Computer-Assisted Instruction: A Survey on the Attitudes of Osteopathic Medical Students

Lloyd J. Forman, PhD†
Sherry C. Pomerantz, PhD

Objectives: To investigate the views of osteopathic medical students on their preferred learning methods, their current use of computers as an educational tool, and their attitudes regarding the role of computers in medical education, based on their skill level.

Methods: A 27-item questionnaire was distributed to first-through fourth-year osteopathic medical students. Items asked students to assess their levels of computer skills and experience, their current use of computers as an educational tool, and their attitudes regarding the role of computers in medical education.

Results: Of the 246 students (80% of enrolled students) who responded to the questionnaire, a majority (129 [53%]) rated themselves as having intermediate computer skills, and the remaining students rated their skills as basic (69 [28%]) or advanced (46 [19%]). Most students (176 [72%]) felt that they learned best by both hearing and seeing or reading new material, that they learned more easily from a printed page than a computer screen, and that live lectures provided them with the best opportunity for learning. However, when compared with students who have basic and intermediate computer skills, students with advanced computer skills were more in favor of computer-assisted instruction and testing as well as a school requirement to own a computer and to use a laptop computer in class.

Conclusions: Students’ opinions of the importance of computer technology in medical education seem to be based mainly on their self-assessed technical competency levels. Understanding this dynamic may aid medical educators in the implementation of computer-assisted instruction.

J Am Osteopath Assoc. 2006;106:487–494

Computer technology provides immediate access to information and a mechanism for the rapid dissemination of knowledge. The use of computer technology has become an important component of education, particularly at the medical school level, and computer-assisted instruction (CAI) has also been integrated into continuing medical education. Currently, medical educators are interested in determining how best to integrate information technology–related learning into the medical curriculum and to clarify the relationship between the learning process and electronic media.

The Association of American Medical Colleges has developed a series of comprehensive learning objectives to be used as a guide for medical education. One series is dedicated to the area of medical informatics, and objectives are designed to promote the use of computer technology to enhance students’ scientific and medical knowledge. Students’ computer skills should be evaluated at the start of medical school, and resources should be made available to ensure that all medical students achieve basic computer literacy and that they are able to access and evaluate Web-based information. Medical school faculty need to be trained in computer technology, provided with adequate and usable software, and given access to experienced technical personnel to create an environment in which students will learn to appreciate the importance of CAI and Web-based learning.

Medical informatics is being incorporated into medical school curricula. Medical informatics allows physicians to access, analyze, and manage information so that they can make educated decisions in patient care. The use of computers and the related technology is essential for communication and information-sharing with colleagues, for public and patient education, and for professional development.

The goal of the current study was to obtain the opinions of osteopathic medical students on the ways in which they learn new material most effectively, their current level of use of computers as an educational tool, and their attitudes regarding the role of computers in medical education. For analysis, these responses were then grouped by students’ self-assessed computer skill level. This information may indicate the need for curricular modification aimed at the development of computer skills among students and the ongoing integration of technology into medical education. In turn, as med-
medical information is increasingly disseminated and tracked, graduating physicians will have the information technology skills required to grow professionally and to provide the best medical care for their patients.

Methods
The study was conducted during the fall semester of 2001. The study was approved by the institutional review board of the University of Medicine and Dentistry of New Jersey–School of Osteopathic Medicine (UMDNJ-SOM) in Stratford.

Participants
Participants in the study were full-time students in the first through fourth years of osteopathic medical school. Students in the first- and second-year classes were informed of the study, the purpose of the study, the requirement to complete a questionnaire, and the general content of the questionnaire. Students were also told that their participation in the study was voluntary and that the questionnaire was anonymous. This process took place after a scheduled examination at which all members of each class were present.

Students in the third- and fourth-year classes were involved in clinical rotations, many of which were conducted at off-campus locations. For this reason, a questionnaire was placed in students’ campus mailboxes with a letter informing them of the study, the purpose of the study, the requirement to complete a questionnaire, and the general content of the questionnaire. It was made clear that their participation in the study was voluntary and that the questionnaire was anonymous. A follow-up reminder was sent via e-mail to all members of the third- and fourth-year classes once each month, for 3 months.

Survey Instrument
The study was conducted using a 27-item questionnaire (Figure) that asked students about their computer skills, the ways in which they believed they learned new material most effectively, their current use of computers as an educational tool, and their attitudes regarding the role of computers in their medical education.

The questionnaire was prepared by the authors and subsequently reviewed by faculty members in the Stuart D. Cook, MD, Master Educators’ Guild of UMDNJ-SOM. The questionnaire was revised according to their comments and suggestions. Individuals from several settings were involved in pilot testing the questionnaire, including undergraduates, faculty members at UMDNJ-SOM, and individuals from outside the academic community. The results of pilot testing were used to prepare the final version of the questionnaire used in the study. Group means and SDs, frequency distributions, and χ² analyses were obtained using SPSS software (version 12; SPSS Inc, Chicago, Ill).

Results
A total of 306 students were enrolled at UMDNJ-SOM at the time the study was conducted. The rate of return of the questionnaire for all four classes was 80% (N=246). Of 246 respondents, 83 (34%) were first-year students; 67 (27%), second-year students; 40 (16%), third-year students; and 56 (23%), fourth-year students. The mean±SD age of the students was 25.2±3.3 years. According to the criteria provided in the questionnaire, 69 (28%) rated their computer skills as basic (defined as being able to do basic word processing and use the Internet), 129 (53%) rated their skills as intermediate (having mastered the basics and developed additional skills, including the use of different software programs), and 46 (19%) rated their skills as advanced (knowledgeable of hardware and software and able to troubleshoot and advise and teach others). One student rated himself/herself as having no skills. This student was not included in subsequent analyses that compared students by computer skill level.

Most students (176 [72%]) responded that they learned best by both hearing and seeing or reading new material. Fifty-eight (84%) of the 69 students with basic computer skills and 104 (82%) of 127 students with intermediate computer skills believed that it was easiest to learn from a printed page. Of the students with advanced computer skills, 31 (67%) of 46 believed that it was easiest to learn from a printed page, 11 (24%) indicated that it was easiest to learn from either a printed page or a computer screen, and 4 (9%) indicated that it was easiest to learn from a computer screen. There were no statistically significant differences in the responses according to skill level (Table 1).

When provided with a list of teaching methods from which to select their preferences, most students expressed a preference for live lectures with an opportunity to ask questions (84%–89%) and having an abbreviated transcript of the lecture (ie, “scribe”) (78%–84%). Watching a video of a lecture to view it was easiest to learn from a printed page (84%–89%) and having an abbreviated transcript of the lecture (78%–84%)

Figure. UMDNJ indicates University of Medicine and Dentistry of New Jersey–School of Osteopathic Medicine.
Technology and Learning Survey
UMDNJ Master Educators’ Guild

This survey is being conducted to learn more about what students actually want with regard to the utilization of technology in their education. By completing this survey, you have an opportunity to participate in shaping education at your school, and this University. Your opinions are important and your efforts in completing this survey will be appreciated. This is an anonymous survey and the data from this survey will be pooled with the responses of the other members of your school.

1. Which UMDNJ school do you attend? ______________________

2. What is your expected degree?

3. What year of your training are you in:
   A. First year  □
   B. Second year  □
   C. Third year  □
   D. Fourth year  □
   E. Other (please specify) ______________________

4. What is your age: ______

5. What is your gender:  Male □  Female □

6. How would you rate your computer skills:
   A. Basic user (Able to do basic word processing and use the Internet).  □
   B. Intermediate user (Have mastered the basics and have developed additional skills, including the use of different software programs).  □
   C. Advanced user (Knowledgeable of hardware and software; able to problem-solve and advise and teach others).  □
   D. I have no computer skills at this time.  □

7. Which of the following do you have experience with (indicate all that apply):
   A. Using the Internet  □
   B. Word processing (e.g. Microsoft Word, WordPerfect)  □
   C. Spread sheets (e.g. Microsoft Excel)  □
   D. Data base applications (e.g. Microsoft Access)  □
   E. Presentation software (e.g. Microsoft PowerPoint, Corel Presentations)  □
   F. Web site development and maintenance  □
   G. I have no experience with any of the above.  □

8. Which way do you think you learn new material best (choose one):
   A. By hearing the material.  □
   B. By seeing or reading the material.  □
   C. By both hearing and seeing or reading the material.  □

9. Which of the following would you take advantage of to maximize your learning at UMDNJ:
   A. A live lecture with an opportunity to ask questions.  Yes □ No □
   B. A video of a lecture to view at your convenience.  Yes □ No □
   C. The ability to access lecture handouts and/or figures on a Web site.  Yes □ No □
   D. A diskette containing the handout.  Yes □ No □
   E. A scribe of the lecture.  Yes □ No □

(continued on the next page)
10. Of which of the following formats for a lecture handout would you take advantage:
   A. A hard copy of a handout for each lecture  Yes □ No □
   B. A diskette containing the handout for each lecture Yes □ No □
   C. The handouts on a secured Web site Yes □ No □

11. If you had a diskette or access to a Web site containing the handout from a lecture, would you be most likely to:
   A. View and read it on the computer screen without printing it out. Yes □ No □
   B. Print it out. Yes □ No □
   C. If you printed it out, would you do it: At home: □
       In the Library: □

12. If a handout of the complete lecture were available and no lecture were given, would you attend a weekly meeting with a professor to:
   A. Ask questions
      I would attend every meeting □
      I would attend some of the meetings □
      I would not attend any of the meetings □
   B. Discuss a specific case presentation
      I would attend every meeting □
      I would attend some of the meetings □
      I would not attend any of the meetings □

13. How do you perceive the role of the faculty in your educational experience (check all that apply):
   A. Lecturer □
   B. Role model □
   C. Mentor □
   D. Advisor □

14. Do you find it easier to learn material by reading it from a (check one):
   A. Computer screen □
   B. Printed page □
   C. I am able to learn from either one □

15. Should the school require each student to own a computer? Yes □ No □

16. Should the school require each student to have a laptop computer which is loaded with a diskette containing the handout of the lecture to which they may add notes during the lecture? Yes □ No □

17. If all textbook material were available on diskette, or on CD-ROM, would you still buy a textbook? Yes □ No □

18. You would still feel like part of a “class” (e.g. the “Class of 2005”), if greater emphasis were placed on individualized, technology-oriented learning, and there were fewer classes, than you do now.
   Strongly Agree □ Agree □ Neutral □ Disagree □ Strongly Disagree □
slightly less than half of the students with advanced computer skills (22 [49%]) shared this view ($\chi^2=15.540, P=.001$). It is notable that most students, regardless of computer skill level, did not support a requirement to have a laptop computer in class to view the lecture handout and to take notes. However, there was a statistically significant difference among students in the three computer skill groups ($\chi^2=15.540, P=.008$). A majority of students (146 [61%]) indicated that they would purchase a textbook even if the same or similar material were available on a diskette or CD-ROM. There was a statistically significant difference among students in the three groups ($\chi^2=6.839, P=.033$). Those with advanced computer skills were less inclined to buy the textbook than were students with basic or intermediate computer skills. Regardless of their skill level, 79% to 86% of students responded that a personal digital assistant would benefit their learning (Table 3).

Forty-six (68%) students with basic skills and 93 (73%) students with intermediate skills indicated that they would use a health science–related Web site to supplement their learning compared with 41 (91%) of those with advanced skills; these percentages were significantly different ($\chi^2=8.483, P=.014$). Most students (87%–98%) reported that they would use a health science–related Web site if it were free or if the medical school paid for it (82%–96%), but not if they had to pay for it (71%–84%) (Table 4).

Students with advanced skills (28 [65%]) indicated greater interest in taking a course on a Web site, studying and taking examinations at their own pace, compared with 41 (91%) of those with advanced skills; these percentages were significantly different ($\chi^2=8.483, P=.014$). Most students (87%–98%) reported that they would use a health science–related Web site if it were free or if the medical school paid for it (82%–96%), but not if they had to pay for it (71%–84%) (Table 4).

Students with advanced skills (28 [65%]) indicated greater interest in taking a course on a Web site, studying and taking examinations at their own pace, compared with 41 (91%) of those with advanced skills; these percentages were significantly different ($\chi^2=8.483, P=.014$). Most students (87%–98%) reported that they would use a health science–related Web site if it were free or if the medical school paid for it (82%–96%), but not if they had to pay for it (71%–84%) (Table 4).

Students with advanced skills (28 [65%]) indicated greater interest in taking a course on a Web site, studying and taking examinations at their own pace, compared with 41 (91%) of those with advanced skills; these percentages were significantly different ($\chi^2=8.483, P=.014$). Most students (87%–98%) reported that they would use a health science–related Web site if it were free or if the medical school paid for it (82%–96%), but not if they had to pay for it (71%–84%) (Table 4).
answer sheet, with no significant differences among the groups (16%–35%). Although less than half of the students with advanced computer skills were in favor of taking medical board examinations on a computer (21 [48%]), this percentage was still greater than the percentages of those with basic (13 [19%]) and intermediate (42 [16%]) levels of skill. There was a statistically significant difference between the three groups ($\chi^2=10.271, P=.006$).

Comment
In the present study, 175 (72%) students reported having intermediate to advanced computer skills, which included basic word processing, use of the Internet, the ability to use different software programs, knowledge of software and hardware, and the ability to troubleshoot and to advise and teach others. The remaining students were still capable of using word-processing software and the Internet. These findings are consistent with those of other studies reporting that increasing numbers of students are entering medical school with greater computer-related knowledge and experience than in past years. This increase most likely reflects a greater emphasis at the undergraduate level on acquiring the necessary knowledge and skills to make technology an important tool for the rapid and convenient acquisition of information. In addition, a study of second-year medical students indicated a rapid ability to adapt to new computer-based resources. The importance of these findings is underscored by a report on a sample of medical residents who were found to have inadequate computer literacy, largely resulting from a lack of computer training and experience in medical school or prior to their medical training.

In a review of the literature, Greenhalgh reports that the advantages of CAI have not been shown consistently. It is suggested that a successful medical school curriculum will better accommodate different learning styles by allowing students to select from self-study modules and modules requiring personal interaction. Furthermore, the literature neither indicates that Web-based learning is superior to text-based methods, nor that it promotes greater self-reported student confidence or competency. It has been asserted that CAI should not replace, but rather should serve as a valuable addition to learning techniques such as textbooks, lectures, small group discussion, and problem-based learning. The survey-based data obtained in the current study are consistent with that assertion. Most respondents indicated that in their opinion, they learn new material best by both hearing and seeing or reading, and they believe that it was easiest for them to learn...
from a printed page. More importantly, students prefer live lectures where they can ask questions and access a Web site containing the lecture handout material. In addition, a majority of students indicate that they would buy a textbook rather than a CD-ROM of the same material, a finding similar to that reported by Steele et al.\textsuperscript{26} The responses of the students in the current study demonstrate a view of CAI as being an important adjunct to traditional educational tools.

Most students were not in favor of a requirement by the school to own a computer or use a laptop computer in class. It should be noted, however, that a statistically significant difference in this preference was determined between students with advanced computer skills and those with basic and intermediate computer skills. Regarding a requirement that medical students own a computer, McAuley\textsuperscript{18} highlighted issues such as whether an adequate amount of curricular material could be made available online to justify the expense to students and whether sufficient staff would be available to provide support. It is not clear from the results obtained in the present study whether the lack of support for such a requirement is based solely on the financial cost or whether there are other issues that were not assessed that would influence this preference. The majority of students were in favor of a personal digital assistant as tools in their medical education, however. Personal digital assistants, which have extensive capabilities yet are affordable, are widely used in clinical practice and by medical educators.\textsuperscript{26,29}

Within each skill group, most students indicated that they would use a Web site to supplement their learning, especially if it were free or paid for by the school. This finding seems to support the suggestion that a successful medical school curriculum should provide students with an opportunity to use a Web-based educational approach.\textsuperscript{17,21} In contrast, only those students with advanced computer skills expressed a willingness to take a Web-based course, and few students endorsed taking examinations on a Web site. This reluctance to take computerized examinations may reflect a concern that this method of testing will not allow them to apply test-taking behaviors to which they have become accustomed. Furthermore, students may have reservations that their performance on these examinations may be adversely affected by their relative level of comfort with the technology, and thus, may not be an accurate reflection of their knowledge of the subject matter.\textsuperscript{30} Such a reservation is supported by reports indicating that students may not perform as well on computerized examinations compared with hard copy examinations.\textsuperscript{31,32}

### Table 3

**Student Survey: Opinions on School Requirements for Technology Purchases by Self-Assessed Computer-Literacy Level, N=245***

<table>
<thead>
<tr>
<th>Educational Tools</th>
<th>Self-Assessed Skill Level, No. (%)†</th>
</tr>
</thead>
<tbody>
<tr>
<td>Should not be required to own a computer ‡</td>
<td>Basic (n=69) Intermediate (n=127) Advanced (n=46)</td>
</tr>
<tr>
<td>Laptop computer should not be required for class ‡</td>
<td>57 (84) 85 (66) 22 (49)</td>
</tr>
<tr>
<td>Would still buy textbook ‡</td>
<td>58 (84) 97 (75) 27 (59)</td>
</tr>
<tr>
<td>In favor of a personal digital assistant</td>
<td>50 (74) 73 (58) 23 (51)</td>
</tr>
</tbody>
</table>

* Not all students responded to every item in the questionnaire.
† Basic: being able to do basic word processing and use the Internet; intermediate: having mastered the basics and developed additional skills, including the use of different software programs; advanced: having knowledge about hardware and software and being able to troubleshoot and advise and teach others.
‡ Significantly different (P<.05) from students with basic and intermediate computer skills.

### Table 4

**Student Survey: Estimated Usage of Recommended Health Science–Related Web Sites by Self-Assessed Computer-Literacy Level, N=245***

<table>
<thead>
<tr>
<th>Web Site Use</th>
<th>Self-Assessed Skill Level, No. (%)†</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Basic (n=69) Intermediate (n=127) Advanced (n=46)</td>
</tr>
<tr>
<td>Would use Web sites ‡</td>
<td>46 (68) 93 (73) 41 (91)</td>
</tr>
<tr>
<td>Conditional use</td>
<td></td>
</tr>
<tr>
<td>If free</td>
<td>59 (87) 113 (88) 44 (98)</td>
</tr>
<tr>
<td>If students paid for it</td>
<td>13 (19) 21 (16) 13 (29)</td>
</tr>
<tr>
<td>If the school paid for it</td>
<td>54 (82) 110 (87) 42 (93)</td>
</tr>
</tbody>
</table>

* Not all students responded to every item in the questionnaire.
† Basic: being able to do basic word processing and use the Internet; intermediate: having mastered the basics and developed additional skills, including the use of different software programs; advanced: having knowledge about hardware and software and being able to troubleshoot and advise and teach others.
‡ Significant difference (P<.05) among those students with basic, intermediate, and advanced computer skills.
There were several limitations of the current study. The data for this study were collected from students at only one school. However, the findings are consistent with those of other studies, suggesting that this sample is not extremely different from other medical school student bodies. In addition, students' opinions may vary according to geographic location. Finally, it must be noted that these data were collected in late 2001 and may differ from current student views.

Conclusion
The findings of this study have important implications. Students recognized the value of CAI; however, continued efforts must be made to teach them the skills necessary so that they can benefit from available and evolving technology. In addition, we recommend that students be introduced to computer-based testing early in their medical school careers to improve their comfort levels with this medium. The continued acquisition and refinement of computer skills and the reinforcement of the importance of technology in education should be emphasized throughout the medical school curriculum.

References