Test-Enhanced Learning in the Classroom: The Columbia Middle School Project, Year 2

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BACKGROUND

Tests are usually thought to serve assessment purposes, but they can also benefit long-term learning better than repeated studying. 1  
Multiple tests are better than single tests in enhancing learning. 1  
Feedback provided after testing also enhances learning. 2  
Prior laboratory research supports these principles, yet none have been thoroughly tested in a classroom setting using a true experimental design. 
We examined whether a test-enhanced learning program, integrated with daily classroom practices, is an effective method of enhancing retention in a middle school setting.

METHOD

This research was conducted at a public middle school in Illinois. 

Materials  
Textbook material from Social Studies and Science classrooms  
Multiple-choice quizzes followed by immediate feedback  
Within-subjects design: Half of the target facts were quizzed during lessons, half were not tested (but non-tested items were covered during the class lecture by the teacher)  

Procedure  
Students took a multiple-choice pre-test over tested items.  
The teacher was not present for the pre-test and did not know which target facts were tested.  
Following the pre-test, the teacher taught the lesson for the day.  
Immediately after the lesson, students took a multiple-choice post-test over tested items.  
Approx. 2 days later, students took a review test over tested items.  
Retention was measured 2-14 days later with multiple-choice exams comprised of all (tested and non-tested) target facts. 

EXPERIMENT 1

Social Studies, N = 112

<table>
<thead>
<tr>
<th>Percent Correct</th>
<th>Tested</th>
<th>Non-Tested</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chapter Exams</td>
<td>91.5</td>
<td>80.8</td>
</tr>
<tr>
<td>End of the Semester</td>
<td>77.2</td>
<td>68.5</td>
</tr>
<tr>
<td>End of the School Year</td>
<td>59.9</td>
<td>56.0</td>
</tr>
</tbody>
</table>

Science, N = 110

<table>
<thead>
<tr>
<th>Percent Correct</th>
<th>Tested</th>
<th>Non-Tested</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chapter Exams</td>
<td>91.1</td>
<td>74.9</td>
</tr>
<tr>
<td>End of the Semester</td>
<td>79.7</td>
<td>60.7</td>
</tr>
<tr>
<td>End of the School Year</td>
<td>61.1</td>
<td>45.4</td>
</tr>
</tbody>
</table>

Testing information led to significant benefits in retention, even over the long term. Further analyses revealed that students with lower standardized test and pre-test scores showed greater benefits of testing ($r = -.38$ and $r = -.39$, respectively).

EXPERIMENT 2

In Social Studies, we evaluated the effect of pre-tests on retention.

Social Studies, N = 102

<table>
<thead>
<tr>
<th>Percent Correct</th>
<th>Pre-Test</th>
<th>Post &amp; Review</th>
<th>Pre &amp; Post &amp; Review</th>
<th>Not Tested</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chapter Exams</td>
<td>89.7</td>
<td>94.7</td>
<td>94.0</td>
<td>88.7</td>
</tr>
</tbody>
</table>

A significant effect of testing was obtained, but pre-tests did not enhance retention.

EXPERIMENT 3

In Science, we evaluated the effect of testing on transfer between application and definition questions.

Science, N = 136

<table>
<thead>
<tr>
<th>Percent Correct</th>
<th>Application</th>
<th>Definition</th>
<th>Final Test Format</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial Test Format</td>
<td>Tested</td>
<td>Non-Tested</td>
<td></td>
</tr>
<tr>
<td>Chapter Exams</td>
<td>81.8</td>
<td>76.5</td>
<td></td>
</tr>
<tr>
<td>End of the Semester</td>
<td>79.5</td>
<td>74.9</td>
<td></td>
</tr>
<tr>
<td>End of the School Year</td>
<td>82.4</td>
<td>77.4</td>
<td></td>
</tr>
</tbody>
</table>

Significant testing effects were obtained and a pattern of transfer appropriate processing was revealed.

CONCLUSIONS

A test-enhanced learning program can be successfully implemented in a classroom setting. 

Results are consistent with the notion of desirable difficulty: more effortful learning conditions (e.g., post-test) produce larger long-term benefits than less effortful learning conditions (e.g., pre-test). 4  

Educational implications: Quizzes can be used as a method to enhance long-term learning. 5

References


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