Helping Students Achieve: Promising Practices and Strategies from Cognitive Science

John Dunlosky
Kent State University
Evidence-based Education Reform

Does the strategy boost performance?

Does it help in the lab and in the classroom?

Does it help all students (K-12, college, all abilities)?

Lots of evidence available on how well strategies improve student achievement
Hattie’s (2009) *Visible Learning*

Reviewed 138 factors (includes over 800 meta-analyses)

Minor influence:

- Class size
- Use of power point

Top 30 included:

- Obtaining formative evaluation
- Reciprocal teaching
- Distributed practice
- Metacognitive strategies
- Study strategies
### Which Study Skills Help Students?

<table>
<thead>
<tr>
<th>Technique</th>
<th>Utility</th>
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<table>
<thead>
<tr>
<th>Strategy</th>
<th>Percent reporting</th>
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<tbody>
<tr>
<td>Rereading notes or text book</td>
<td>83.6</td>
</tr>
<tr>
<td>Doing practice problems</td>
<td>42.9</td>
</tr>
<tr>
<td>Flashcards</td>
<td>40.1</td>
</tr>
<tr>
<td>Retrieval practice</td>
<td>10.7</td>
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adapted from Karpicke et al. (2009), Table 1

Similar results from Kornell & Bjork (2007) and Hartwig & Dunlosky (2012)
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<td>67</td>
</tr>
<tr>
<td>Test yourself/practice problems</td>
<td>72</td>
</tr>
<tr>
<td>Flashcards</td>
<td>54</td>
</tr>
<tr>
<td>Highlighting</td>
<td>53</td>
</tr>
<tr>
<td>Cram</td>
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adapted from Morehead, Rhodes, and DeLozier (2015)
Which Study Skills Can Help Students?

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Talk Overview

1. Which Study Strategies Help Students?
   2. Retrieval Practice
   3. Distributed Practice
   4. Successive Relearning
Talk Overview

For Each Strategy:

Lab research

Classroom implementation

Under the Hood
Talk Overview

1. Which Study Strategies Help Students?
2. Retrieval Practice
3. Distributed Practice
4. Successive Relearning
5. A Few Tips for Exploring Your Innovations
Retrieval Practice

Aka: Test taking
Retrieval Practice

Practice tests:

Multiple-choice tests
Fill-in-the-blank tests
Essay-style recall tests
Retrieval Practice

60 Swahili-English translations

e.g. zabibu - grapes

Initial study trial for all items

Karpicke (2009) JEP:General
Retrieval Practice

60 Swahili-English translations

e.g. zabibu - grapes

Initial study trial for all items

Then, either:

study – study – study – study

test  – study – test  – study
vumbi - dust
leso - scarf
lozi - almond
nafaka - corn
ziwa - lake
pombe - beer
60 Swahili-English translations

e.g. zabibu - grapes

Initial study trial for all items

Then, either:

study – study – study – study

or:

test – study – test – study

Then, a final recall test
Final Recall % Correct

study, study, study

Karpicke (2009) *JEP:General*
Retrieval Practice

Initial study ~1000 word texts

Then, test-restudy or restudy only for key facts and concepts

One week later – final test with NEW inference questions

Butler (2010) *JEP:LMC*
Retrieval Practice

Has multiple benefits!

Effective when:

Followed by feedback

Responses are (eventually) correct
Implementing

Flash cards

Note taking (e.g., Cornell notes)

Daily “reviews”

Peer Instruction
Implementing: Peer Instruction

A Single Genetics Course

Multiple choice question followed by peer discussion

Same question and isomorphic question

Implementing: Peer Instruction

Smith et al. (2009)
Under The Hood

A Single Genetics Course

Pre-instruction Test Critical

Was it peer instruction?

To know, a control is needed…

Smith et al. (2014)
Under The Hood

A Single Genetics Course

Pre-instruction Test Critical

Freeman et al. (2014). *PNAS.*
What versus When

Retrieval practice: What to do.

Distributed practice: When to study.
Distributed Practice

Spreading out study (of the same content) across time
Distributed Practice

Session 1: Study relevant material

Session 2: Restudy the same material

Session 3: Restudy the same material

Session 4: Restudy the same material

Exam
versus Cramming

One Session the Night Before

Exam
Distributed Practice

Initial study of vocabulary word pairs

Then, test-restudy trials:

- eight on one day or two on four days

One day later – final test

Kornell (2009)
Kornell (2009)
Distributed Practice & Math

7th Graders

Learned to solve 4 problems:
- Solve linear equation
- Solve word problem w/proportions
- Graph an equation
- Determine slope of line

Rohrer, Dedrick, & Burgess (2014)
Distributed Practice & Math

9 weeks of (10) practice assignments

Assignment: Solve 12 problems
 Massed in one assignment

OR

Distributed across assignments

Two week delay, surprise test

Rohrer et al. (2014)
Distributed Practice & Math

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<td>Distributed practice</td>
<td>.72</td>
<td>.30</td>
</tr>
<tr>
<td>Blocked practice</td>
<td>.38</td>
<td>.35</td>
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Rohrer, Dedrick, & Burgess (2014)
Under The Hood

Eight classes and 3 teachers

Two Groups of Four Classes

Used 4 Practice Problems so as to:

Counterbalance Problems to Distributed vs. Massed Practice

Rohrer et al. (2014)
Distributed Practice

Essential for long-term retention

Most effective when:

Practice is distributed ACROSS sessions

Distributed practice involves Effective Strategies
Implementing

Repeat problem types/content across class days

Repeat problem types in homework assignments across weeks
What: Retrieval Practice Until You Get it Right

When: Distributed Across Several Sessions

Successive Relearning
Successive Relearning

Session 1: Learn material to a specific criterion (practice retrieval plus restudy until correct)

Session 2: Relearn the same material

Session 3: Relearn the same material

Session 4: Relearn the same material

Exam
Power of Successive Relearning: Paired-Associate Method

Swahili – English pairs (pombe – beer)

Session 1: 1 - 7 correct recalls

Relearning sessions: 1, 2, 3, or 4

Continue until 1 correct recall

One week delay between each session

Relearning sessions begin with recall

Vaughn, Dunlosky, & Rawson (2016)
Retention After One Week

70 Swahili-English pairs (*pombe* – *beer*)
## Retention After One Week

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<thead>
<tr>
<th></th>
<th>Cram</th>
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<tbody>
<tr>
<td>Two correct</td>
<td>22%</td>
<td>48%</td>
</tr>
<tr>
<td>Three correct</td>
<td>28%</td>
<td>68%</td>
</tr>
<tr>
<td>Four correct</td>
<td>28%</td>
<td>75%</td>
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Power of Successive Relearning: Introductory Psychology

Students in large section (400+) of Intro Psych

Instructor provided key concepts from 8 units

32 successive relearning, 32 baseline

For successive relearning:

Initial learning + 3 relearning sessions

Rawson, Dunlosky, Sciartelli (2013)
What is the self-serving bias?

When I think that my good behaviors are because I’m a good person but my bad behaviors are due to someone else.
Tendency to attribute positive outcomes to our own traits or characteristics but negative outcomes to factors beyond our control.

What is the self-serving bias?
Power of Successive Relearning: Introductory Psychology

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For successive relearning:

Initial learning + 3 relearning sessions

Sessions synchronized with class
When casinos make such a big deal out of drawing attention to winners, they are taking advantage of the _________ as a way to encourage patrons to return regularly.

a. conservation heuristic
b. representativeness heuristic
c. availability heuristic
d. confirmation bias
Rawson, Dunlosky, Sciartelli (2013)
Under The Hood

A Single Psychology Course

Within-participant manipulation:

Two sets of concepts

Each student was his/her own control

Rawson et al. (2014)
Successive Relearning

Essential for long-term retention

Relatively efficient: relearning requires (much) less time
Exploring Intervention Efficacy: A Few Tips

Use Pre- and Post-Intervention Tests When Possible

Use Within-Student Design When Possible

With 2 or More Classes Using Same Content:
Begin After Exam 1 (use as baseline)
Vary Intervention Across Subsequent Exams
Baseline to establish classes are similar

Conclusions

Effective Study Strategies Can Improve Achievement

Strategies Can Be Implemented in the Classroom and Out-of-class Assignments

Evaluate Your Innovations in Your Own Classroom!
Thank You

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jdunlosk@kent.edu
What About Younger Learners?

8th grade students, key concept definitions

Successive relearning vs. baseline control

Relearning: 1, 2, 3, or 4 sessions

Final Test after one month
Recall on One Month Test

Number of Relearning Sessions

Baseline

Rawson & Dunlosky (in preparation)
Retrieval Practice for Science

8th grade students

Content: Foundational concepts from genetics, evolution, and anatomy

Some material was targeted for in-class quizzes (multiple choice)

McDaniel et al. (2011)
Retrieval Practice for Science

Class unit exam (50% of overall grade)

End of semester exams

End of the year exams

McDaniel et al. (2011)
Proportion Correct on Exam

McDaniel et al. (2011)