Dental Students Attitudes Regarding Online Education in Pediatric Dentistry

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ABSTRACT

Purpose: The *Atlas of Pediatric Dentistry* is a Web-based (http://depts.washington.edu/peddent/) and disk-deployed comprehensive textbook of pediatric dentistry that features approximately 3,500 frames and 2,500 images, including color clinical photographs, illustrations, and radiographs; There are also end-of-chapter quizzes, laboratory manuals, photo banks, and a scrollable index incorporated as features in the book. The purpose of this study—which is among a series of studies being conducted at the University of Washington—was to evaluate dental student perceptions regarding online/computer-deployed education.
Methods: 55 third year dental students were surveyed regarding their use of the Atlas of Pediatric Dentistry as the textbook resource during a comprehensive, introductory course in pediatric dentistry. The response rate was 84% of 55 dental students.
Results: Most students (80%) preferred the online textbook to traditional textbooks. Ninety-six percent rated the educational content of the Atlas as good, very good, or excellent, and all respondents indicated they would recommend the textbook highly to a colleague. Positive perceptions were associated with the: (1) scope of content; (2) large number of images (especially color images); and (3) ease of use. The most negative perceptions were due to technical problems associated with online use of computers running obsolete (Internet) browser software. The majority of respondents (87%) had access to a computer at home. Fifteen percent of the total 46 respondents used printouts of the text material.
Conclusions: Students strongly preferred the online textbook to a traditional text. There continues to be a small number of students who do not have access to a computer at home and whose computers are equipped with obsolete software. To optimize student access to the online program, it is important to plan for students to be able to use computers at the university and to program any online resource so that it is compatible with older browser software. (J Dent Child 2007;74:10-20)

KEYWORDS: ONLINE EDUCATION, DISTANCE EDUCATION, PEDIATRIC DENTISTRY, TEXTBOOK, DENTAL STUDENTS, SURVEY

Online education has the potential to revolutionize how instructional content is delivered. The Internet has affected and will continue to affect the distribution of information on a scale never witnessed before in history. Information can be transmitted globally on a virtually instantaneous basis so that access to information is available to anyone at anytime. This technology is completely revolutionizing how societies and their institutions of education function. The potential of distance education to provide greater access to information and reach greater numbers of students through online delivery has stimulated huge interest on the part of administrators, faculty, and students at all levels, including those in higher education and professional schools.[1] For example, Andrews and Demps,[2] in a survey of dental school academic associate deans and faculty, determined that online delivery of content and information had a bright future in the delivery of the dental school curriculum. Specifically, 52% of the associate deans indicated that online applications currently were employed and 21% were considering implementation. It is likely that online instruction eventually will become the most important means of transmitting educational information in dentistry.

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Online education has been shown to have significant advantages. For example, it is possible to incorporate numerous diverse media in online educational products. Text content, images (including photographs and drawings), interactive exercises, video, and audio can be combined in the same educational program or Web site.[2,3] The power of integrating such a variety of educational approaches makes it possible to reach a diverse body of students with various learning styles. Online education makes it possible for the student to access information and engage in learning when it is most convenient (ie, anytime, anywhere, and at any pace), which makes improvements in learning possible by using time more efficiently. These advantageous features of online education especially benefit students who want to modulate the pace of instruction, which is not possible with traditional delivery formats for course instruction.[3,4]

Daugherty and Funke[5] surveyed faculty and students at a southeastern university regarding the advantages, disadvantages, and general effectiveness of Web-based instruction. They determined that there were numerous benefits for students with the Web approach, and that the efficient use of time was a particular benefit for nontraditional students (ie, students who were employed and/or had families). In fact, they determined that the convenience and self-paced format of Web-based instruction were the most important benefits for students in advanced educational programs where the academic demands were very fast paced. Studies also have shown that dental practitioners appreciate the value of online instruction due to time and convenience factors.[6]

Online educational programs make it possible to incorporate interactive learning exercises that are not easily duplicated with conventional instructional tools. Engaging the student in the active process of learning through interactive quizzes, for example, is a major advantage of electronic approaches to the delivery of instruction. Interactive exercises have the potential to provide immediate feedback for students, one of the most potent and effective reinforcement schedules in learning.

Certainly, online education should be available in dentistry so that practitioners and students can benefit from its many advantages. The number and variety of educational programs available in dentistry have grown rapidly, especially as more interest has evolved in computer-deployed instruction in the profession.[3] Unfortunately, some surveys have demonstrated that very few of the online programs in dentistry are either large or comprehensive.[7] The programs available often tend to: (1) be very hard to find; (2) be short; (3) be of poor quality; and (4) have limited objectives and appeal. In fact, Schleyer and Pham[7] found that the average online continuing education program in dentistry was only 16 pages long.

In addition, Kassebaum et al[8] determined in an extensive study of curricular innovations in North American dental schools that the most frequent innovation was the development of computer and Web-based learning (86%). It also was determined, however, that few schools had incorporated distance learning capacity into their programs (5%) and that only a modest 11% provided distance learning opportunities as a curriculum innovation. The data from the Hendricson[9] study on electronic curriculum development at North American dental schools supports this view, in that it was found that only a small percentage of courses had Web sites. A survey on the subject of information technology management by Wrzosek et al[10] found that the preferred vehicle for computer deployment of educational content was via DVD, not online delivery.

Nonetheless, there are a number of studies on the subject of online education specific to dentistry. In general, they support the view that it is very advantageous where it is used. For example, a study evaluating an online/computer-aided program on minor oral surgery concluded that:

1. 77% of the respondents rated it more favorably as a learning tool than video;
2. 69% rated it better than traditional textbooks; and
3. 80% preferred it to journals.

The most positive program characteristics identified by the subjects were: (1) its interactivity; (2) its ease-of-use; (3) its navigability; and (4) the presence of a quiz section for reinforcement of learning.[11] Ludlow and Platin[12] evaluated the difference in performance of dental students in radiographic interpretation by comparing those who used a Web page with those who used a traditional instructional slide/tape presentation to learn the material. The two approaches were equally efficacious. Pilcher[13] evaluated an online program on the topic of fixed prosthodontics and determined that 96% of the students rated the material as either helpful or very helpful. Plasschaert et al[14] conducted one of the studies involving the largest number of dental schools to date on computer-deployed instruction. Opinions and attitudes of faculty and students about computer-deployed education were assessed at 3 dental schools. This type of instruction was perceived as: (1) challenging; (2) highly motivating; (3) not difficult; and (4) not impersonal. Notably, the capacity for computer-deployed programs to combine text, images, and sound was believed to be especially valuable.

Greater use of computer-deployed, online educational resources is important in the evolution of dental education. The *Atlas of Pediatric Dentistry* by Peterson and Davis is an online, computer-deployed, comprehensive textbook of pediatric dentistry developed at the University of Washington, Seattle, Wash.[15] It is the largest online textbook available in dentistry. It was developed for use as the sole textbook for courses in pediatric dentistry (ie, without use of or supplementation by traditional textbooks). The objective of the *Atlas* is to provide global access to current, state-of-the-art instruction on children's dental health for health care professionals and students. It includes 11 chapters on various topics and can be used as the primary textbook in pediatric dentistry courses for dental students and for residents and graduate students in postdoctoral dental programs. It also can be used by health care providers who require an inclusive reference in pediatric dentistry. Currently, general dentists, pediatric dentists, various other health professionals, and several dental and medical schools use the *Atlas*.

The Department of Pediatric Dentistry of the University of Washington is developing a series of studies regarding online and computer-deployed education. In this case, the study involved the student of the *Atlas*.

The purpose of this study was to evaluate dental student perceptions about online education and how dental students used it during a comprehensive undergraduate course in pediatric dentistry. This study is part of the ongoing series of investigations. Specifically, the study aimed to assess the effectiveness of the use of online education, including its advantages and disadvantages, and to evaluate dental student attitudes towards the online educational approach compared with their earlier educational experience with traditional forms of instruction. In addition, the patterns of use of the online instructional programs were analyzed.

METHODS

The subjects consisted of all 55 third-year dental students who were enrolled in the introductory course in pediatric dentistry at the University of Washington during the summer quarter of 2003. Students used the *Atlas of Pediatric Dentistry* as their sole textbook during this course. The survey was administered in August, 2003. The subjects were asked to complete the survey during regular classroom time. Two research assistants administered the surveys, and no faculty members were present while the students completed them. The study was approved by the Internal Review Board of the University of Washington.

A paper-pencil questionnaire was developed that included 32 closed-ended and 7 open-ended items (a complete copy of the survey instrument is available by contacting the corresponding author). The questions regarded the following:

1. student attitudes toward the *Atlas* and online education in general;
2. major influences on their learning experience;
3. the usefulness of the content material in the *Atlas*;
4. study habits and grade expectations;
5. access to computers;
6. use of computers; and
7. demographic data.

Open-ended questions were used in addition to closed-ended ones to allow findings that did not impose predetermined responses. Most questions were selected from previous surveys designed for student and practitioner groups.[5,14,16-18] The survey was pretested by 10 students who had used the *Atlas* during their pediatric course the previous year. None of the students who pretested the instrument were participants in the actual survey. The questionnaire was modified based on the pilot survey's results.

Eight questions were taken from standardized evaluation forms that are designed for use by all schools and departments at the University of Washington (UW) to measure student assessments of the quality of instruction and coursework.[16,17] Four of the eight questions were taken from the assessment form used to evaluate regular, campus-wide UW courses.[16] The remaining four questions were selected from the form that is used to evaluate student opinions concerning distance learning courses where online resources frequently were used.[17] The questions taken from the form used to assess distance learning courses were used to gauge dental student attitudes about the online textbook and their study habits relating to the online text and their grade expectations. The initial six questions were rated on a 6-point scale from excellent (5) to very poor (0). The other two questions involved quantifying the number of hours students spent studying and the students' grade expectations for the course.

Also included were:

1. items concerning the location where students used computers to access course material;
2. the value of computers as instructional tools; and
3. student attitudes toward computers.

These questions were derived from a previous survey evaluating opinions about computer-assisted-learning among dental students and dental faculty at 3 dental schools.[14] All the questions required yes/no answers.

The survey included questions regarding the: (1) influence of the educational content; (2) navigational tools; (3) photographs and diagrams; (4) quizzes; and (5) layout on the students' overall learning experience. The answers to these questions varied from excellent (5) to poor (1). In addition, the students were asked to rate the educational value of the *Atlas* to a colleague on a 4- point scale from very good (4) to very poor (1). All of these items had been pretested and used in a previous survey involving 30 practicing general dentists who had subscribed to *Atlas*.[18]

Seven open-ended questions were included to assess student opinions regarding the advantages and disadvantages of the online textbook. These questions had previously been used in a survey of students about online resources.[5] Open-ended questions also were taken from the Shenfield study to assess what the students liked and disliked about the *Atlas* and how they would rate the *Atlas* to a colleague.[18]

ANALYSES

Descriptive statistics were obtained using the Statistical Package for the Social Sciences (SPSS, Inc., Chicago, Ill) to depict student perceptions regarding their: (1) experience with online instruction; (2) patterns of use of the subject material; and (3) demographic data.[19] The descriptive statistics from this study were compared with the data available from other studies and surveys where identical questions were used.[14,18] In addition, the response data for "at large" UW students were taken from data regarding all UW students during winter, spring, summer, and fall quarters of the regular academic year (summer quarter data were not available). Specifically, the data regarding at-large students are derived from surveys of all students on the UW campus (ie, students from all undergraduate, graduate, and professional school programs from all schools in the university). The at-large UW results

included data from 253 regular courses and 128 courses where computer-deployed material was used. Chi-square analysis was used to compare the students' perceptions about online instruction and how they used it with various individual demographic and academic factors. The open-ended questions were coded in terms of the most common response categories elicited from the subjects.

RESULTS

The response rate was 84%. From the returned 46 surveys, not all respondents answered every question, so the sample sizes varied in some individual analyses. The mean age of respondents was 26.1 years (±3.2 years; range=23-37 years), and 70% were male. All students were taking the introductory course in pediatric dentistry (PD), which is offered during the summer quarter between the second and third years of the dental curriculum. Two class members were taking the course for the second time. There were no significant differences between female and male student responses.

Table 1. The University of Washington Dental Student Evaluation of the Pediatric Course in which the Online Instruction was used

	Excellent	Very good	Good	Fair	Poor	Very poor
	% (N)	% (N)	% (N)	% (N)	% (N)	% (N)
The textbook overall was:	28 (13)	59 (27)	11 (5)	2 (1)	0 (0)	0 (0)
Relationship between lectures and text was:	38 (17)	53 (24)	7 (3)	2 (1)	0 (0)	0 (0)
Amount learned in the course:	16 (7)	51 (23)	31 (14)	2 (1)	0 (0)	0 (0)
Relevance and usefulness of homework assignments:	29 (12)	45 (19)	26 (11)	2 (1)	0 (0)	0 (0)
Usefulness of computer resources in understanding course content:	42 (19)	42 (19)	13 (6)	2 (1)	0 (0)	0 (0)

Of the respondents, 80% (35/44) preferred the *Atlas* to a traditional textbook (question no. 25). The students' responses evaluating the textbook and the course from UW instructional assessment forms are displayed using frequency and percentage data in Table 1. The average score given by the pediatric dentistry students (PDS) regarding the online *Atlas of Pediatric Dentistry* was 4.1 (0.69±SD) on a scale from 5 (excellent) to 0 (very poor). This placed the PDS in the top ninth percentile among campus-wide UW students. The average response among PDS was 4.3 (0.69±SD) when asked about the relationship between lectures and the *Atlas*, which placed them in the top 13th percentile of all UW students.

The mean response given by the PDS regarding the amount learned in the course was 3.8 (0.73±SD), placing the PDS in the top 48th percentile among all UW students campus-wide. In other words, the PDS ranked among the top half of all students campus-wide regarding how much they believed they learned in the course compared to all other UW students (the question asked how much you learned in the course taken). Among PDS, the average response for the relevance and usefulness of the homework assignments was 4.0 (0.75±SD). The PDS ranked in the top 27th percentile of all responses. The mean score given by the PDS concerning the usefulness of the reading assignments in understanding the course content was 4.0 (0.78±SD), compared to the at-large UW students whose average responses varied between 2.00 (0.00±SD) and 5.00 (0.00±SD). The PDS rating was in the top 34th percentile of all the responses. When asked about the usefulness of computer resources in understanding the course content, the PDS mean response was 4.2 (0.77±SD). When asked the same question from the at-large UW students, their mean response ranged from 1.00 (0.00±SD) to 5.00 (0.00±SD). The PDS rating was in the top 11th percentile of all the responses. On average, the PDS spent 4.3 hours per week on the course outside of scheduled class activities (2.0±SD); the at-large students outside of class study time varied between 1 to 16.5 hours. The majority of PDS (94%) expected to receive an A or A- grade.

All the 46 respondents assigned the highest ratings (ie, very good or good) regarding how they would rate the educational value of the Atlas to a colleague.

Fifteen percent of the PDS (7/46) reported printing content material from the *Atlas*. The most common reasons given by the students for printing book content were related to wanting a hardcopy to use for studying (eg, for examinations) and later reference.

The PDS and practitioner groups were asked about how the following *Atlas* features influenced their overall learning experience: (1) educational content; (2) navigational tools; (3) photographs; (4) end-of-chapter quizzes; and (5) layout. The mean evaluation scores concerning how the different features affected the learning experience between practicing dentist and PD groups are presented in Table 2.[11] The results show that both groups highly appreciated the *Atlas*.

All PDS ratings, however, were significantly higher than the ratings given by practicing dentists. The majority of students (91%) rated the educational content as good or excellent, compared to 53% of the practicing dentists. Of the PDS group, 83% rated the navigational tools as good or excellent compared to 30% of the practicing dentists. Most of the students (98%) rated the photographs as good or excellent compared to 77% of the practicing dentists. When evaluating the end-of-chapter quizzes, 85% of the dental students assessed them as good or excellent compared to 67% of the practicing dentists. Most of the PDS group (87%) rated the *Atlas* layout as good or excellent com-

Table 2. The Difference in the Mean Atlas Evaluation Scores Between Students in Pediatric Dentistry at the University of Washington and Community Practitioners in Washington State

How did the following influence your overall learning experience:	(Mean±SD)	*P* value
Educational content		
Dental students	4.30±0.54	<.000
Practicing dentists*	3.60±0.77	
Navigational tools		
Dental students	4.10±0.67	<.000
Practicing dentists*	3.10±0.71	
Photographs		
Dental students	4.80±0.48	<.000
Practicing dentists*	3.90±0.71	
End-of-chapter quizzes		
Dental students	4.60±0.62	<.000
Practicing dentists*	3.70±0.71	
Layout		
Dental students	4.30±0.65	<.000
Practicing dentists*	3.50±0.82	

** Shenfield, 2002.*

pared to 53% of the practicing dentists. The practitioner group tended to have lower percentages of responses in the higher rating categories (ie, excellent and good) and a larger percentage of responses among the midrange categories (ie, neutral and fair). For example, there were no PDS group members who gave less than a neutral, good, or excellent rating, while a number of practitioners gave fair ratings (7%, 20%, 3%, 7%, and 10% of the practitioner respondents gave fair ratings in the areas of educational content, navigational tools, photographs, end-of-chapter quizzes, and layout, respectively).

The responses to the items concerning dental student opinions regarding computer-assisted learning in general are shown in Table 3. This study's PDS responses are compared with student responses from 3 other dental schools: (1) the University of Kentucky, Lexington, Ky (40 respondents); (2) the University of Manchester, Manchester, UK (42 respondents); and (3) the University of Nijmegen, Nijmegen, The Netherlands (41 respondents).[14] The data indicate the percentage of yes responses. In general, the UW PDS showed higher rates of response concerning: (1) access to computers; (2) use of computers; and (3) perceptions of the value of computer-assisted-learning programs.

The PDS opinions about the *Atlas of Pediatric Dentistry* are shown in Table 4. The Atlas features that were liked most by students were the: (1) images (particularly the clinical photographs); (2) comprehensive coverage of the field; (3) overall organization and layout; (4) ease of navigation; and (5) end-of-chapter quizzes. The most common reasons given as advantages of an online textbook related to low cost and ease of access. The factors most disliked by the students included: (1) lack of access to the computer; and (2) problems with internal navigation. The major suggestion for improvement was to consolidate content—such as moving more content to single pages (ie, frames)—and, therefore, include more scrolling of content on each frame.

Table 4. Opinions of Pediatric Dental Students at the University of Washington Regarding The Atlas of Pediatric Dentistry and Online Education

Qualitative themes*	Frequency
What did you like about the Atlas:	
Images	22
Organization/concise/comprehensive	16
Navigation	10
Quizzes	6
What did you dislike about the Atlas:	
Computer access	13
Navigation	7
The advantages of textbook on the Web:	
Cost	18
Access	15

** Coded by frequency of response from open-ended questions.*

DISCUSSION

This study was undertaken to assess dental student views about online education and how dental students used an online textbook during a comprehensive predoctoral course in pediatric dentistry. The results were compared to previous studies regarding attitudes about online/disk-deployed education, including studies involving: (1) dental students; (2) dental practitioners; and (3) campus-wide students at the UW.[5,14,18,20]

The overall dental student evaluation of the *Atlas* was positive. The majority (79.5%) of PDS indicated that they preferred to use the *Atlas* over a traditional textbook. In addition, 98% of the respondents rated the Atlas as a textbook as good, very good, or excellent (Table 1). Similarly high ratings were given in other areas. For example, 98 percent of the students rated the usefulness of computer resources in understanding the course content as excellent, very good, or good (Table 1).

These appraisals seemed to compare favorably with ratings assigned to other online courses and online resources at the University of Washington. Nevertheless, the attitudes

from at-large students concerning other UW courses and online educational resources varied, but were positive overall. The results suggest that the opinions of the PDS concerning the course and the computer resources involved in the course were very positive—indeed more favorable than was demonstrated among UW students responding to surveys about computer-based course resources and online education in other UW courses.

Table 3. Computer Experience and Opinions About the Use of Computers in Learning Among Dental Students

	WASH*	LEX*†	MAN*†	NIJM*†
Do you have access to computers at:				
Dental school	100	56	36	43
Home	87	48	52	42
Other	17	–	–	–
Do you use computers for:				
Self-instructional learning	96	55	44	27
Interactive multimedia	90	22	8	7
The use of computers in learning is:				
Impersonal	56	33	34	29
Difficult	21	32	32	24
Challenging	22	63	46	34
Motivating/stimulating	60	60	44	44
Computer-assisted learning programs have value for:				
Lectures	77	41	37	27
Reading	84	52	40	62
Instruction/demonstration	87	77	51	69
Self-assessment	93	63	89	60
Testing	91	60	84	65

** WASH=University of Washington, Seattle, Wash; LEX=University of Kentucky, Lexington, Ky; MAN=University of Manchester, Manchester, UK; NIJM=University of Nijmegen, Nijmegan, The Netherlands.*

† Plasschaert et al, 1995.

The majority of PDS agreed that computer-assisted learning programs had value for lectures, reading, instruction/demonstration, self-assessment, and testing (see Table 3). The fact that students in this study saw value in computer-assisted learning, CAL, programs is consistent with the results of other studies for use in: (1) lectures; (2) reading; and (3) instruction/demonstration.[14,18] What may be more intriguing, however, especially for faculty, is that the highest percentages of yes responses related to self-assessment and testing (93% and 91%, respectively). In the previous study by Plasschaert,[14] the ability to use CAL programs for self-assessment and testing also were highly valued by students from 3 other dental schools. The findings lend credence to the concept that online and computer-deployed programs can be used effectively to insure that students are meeting the educational goals of a course or exercise. In fact, self-assessment and testing features can be incorporated very well in online and CAL programs. For example, the *Atlas* contains interactive, multiple-choice review questions at the end of each chapter. When the student submits a response to a question, an explanation of the question and the correct and incorrect answers are displayed. This feature takes advantage of the power of immediate reinforcement.

As mentioned previously, the study by Plasschaert[14] included surveys of dental students from 3 schools in 1994. The percentage of yes answers in the study was less for every school and in every response category compared to the responses of the UW PDS group. The authors speculate that the increase in the use of computers and especially the use of numerous online resources has raised the appreciation levels of students to these functionalities since 1994.

The most frequently mentioned advantages of an online textbook by the PDS were: (1) lower cost; and (2) better access. The fact that cost was given most frequently as a reason to prefer a Web-deployed and disk-deployed textbook is important because the students were given the choice of using the *Atlas* at no cost or purchasing a traditional textbook through the university bookstore. As far as the authors know, no student has ever purchased a conventional textbook over the last 11 years that the *Atlas* has been used. This is an important observation, since the cost of software development is a front-loaded expense, mostly as a result of faculty and programmer time. Once it is developed, any revenue arising from sales of the program translate into profits for the institution. The *Atlas* currently is available to institutions at price levels that are significantly less than conventional textbooks on a per-student basis. Therefore, it is possible for schools to use this online product at less cost for their students. The UW students recognized this and seemed to appreciate and acknowledge the cost differential.

In spite of the general preference for an online approach over a conventional textbook, 15% of the students still indicated that they printed content from the *Atlas* and that they used the hardcopy for studying, particularly for examinations. Other investigators have had similar findings. Wong et al[21] determined that almost all students in an online course printed out reading material and work from paper copies. In fact, they even resorted to photocopying some of the material for course packs where it was not readily available online. In the case of this course, consideration is being given to providing hardcopy of the end-of-chapter evaluation questions, since many of them are used on the final examination.

Many students mentioned ease of access as a desirable feature. Of all the students, 87% were able to use the *Atlas* at home and 100% used it at school (there are numerous computers available for students to use in the UW Health Science complex). A previous study explored the perceptions of Web-based instruction by graduate and undergraduate students and faculty at a southeastern university.[5] The study demonstrated that the convenience provided by WBI (ie, Web-based instruction) is a definite advantage for some populations. These findings are consistent with the attitudes of PDS in the current study.

The images were the most-liked feature of the *Atlas* (Table 4), especially the clinical photographs. One respondent also mentioned the illustrations. Clearly, the use of an online educational resource offers the potential to deliver significantly more images than conventional textbooks. For example, the *Atlas* contains approximately 2,500 images, virtually all of them in color except for radiographs. In the previous study by Shenfield (2002), 77% of the community practitioners using the *Atlas* specifically mentioned photographs as a feature they liked about the Atlas.18 There are other studies that also support the fact that online, computer-deployed programs are favored over traditional educational resources due to the integration of images or multimedia content with instructional content.[2,3]

The other *Atlas* features most liked by students were: (1) navigation; (2) organization; and (3) concise-yet-comprehensive presentation. It was clear that these categories were related based on the specific individual responses. The students liked using an educational resource that assisted them in an efficient learning process (eg, well organized, sequential presentation, good explanations, easy to use and find topics, and concise content that still covers the entire field). Online and CAL programs lend themselves to good organizational planning and layout. For example, tools are used in the *Atlas* such as a scrollable index, multiple menus, links to related topics inside the book and on the Web, and easy searching.

The UW PDS apparently saw the value in these learning tools. The practitioners surveyed by Shenfield[18] also indicated that they were positively influenced by: (1) educational content; (2) navigational tools; and (3) layout.

At the same time, the PDS group gave higher ratings for these features (see Table 2). It would be interesting to study the reasons why students seem to value these features more highly than practitioners. It is tempting to speculate that the students were more positive regarding these functions than practitioners because they were younger. The average PDS age was 26 and the average practitioner age was 42. One of the most interesting outcomes from the Shenfield[18] study, however, was that older practitioners valued the *Atlas* more highly than younger practitioners. Consequently, age may not be a factor. The explanation may be that students and practitioners use an online educational resource differently.

Ironically, the most unpopular aspect of the program related to access, which also has been mentioned previously as the most popular aspect of the program. On the surface, these results would seem to be entirely contradictory. Nonetheless, the most serious access problem mentioned by some students concerned a programming glitch that made it difficult to access the end-of-chapter quizzes. The quiz problem was caused by a programming "upgrade" that was authored by a more recent version of the Java language. The computers owned by most of the students and the computers in the UW Computer Learning Laboratory were not equipped with the newer version of the Java language. Once the problem was identified, the students were given instructions on how to upgrade the Java program on their computers and the computers in the Learning Laboratory were upgraded. The problem was corrected, but not before some of the students grew very frustrated with difficulties accessing the quizzes.

Some of the students complained that they would have been helped by faster connection speeds on their home computers. Eighty-seven percent of the UW PDS used computers at home (Table 3). A number of students commented that they appreciated being able to access the program anywhere. Indeed, this is a commonly preferred feature of online and/or CAL programs by users.[5] Nevertheless, some students commented that access would be improved with faster Internet connections at home. To the extent that this is a serious problem, the rapid introduction of faster speed connections for home computer use globally will ameliorate this problem eventually. The highest frequency of other complaints related to navigation issues. Examples mentioned by some respondents included:

1. not being able to find a topic quickly; and
2. the volume of information was too much (ie, the book was too long).

There is a very important lesson in this experience. Students can lose confidence in a computer-deployed resource very quickly when there are serious access problems that prevent students from completing their required assignments. Other studies have shown that lack of confidence in the ability to operate an online system can interfere with its use.[22] This is a particularly serious problem when the authors inflict an unworkable program on students and other faculty. Confidence is lost in the program, and frustration can set in. Most faculty are content experts and authors, not programmers. This potential problem underscores the importance of faculty developers maintaining good communication with programmers and making sure that the programmers understand clearly what is needed. Programmers who "do the faculty developers a favor" by incorporating the most up-to-date programming tools actually may create serious problems.

CONCLUSIONS

Based on this study's results, the following conclusions can be made:

1. Students using an online, computer-deployed textbook generally had very positive attitudes about using it. In fact, the students preferred using the online, CAL, resource over a traditional textbook.

2. The Atlas of Pediatric Dentistry features that the students most favored were the large number of images, especially the color clinical photographs.
3. The most popular aspects of using an online resource were cost and access. Cost can be lower for students once the development of an online resource is complete. The students particularly liked being able to use the program anywhere (at home, school, libraries, etc.).
4. Ironically, the online aspect most disliked by the students also related to access. The complaints resulted from the use of home computers with slower connect speeds and a programming problem that made accessing the quiz component of the book difficult. Both of these problems will be ameliorated over time as faster connection technology becomes more widely available and as faculty become more aware that their requirements are fully understood by programmers.

REFERENCES

1. Grimes EB. Effectiveness of an online course in dental terminology. J Dent Educ 2001;65:242-7.
2. Andrews KG, Demps EL. Distance education in the U.S. and Canadian undergraduate dental curriculum. J Dent Educ 2003;67:427-38.
3. Schittek M, Mattheos N, Lyon HC, Attström R. Computer-assisted learning: A review. Eur J Dent Educ 2001;5:93-100.
4. Browne L, Mehra S, Rattan R, Thomas G. Comparing lecture and e-learning as pedagogies for new and experienced professionals in dentistry. Br Dent J 2004;197:95-7.
5. Daugherty M, Funke B. University faculty and student perceptions of Web-based instruction. J Dist Educ 1998;13:21-39.
6. Spallek H, Pilcher E, Lee JY, Schleyer T. Evaluation of Web-based dental CE courses. J Dent Educ 2002; 66:393-404.
7. Schleyer TK, Pham T. Online continuing dental education. J Am Dent Assoc 1999;130:848-54.
8. Kassebaum DK, Hendricson WD, Taft T, Haden NK. The dental curriculum at North American dental institutions in 2002-03: A survey of current structure, recent innovations, and planned changes. J Dent Educ 2004;68:914-31.
9. Hendricson WD, Panagakos F, Eisenberg E, McDonald J, Guest G, Jones P, Johnson L, Cintron L. Electronic curriculum implementation at North American dental schools. J Dent Educ 2004;68:1041-57.
10. Wrzosek M, Warner G, Donoff RB, Howell TH, Karimbux N. A survey of information technology management at US dental schools. J Dent Educ 2003;67:1095-1106.
11. Matthew IR, Pollard DJ, Frame JW. Development and evaluation of a computer-aided learning package for minor oral surgery teaching. Med Educ 1998;32:89-94.
12. Ludlow JB, Platin E. A comparison of Web page and slide/tape for instruction in periapical and panoramic radiographic anatomy. J Dent Educ 2000;64:269-75.
13. Pilcher ES. Student's evaluation of online course materials in fixed prosthodontics: A case study. Eur J Dent Educ 2001;5:53.
14. Plasschaert AJ, Wilson NH, Cailleteau JG, Verdonschot EH. Opinions and experiences of dental students and faculty concerning computer-assisted learning. J Dent Educ 1995;59:1034-40.
15. Peterson DS, Davis JM. Atlas of Pediatric Dentistry. 4th ed. Seattle, Wash. University of Washington; 2003.
16. University of Washington Office of Educational Assessment. Instructional Assessment System Course Evaluation Form G. Seattle, Wash: University of Washington; 1999.
17. University of Washington Office of Educational Assessment. Instructional Assessment System Course Evaluation Form I. Seattle, Wash: University of Washington; 1995.
18. Shenfield, L. Online Continuing Education in Pediatric Dentistry [thesis]. Seattle, Wash: University of Washington; 2002.
19. SPSS, Inc. SPSS for UNIX Basic System User's Guide. Release 5.0. Chicago, Ill: SPSS; 1993.
20. University of Washington Office of Educational Assessment. Instruction Assessment System (IAS) Custom Summary Report. Available at: www.washington.edu/oea/ias1.htm. Accessed April, 2004.
21. Wong G, Greenhalgh T, Russell J, Boynton P, Toon P. Putting your course on the Web: Lessons from a case study and systematic literature review. Med Educ 2003;37:1020-3.
22. Walmsley AD, White DA, Eynon R, Somerfield L. The use of the Internet within a dental school. Eur J Dent Educ 2003;7:27-33.

ONLINE/COMPUTER DEPLOYED INSTRUCTION – STUDENT ASSESSMENT SURVEY

		Excellent	Very Good	Good	Fair	Poor	Very Poor
1.	**The textbook overall was (i.e., the online Atlas of Pediatric Dentistry overall was):**	O	O	O	O	O	O
2.	**Relationship between lectures and the Atlas was:**	O	O	O	O	O	O
3.	**Amount you learned in the course was:**	O	O	O	O	O	O
4.	**Relevance and usefulness of homework assignments were:**	O	O	O	O	O	O
5.	**Usefulness of reading assignments in understanding course content was (e.g., reading assignments in the Atlas):**	O	O	O	O	O	O
6.	**Usefulness of computer resources in understanding course content was (i.e., usefulness of the Atlas as an online resource in understanding course content):**	O	O	O	O	O	O
7.	**On average, how many hours per week have you spent on this course (Pedo 520), including attending classes, doing readings, reviewing notes, writing papers and any other course related work?**	O Under 2	O 2-3	O 4-5	O 6-7	O 8-9	O 10-11
		O 12-13	O 14-15	O 16-17	O 18-19	O 20-21	O 22 or more
8.	**What grade do you expect in the course?**	O A 3.9-4.0	O B 2.9-3.1	O C 1.9-2.1	O D 0.9-1.1		
		O A- 3.5-3.8	O B- 2.5-2.8	O C- 1.5-1.8	O D- 0.7-0.8		
		O B+ 3.2-3.4	O C+ 2.2-2.4	O D+ 1.2-1.4	O E+ 0.0		
9.	How did the educational content of the Atlas influence your overall learning experience?	O	O	O	O	O	O
10.	How did the navigational tools of the Atlas influence your overall learning experience?	O	O	O	O	O	O
11.	How did the photographs and diagrams included in the Atlas influence your overall learning experience?	O	O	O	O	O	O
12.	How did the end-of-chapter quizzes in the Atlas influence your overall learning experience?	O	O	O	O	O	O
13.	In general, how did the overall layout of the Atlas influence your learning experience?	O	O	O	O	O	O

14. **How would you rate the educational value of the Atlas to a colleague?**

- O Very Good
- O Good
- O Poor
- O Very Poor

15. **What did you like about the Atlas?**

15. What did you like about the *Atlas*?

16. What did you dislike about the *Atlas*?

17. Do you have any specific suggestions for improving the *Atlas*?

		YES	NO
18.	**Do you have access to computers at:**		
a.	Dental School	O	O
b.	Home	O	O
c.	Other If other, where?	O	O
19.	**Do you use computers for:**		
a.	Self-instructional learning	O	O
b.	Interactive multi-media	O	O
20.	**The use of computers in learning is:**		
a.	Impersonal	O	O
b.	Difficult	O	O
c.	Challenging	O	O
d.	Motivating/Stimulating	O	O
21.	**Computer-Assisted-Learning programs have value for:**		
a.	Lectures	O	O
b.	Reading	O	O
c.	Instruction/demonstration	O	O
d.	Self-assessment	O	O
e.	Testing	O	O

22. Did you print course material? O Yes O No If yes, why?

23. What were the advantages of taking a course where the textbook is on the Web (and deployed via compact disk)?

24. How would you rate the difficulty of this course compared to other dental school courses? Why?

25. If you used the *Atlas* as your textbook in this course, in retrospect, would you have preferred to use a traditional textbook or the *Atlas*?

O Traditional Text

O *Atlas*

26. Is there anything we overlooked? Please use this space to make any additional comments you might have regarding online/computer-deployed instruction or the Atlas.

The last two questions will help us be able to describe the participants in the survey.

27. How old were you on your last birthday?

____ years old (Insert a number)

28. What is your gender?

1. Male
2. Female