Science of Learning III: High-Impact Approaches

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Key Working Assumptions

**For Students**: important differences in learning outcomes reflect strategies used.
  - Control over choice of strategy.

**For Instructors**: implementing evidence-based learning strategies can positively affect learning outcomes.
  - Control over learning environment.
Overview

• I will cover 2 high-impact strategies.
  • Spacing
  • Testing

• For each:
  • A lab example.
  • A classroom example.
  • Putting it into practice.
Spacing

- The schedule of studying has a substantial impact on learning.

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Spacing

• **massed practice**: all studying occurs in one block of time.

  ![Diagram showing massed practice]

• **spaced practice**: studying spread out across time.

  ![Diagram showing spaced practice]
Spacing in the Lab

• Spaced practice leads to far superior learning than massed practice.

• Kornell (2009): Ss study vocabulary words (e.g., *effulgent*: *brilliant*).
  • For ½ words practice is *massed* and for the remaining ½ practice is *spaced*.
Kornell (2009)

The bar chart shows the mean percentage of memory performance and predictions for massed and spaced presentations. For memory performance, the mean is 21% for massed and 54% for spaced. For predictions, the mean is 60% for massed and 41% for spaced.
Spacing in the Classroom

- **Yazdani & Zebrowski (2006)**: assigned different homework schedules for HS geometry.

- Two different schedules:
  - **Massed**: all homework the day after class.
  - **Spaced**: homework spread out over 24 days.

- Final test administered at the end of the unit.
Yazdani & Zebrowski (2006)

![Bar chart showing the comparison between Massed and Spaced conditions. The Massed condition has 20 correct responses, while the Spaced condition has 25 correct responses.]

- **Massed**: 20 correct responses
- **Spaced**: 25 correct responses
Spacing in Practice

• Many ways to implement spacing:
  • Begin class with reviews.
  • The wild card approach.
  • Cumulative testing and quizzing.

• About testing…
Testing

• Why do we test students?

• **Majority View**: Testing allows evaluation of learning.

• What this neglects…
  • Testing is a powerful method of learning

“Don’t think of it as a math test, think of it as binge solving.”
Testing in the Lab

- Participants Read Passages (Phase 1)
- Read Passages Again
- Take a Test (Phase 2)
- Take a Final Test

5 min
2 days
1 week

Phase 1
Phase 2
Phase 3
Roediger & Karpicke (2006)

Mean Percent Recalled

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<th>Study, Test</th>
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<tbody>
<tr>
<td>5 Min</td>
<td>81</td>
<td>76</td>
</tr>
<tr>
<td>2 Days</td>
<td>54</td>
<td>68</td>
</tr>
<tr>
<td>1 Week</td>
<td>42</td>
<td>56</td>
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Testing in the Classroom

• **Larsen, Butler, Roediger (2009):** medical residents learn 2 lessons.
  • Presented in 3 sessions over 2 wks.

• 1 lesson repeatedly studied, 1 lesson repeatedly tested.

• Final exam 6 months after first teaching session.
Larsen, Butler, & Roediger (2009)

![Bar graph showing mean percent correct for repeated study and repeated test. The graph shows a mean of 26 for repeated study and a mean of 39 for repeated test.]
Testing in Practice

• Literature suggests frequent testing benefits learning.
  • Low-stakes quizzes.
  • Mastery quizzing.
  • Frequent exams.

• Most potent learning comes from combining spacing with test.
Concluding Remarks

• Simple approaches can yield substantial learning benefits.

• Each can be easily implemented by students and instructors.
Thank You!

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