Comparison of Knowledge Acquired by Students in Small-group Seminars With and Without a Formal Didactic Component

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Background and Objectives: This study compared student knowledge gain from using a CD-ROM-based lecture only, from attending small-group seminars only, and from using a combination of both methodologies. Methods: During a required second-year case-based seminar about falls in the elderly, one third of the 96 second-year medical students were randomized into each of three study groups. One group viewed a 12-minute CD-ROM didactic presentation on falls in the elderly, another group participated in the small-group seminars, and the third group did both. All three groups took a pretest and posttest to assess any change in knowledge. The timing of the viewing of the CD-ROM and of the pretests and posttests were varied to test the effects of each modality separately and of the modalities combined. Results: The difference between the pretest and the posttest scores was significantly different among groups. Post hoc analysis showed that the change from pretest to posttest was greater for students who participated in the combined modalities than in those who viewed the CD-ROM only or participated in case-based seminars only. Discussion: The addition of a 12-minute CD-ROM on the topic to a small-group seminar appears to increase student knowledge of the material being taught.

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New educational technologies are appearing rapidly. Traditional lectures are gradually being augmented or replaced by other methods such as videotape, computer-aided instruction, Web-based teaching, case-based teaching, and small-group seminars. Great interest exists among medical educators in determining the relative effectiveness of these new technologies compared to traditional lecture-based instruction. Numerous studies have shown that videotaped didactics, computer-aided instruction, and Web-based instruction result in student knowledge increases that are comparable to those achieved by traditional lectures.1,9

Case-based medical education and problem-based education, while controversial, also appear to result in knowledge gains that are comparable to traditional lecture-based curricula.10-16 In addition, case-based and problem-based education have been reported to be more enjoyable for both the faculty and the students.14-16

Unfortunately, these small-group formats are more faculty intensive and therefore more costly than lectures.12,13,15,16

While the medical education literature contains numerous reports comparing two modalities of instruction to each other; it contains relatively little information on the effectiveness of combining multiple modalities of instruction. To further complicate matters, not all lectures are equal. Lectures that are engaging to the audience, that are clear and concise, and that use a case-based format tend to be evaluated as being of higher quality.17

To improve the medical student education in geriatrics at the University of California-Davis, we developed 17 10–20 minute modules delivered by local experts who were also deemed to be excellent teachers. These expert teachers were videotaped, and the content was transferred to CD-ROM. Their audiovisual aids were digitized and added to the CD-ROM, and opportunities for student interactivity were added to the lecture presentation. Selected modules have been incorporated into the medical student curriculum to augment small-group seminars on topics where no lecture existed previously. This study compared student knowledge acquisition from using the CD-ROM-based lec-
ture only, from attending the small-group seminars only, and from using a combination of both methodologies.

**Methods**

During the second-year medical student curriculum, all medical students at our institution participate in a case study of falls in the elderly. This small-group case study is taught in groups of six to eight students, and the case seminar consists of three weekly 2-hour sessions. In addition to the small-group seminar, a standard 12-minute didactic lecture on falls and hip fractures has been created using CD-ROM technology.

Approval for the study was obtained from the Institutional Review Board at the University of California-Davis.

The medical student small groups were randomly assigned to one of three study arms. One third of the 96 medical students were randomized into each arm of the study. Study arm 1 was designated the CD-ROM-only group. This group viewed the CD-ROM in advance of the small-group discussion sessions, took a knowledge pretest prior to viewing the CD-ROM, and then took a posttest after viewing the CD-ROM but before attending the small-group seminars. Study arm 2 was designated as the combined modality group. This group took the pretest prior to viewing the CD-ROM or attending the small-group session. They then attended the small-group sessions and viewed the CD-ROM. Their posttest occurred after completing both the CD-ROM and the small-group seminars. Study arm 3 was designated the small-group seminar arm-only group. This group took the pretest prior to beginning the small-group seminars and took the posttest after completing the small-group seminars. (They viewed the CD-ROM after the completion of the posttest).

The pretest/posttest were created to reflect the information that was contained in the didactic CD-ROM material. The exam had 20 multiple choice questions, and the same test was given as both the pretest and the posttest.

Paired pretest and posttest data were used to assess the effectiveness of each instructional modality. Differences between pretest and posttest scores for each group individually were compared using a paired t test. ANOVA was used to detect a difference in the size of the performance change among the three groups. Any significant differences among the groups were subjected to post-hoc analysis using least-squared differences.

**Results**

Paired data were obtained from 69% (n=66) of the second-year students. The study arms were approximately equally represented, with study arm 1 having a response rate of 65%, study arm 2 having a response rate of 75%, and study arm 3 having a response rate of 67%.

In group 1 (CD-ROM only), the pretest score was 11.3±1.3, the posttest score was 12.7±2.4, and the scores showed a significant improvement (t=2.9, P<.01). In group 2 (combined modalities), the pretest score was 12.0±1.9, the posttest score was 15.0±2.1, and the scores showed a significant improvement (t=7.1, P<.01). In group 3 (seminar only), the pretest score was 12.4±2.0, the posttest score was 12.8±2.1, and no significant difference was noted (t=0.6, P=not significant [NS]).

Pretest scores among the three groups showed no significant differences, with group 1 scoring 11.3±1.3, group 2 scoring 12.0±1.9, and group 3 scoring 12.4±2.0. (f=1.88, df=62, P=NS) (Table 1). Posttest scores for the three groups showed significant differences and were as follows: group 1=12.7±2.4, group 2=15±2.1, group 3=12.8±2.1 (f=7.6, df=62, P=.001). On post hoc analysis, the posttest score of group 2 (combined modalities) was significantly higher than the posttest score of either individual modality group (P<.01). The difference between the pretest and the posttest scores was also significantly different between groups (f=7.0, df=62, P=.002). Post hoc analysis showed that the change from pretest to posttest was greater in group 2 (combined modalities) than in either group 1 (CD-ROM only) or group 3 (case-based seminar only). No difference in the test score improvement was noted between group 1 and group 3.

**Discussion**

The combination of didactic material and small-group seminars appeared to be more effective than either modality separately. The students in the combined modality groups had a significantly greater increase in their test scores from the pretest to the posttest than did either of the other groups. The groups that were exposed to only one modality or the other were not significantly different in their change from the pretest to the posttest. This finding suggests that the teaching

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**Table 1**

Comparisons of Pretest and Posttest Scores Among the Three Groups

<table>
<thead>
<tr>
<th></th>
<th>Pretest Scores</th>
<th>Posttest Scores</th>
<th>Pretest/Posttest Difference</th>
<th>Statistical Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1</td>
<td>11.3±1.3</td>
<td>12.7±2.4</td>
<td>1.33±2.1</td>
<td><em>P&lt;.05</em></td>
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<tr>
<td>Group 2</td>
<td>12.0±1.9</td>
<td>15.0±2.1</td>
<td>3.05±2.0</td>
<td><em>P&lt;.05</em></td>
</tr>
<tr>
<td>Group 3</td>
<td>12.4±2.0</td>
<td>12.8±2.1</td>
<td>0.40±2.9</td>
<td>NS</td>
</tr>
</tbody>
</table>

* Posttest score significantly higher than pretest score
† Pretest/posttest difference significantly larger from group 2 than for group 1 or group 3
modalities synergize rather than simply provide additive effects.

One possible explanation for this finding is that the CD-ROM didactic material serves to focus the students toward specific content. This then allows the case study to serve as a reinforcement to the information learned in the seminar session. In this regard, the 12-minute CD-ROM may serve the same purpose as required readings that are often assigned in advance of small-group seminars.

There are, however, several limitations to this study. First, the study is of a single CD-ROM used by one seminar in a single medical school. The results may not be generalizable to other content areas or other institutions. The study will need to be replicated prior to drawing any general conclusions. Second, it is not clear to what extent a lecture or required advanced readings would be as effective as the CD-ROM was, since students who do additional work outside of class would be expected to score higher since they have spent more time on task. However, the use of the CD-ROM reduces this preparation time to only 12 minutes. It is likely that reviewing assigned readings would take substantially longer than this. Finally, the response rate for paired data was about 70%. Had we had a higher response rate, it is possible that nonrespondents could have had a different outcome than the respondents. Despite these limitations, we conclude that the addition of a 12-minute topic-related CD-ROM shown to a small-group seminar appears to increase student learning of the material being taught.

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REFERENCES