Exam over, knowledge gone?
Retention of conceptual and procedural knowledge in genetics
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**Goal**

Measure retention of conceptual understanding versus problem solving ability 2.5 months after students completed the required second year genetics course.

**Key Course Concepts**

- Inheritance of alleles and chromosomes
- Mutation: Effect on DNA, proteins, somatic vs. germ line
- Phenotype: Genotype + Environment = Phenotype
- Linkage: Effects assortment of alleles
- Complementation: 2 genes affecting phenotype

**Measuring Retention**

**Sept 2012**

- **CI Pre-Test** first day of class
- **PS Test**: Midterm 1
- **PS Test**: Midterm 2

**Dec 2012**

- **CI Post-Test**, last day of class
- **PS Test**: Final Exam

**Feb 2013**

**Retention Testing:**

- **CI Test**
- **PS Test**: Qs isomorphic to midterm & final exam

**Conceptual vs. Problem Solving**

Selecting the correct response on the conceptual test (CI) was not correlated with performance on a problem solving (PS) test item that required understanding, application, or integration of that same concept.

<table>
<thead>
<tr>
<th>CI Item</th>
<th>PS Item Required</th>
<th>Correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concept A</td>
<td>Apply</td>
<td>-0.19</td>
</tr>
<tr>
<td>Concept A</td>
<td>Integrate</td>
<td>0.07</td>
</tr>
<tr>
<td>Concept B</td>
<td>Understand</td>
<td>-0.16</td>
</tr>
<tr>
<td>Concept B</td>
<td>Apply</td>
<td>-0.14</td>
</tr>
</tbody>
</table>

**Do students understand & retain the concepts?**

CI Test: 14 multiple-choice questions from validated conceptual inventory tests. Average end of term score (n=441): 70%

**Can students apply understanding to solve a problem?**

PS Tests: written, open-ended, problem solving questions. Average scores during term (n=441): 66%

**Figure 1.** Student performance on concept inventory (CI) and the Problem Solving Tests [midterms (I, II), final exam (III)], +/- standard error. N=44. * t-test, p<0.01.

- Reduced success at solving problems at the time of retention testing, *t*-test p<0.01.
- Items which students rely more on memorized tactics (A, C) have greater losses.
- Conceptual understanding (B, A) not correlated to problem solving ability.

**Knowledge gone?**

2.5 months after the course, conceptual understanding retained but ability to apply concepts to solve problems is reduced.