Learning and Retention from an Online Tutorial among Resident Physicians

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Abstract
We randomized 91 residents who had completed an online diabetes tutorial to take a post-test after 0, 1, 3, 8, 21, or 55 days. 87 subjects provided complete follow-up data (96%). Knowledge scores increased were 2.5 standard deviations higher than baseline for those tested immediately the tutorial. Gains were half as great after 8 days; no retention remained at 55 days. In linear regression modeling, critical appraisal skills and time spent on the interactive tutorial were associated with greater learning.

Introduction
Online education is a growing medium for both postgraduate and continuing medical education. Results from studies of online education have been mixed. We sought to explore factors associated with learning and retention from an online tutorial.

Methods
Residents were recruited from internal medicine and family medicine training programs at 2 universities. Subjects completed a survey, including a test of critical appraisal (CA) skills, a randomly-generated 20-question pretest and then a tutorial on diabetes guidelines. They were then randomized to take a 20-question posttest (new questions), either immediately or after a delay of 1, 3, 8, 21, or 55 days.

The site tracked time spent on each page. If no mouse movement was detected for 30 seconds the user was considered to be idle. Knowledge scores were calculated based on 16 of 20 learning objectives for which subjects demonstrated any learning. We analyzed results using linear regression. Gain scores were adjusted based on item difficulty scores.

Results
Of 197 residents invited, 105 began the tutorial, 91 completed it and were randomized, and 87 completed the study (14–15 per group). These 87 didn’t differ in specialty, PGY or gender from the other 111 residents. Pretest scores averaged 7.5 out of 16. Posttest scores declined over time after the tutorial (-0.5 points/day0.5, $r^2 = 0.24$; Figure 1), as did adjusted score gains. Scores were not correlated with total session times but after correction for idle times, scores correlated and with time spent in the tutorial’s interactive part. In multivariate regression, CA skills and tutorial time both predicted score gains (Table 1) but neither slowed the decline in retention with time.

![Figure 1. Retention of knowledge over time after the tutorial. (Means; 95% CI’s; regression with sqrt time)](image)

### Table 1. Factors associated with unadjusted posttest score or adjusted knowledge gain. Numbers are the regression coefficients ($P$ values), indicating the change in knowledge score expected for each unit change in the independent variable.

<table>
<thead>
<tr>
<th>Independent variable</th>
<th>Posttest ($P$)</th>
<th>Adjusted Gain ($P$)</th>
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<tbody>
<tr>
<td>Days to posttest0.5</td>
<td>-0.30 (.003)</td>
<td>-0.41 (.003)</td>
</tr>
<tr>
<td>CA skill score</td>
<td>+0.83 (.002)</td>
<td>+0.68 (.008)</td>
</tr>
<tr>
<td>Minutes on tutorial</td>
<td>+0.10 (.05)</td>
<td>+0.16 (.01)</td>
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Conclusion
Time invested in the interactive portion of an online tutorial enhanced learning but recall fell rapidly. Learners should consider explicitly planning to reinforce new learning after a time delay.

References