice
  - Even when they knew the test results

Kornell and Bjork 2008

Interleaving and Spacing

- Take a break, and come back later
- Add review questions on old material
- In the space, study something different
  - We learn from the differences
- Three admissions for chest pain on a single night
  - Discuss how they are different
  - Recall the admission from two calls ago

Myth of Massed Practice

- Rapid gains make us think we are learning
- Rapid gain = rapid forgetting
- Massed Practice isn’t true to life
  - Practice like you play and you will play like you practice

Another question...
Beanbag Toss

- Practiced 12 weeks
  - One Group: always 3 feet away
  - Second Group: Alternated 2 feet and 4 feet
- The test was on a 3 Foot Bucket

Who Did Better?

- Group who had varied practice performed better
  - No matter the age
  - No matter the baseline ability
  - Varied practice increases flexibility
  - Adaptable to new conditions

Motor training: Baseball

- Six weeks of batting practice
  - Standard practice: 15 fastballs, 15 curve balls, 15 changeups
  - Varied Practice: 45 pitches in random order
- Standard practice group felt they were improving
  - Varied Practice group was frustrated
- Varied practice group performed better

I promised you a jump shot

- Shoot jump shots (Testing effect)
  - Take a break (Spacing)
    - Defense skills
    - Ball control
  - Mix it up (Interleaving)
    - Practice layups, jumpers, 3-pointers
    - All over the court, randomly
    - With defenders
    - Listen to your coach

Improve your teaching

Small Group Activity
Testing Effect

- Teaching through questions is powerful
- Good questions
  - Open ended
  - Designed to explore the thought process
  - Can be followed up with a “why” question

Teaching through questions

- Helps the learner recognize their deficiencies
- Lets you know on what level to teach
- Encourages active participation instead of passive learning

Spacing Your Teaching

- Encourage reading after you have discussed a topic
- Repeat questions or learning points over time
  - “Repetition is the key to learning”

Interleaving Your Teaching

- The clinical environment does that for us!

Desirable Difficulties

- Learning for understanding
  - Requires active processing
  - Requires deep processing
- Use questions to make the learner talk
- Have learner apply knowledge via a case

Teach Less

Osler:
- “The problem with medical students is that they try to learn too much;
  the problem with medical educators is that they try to teach too much”

Teach to Promote Retrieval

- Retrieval enhancing strategies
- Show or ask applicability
- Teach Advanced Organizers

Advanced Organizers

- Mental constructs useful to organize knowledge
- Acronyms, mnemonics, algorithms and diagrams
- AKI: prerenal, intrinsic, postrenal
- Anemia: factory production of RBCs
- Helps retrieval later

Teaching on the fly: Cognitive Science Style

Microskills of clinical Teaching

1. Obtain a commitment
2. Probe for supporting evidence
3. Teach general rules

Chalk Talk: Cognitive science style

- Start with a case
- Show applicability
- Teach an advanced organizer
- Use questions throughout the whole talk
- My approach to the problem
- End with learners applying knowledge to another case
- Refer back to chalk talk in subsequent teaching

Takeaways

- Retrieval is critical to studying
- Know what you don’t know
- Spacing and interleaving allow for memory consolidation
- Practice like you play
  - Mix it up
- Talk less, ask more
  - Promote metacognition
- Teach and Model study skills

References

- Roediger HL, Karpicke JD. The Power of Testing Memory: Basic Research and Implications for Educational Practice. 2006, Psychological Science, volume 17, issue 3, p 253
- Kerr R and Booth B. Specific and varied practice of motor skill. Perceptual and Motor Skills 46 (1978), 395 - 401
- Hall KG, Domingues DA, Cavazos R. Contextual interference effects with skilled baseb
- List A: 24 words, 24 pellets. List B: 24 words, 5 pellets. Memory after 24 hours: List A 112%, List B 55%
Application of Knowledge

Kolb’s Cycle of Experiential Learning

Concrete Experience → Reflective Observation
Reflective Observation → Abstract Conceptualization
Abstract Conceptualization → Active Experimentation
Active Experimentation → Concrete Experience

Image by norm kirs

http://serc.carleton.edu/introgeo/enviroprojects/what.html