Teaching Blood Morphology:
Audiovisual Method Compared to Microscope Slides
With Written Text and Instructor

By John Stanley and Paul Reich

Two methods of teaching first-year medical students peripheral blood morphology were compared. A group of 27 students learned using a self-teaching audiovisual method of 35-mm color slides accompanied by an audio tape explanation. A group of 20 students were taught using the classic method of microscope slides explained by a written text, with an instructor to point out morphology. Both methods presented the same information to the students. Both groups were evaluated by a quiz consisting of actual blood smears. Although the mean learning time per student for the color slide group was significantly shorter than that for the microscope group, there was no significant difference between the mean quiz scores of the two groups, and both were significantly greater than the mean score of a control group which had no learning session.

Although there has been a multitude of articles written about medical education, there have been surprisingly few controlled studies in this field to evaluate the effectiveness of different proposed educational approaches. One educational approach which has received increasing attention in medical schools is the use of photographic slides accompanied by audio tapes as self-teaching devices to teach various subjects, such as radiology, electrocardiography, microscopic anatomy, hematology, and endocrinology, among others. The purpose of this study is to compare the effectiveness and efficiency of two methods of teaching peripheral blood morphology to first-year medical students. The first method uses color photographic slides of peripheral blood with a synchronized audio cassette tape which explains the blood smears and has a self-testing question and answer unit. The second method, the "classic" method, uses a set of microscope slides of peripheral blood smears explained by a written text, with an instructor present to point out the relevant morphology. Both groups were evaluated for effectiveness of learning with actual peripheral blood smears.

MATERIALS AND METHODS

Subjects

First-year Harvard Medical School students were asked to volunteer for a study in which they would learn peripheral blood morphology by different methods. First-year students were chosen because they had no previous instruction in hematology. The volunteers were assigned randomly to one of three groups: a control group (N = 6), a microscope group (N = 20), and a color slide group (N = 27).
Teaching Methods

The color slide group learned from a series of 90 Kodachrome 35-mm slides of peripheral blood smears. Twenty-five slides showed normal red cells and red cell abnormalities, followed by 20 slides presented as unknown red cell abnormalities. Then white cells were shown in the same way. The slides were projected on a rear screen projector with a built-in cassette tape player (Coxco SP-120). The slides were synchronized with an audio cassette tape which provided explanations for each of the slides or, in the case of the unknowns, asked a multiple choice question, followed by an answer and explanation. The tape advanced the slides and automatically stopped after each explanation or question. The student then restarted the tape. Students saw the slides in groups of two to five and were free to discuss the slides among themselves. These students were also provided with a response-answer sheet on which to specify their answers.

The microscope group learned from a set of 27 microscope slides which showed the same normal cells and abnormalities shown on the color photograph slides. These slides were from the same collection from which the photographs were taken. Each microscope slide was explained by a written text. This text contained exactly the same information as the audio cassette tape and was, in fact, just a condensation and rearrangement of the transcript for that tape. An instructor was present only to point out the normal and abnormal morphology and answer questions about morphology. Students looked at the blood smears with their own microscopes in groups of one to three.

It should be stressed that the same total information (both morphology and written or verbal explanations) were presented to both groups. In addition, the instructor for the microscope group was the same person who prepared and presented the color slide material.

Questionnaire

A questionnaire was given to each student to evaluate his previous experience in hematology and his opinion of the teaching method.

Evaluation Quiz

Approximately 1 wk after the learning session, each student was given a set of 12 peripheral blood smears to be examined under his own microscope. The student was asked for a diagnosis on three slides (types of leukemia), and on the other nine was asked to list the predominant abnormality or abnormalities present. The student chose the diagnoses and abnormalities from an extensive list. There was a total of three correct diagnoses and 17 correct abnormalities. The student was graded as a per cent of the total correct answers, agreed upon by both authors prior to testing. The 12 blood smears for this evaluation were taken from the collections of two hematologists not involved in this study.

Control Group

This group of students took the evaluation quiz without having had a learning session. We limited the number of students in this group because it requires student time without providing any teaching in return, and the statistical analysis of the preliminary six students’ test scores showed a highly significant difference compared to the test scores of students who had learning sessions.

RESULTS

Twenty-seven students learned by the color slide method, 20 students learned by the microscope method, and six students took the evaluation quiz without any learning session (Table 1). No students in any group had significant past experience in blood morphology. The average time between learning session and evaluation session was 8.0 days for the color slide group and 7.6 days for the microscope group (Table 1). The mean learning time per student for those in the color slide group, 86 min, was significantly less than that for those in the microscope group, 101 min (Table 1). The evaluation quiz results revealed that there was no significant difference between the mean scores of the microscope group and the evaluation group.
Table 1

<table>
<thead>
<tr>
<th></th>
<th>Color Slide Group</th>
<th>Microscope Group</th>
<th>Control Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of students</td>
<td>27</td>
<td>20</td>
<td>6</td>
</tr>
<tr>
<td>Interval from learning session to evaluation quiz (days)</td>
<td>8.0</td>
<td>7.6</td>
<td>—</td>
</tr>
<tr>
<td>Significance</td>
<td>NS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean learning time per student ± SE (min)</td>
<td>86 ± 2.7</td>
<td>101 ± 3.1</td>
<td>—</td>
</tr>
<tr>
<td>Significance</td>
<td></td>
<td>p = 0.001</td>
<td></td>
</tr>
<tr>
<td>Evaluation quiz score ± SE (%)</td>
<td>40 ± 2.5*</td>
<td>44 ± 3.1</td>
<td>22 ± 3.4</td>
</tr>
<tr>
<td>Significance</td>
<td>NS</td>
<td>p &lt; 0.001</td>
<td></td>
</tr>
</tbody>
</table>

NS, no significant difference; SE, standard error.

*Compared to control group, p = 0.001.
†p (two-tailed) determined by unpaired t test.

group, 44%, and the color slide group, 40%; however, both were significantly better than the control group’s mean score of 22% (Table 1).

The questionnaire (Table 2) indicated a good student acceptance of the color slide method of learning. Forty per cent of the color slide group thought that their method of learning peripheral blood morphology was excellent as opposed to 25% of the microscope group. Forty-one percent of the color slide group found their learning experience very enjoyable as opposed to 10% of the microscope group.

DISCUSSION

The results showed that, although the microscope group took a significantly longer learning time than the color slide group, there was no significant difference detected between the two groups in the amount learned, and both groups learned significantly more than a control group of students who had no learning session. Furthermore, the students found the audiovisual method an acceptable and enjoyable way to learn.

To some, the 40% and 44% test scores might appear low, but this was the

Table 2. Students’ Evaluation of Their Method of Learning.*

<table>
<thead>
<tr>
<th>Method</th>
<th>Excellent</th>
<th>Good</th>
<th>Fair</th>
<th>Poor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Color slide</td>
<td>40†</td>
<td>56</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>Microscope</td>
<td>25</td>
<td>60</td>
<td>10</td>
<td>5</td>
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</table>

<table>
<thead>
<tr>
<th>Method</th>
<th>Very Enjoyable</th>
<th>Enjoyable</th>
<th>Not Enjoyable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Color slide</td>
<td>41</td>
<td>59</td>
<td>0</td>
</tr>
<tr>
<td>Microscope</td>
<td>10</td>
<td>85</td>
<td>0</td>
</tr>
</tbody>
</table>

*Students were directed as follows: “We would appreciate your comments concerning this method of learning peripheral blood morphology.”
†Per cent of students recording this response.
| One student responded by writing “Satisfactory.”
first exposure to red and white cell morphology for these first-year students, and the total time spent was less than 2 hr. Starting at the beginning of their second year, they will be taught by many different teachers who will use audiovisuals, microscope slides, and patient's blood to obtain an acceptable competency in morphology before graduation.

Since we did not continue to use this audiovisual method to teach morphology, it is not possible to say whether the initial performance and student enthusiasm would persist. It is clear, however, that as an initial introduction to blood morphology, it can save instructor time, and it is possible for a student to generalize from photographic pictures of blood smears to actual blood smears.

Finally, despite our attempts to control for all variables in both the audiovisual and microscope group by having the same instructor prepare and present the materials and by having the evaluation quiz a completely objective examination, several factors remain which might explain our results. Student to student interaction is encouraged by the group use of the audiovisual machine, and self-testing is required when using these units. There is a known positive effect on learning when a new approach is presented to the students. The latter effect was minimized since this group of students had been exposed to color slides and programmed, self-testing instruction, as well as individualized instruction, during their initial first-year courses. Future studies will look into the contribution of these factors to the effectiveness of the audiovisual method.

ACKNOWLEDGMENTS
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REFERENCES
1. Implications of individual and small group learning systems on medical education. WHO Tech Rep Ser No. 489, 1972
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