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Opinions and Experiences of Dental Students and Faculty Concerning Computer-Assisted Learning

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Abstract: This study assessed the opinions and attitudes of faculty and students concerning the use of computer-assisted learning (CAL) at three different dental schools on two continents (Manchester, U.K.; Nijmegen, The Netherlands; and Lexington, Kentucky, U.S.A.). In each school students and faculty received a questionnaire; faculty by internal mail, students at the end of a lecture. Response rates for students were 76 percent in Manchester, 64 percent in Nijmegen, and 91 percent in Lexington. The respective figures for faculty were: 42 percent, 47 percent, and 39 percent. In all three schools approximately 50 percent of students had a computer at home. Students in Lexington and Manchester seemed to be more advanced in the use of computers for self-instructional learning. Students and faculty in Lexington had more experience with interactive multimedia than did those in Manchester and Nijmegen. In general, Lexington students were somewhat more familiar with computers and CAL than Manchester students, with Nijmegen showing the lowest percentages. Few CAL programs were available at any school, with small numbers of dental students having been exposed to programs involving animation (vision, sound). The majority of students are of the opinion that the use of computers for learning is not impersonal, nor difficult, but challenging and motivating. There is good agreement that if a program is to be bought or developed, it should be a combination of text, images, and sound. It is postulated that concerted action by dental schools is required to realize the potential of CAL in dental education, and that international organizations should give consideration to coordinating this action.

Key Words: computers in dental education; computer-assisted learning; students and faculty opinions.

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During the last two decades the impact of computers in general and in dental education in particular has been considerable and further developments are anticipated.^{1,2} In dental education, students, teachers, and patients may access information stored in computers for administrative, managerial and learning processes.^{3,4} Students are eager to use sophisticated tools for learning, while teachers strive to make the teaching process easier and more attractive.⁵ However, the technology and methodology for use in developing computer-assisted learning (CAL) programs are problematic. To date, the development of CAL programs tends to be based on the work of enthusiastic individuals⁶⁻¹⁰ rather than on a school policy.^{11,12}

The development of a CAL program demands a considerable investment of time and resources. It is difficult to assess the quality of a program, the frequency and the duration of use, its effectiveness, and the transferability to other schools and countries. The variety of technical options available for creating a CAL production and the speed at which changes and innovations are being introduced contribute to the difficulties in developing a school policy. When a school wishes to develop such a plan, it seems relevant to know more about the experiences and opinions of faculty and students concerning computers in dental education.

Lang et al.⁵ assessed the knowledge, opinions, and behaviors in dental students in one dental school regarding dental informatics and computer applications. They found few differences between first- and fourth-year students. Generally, both groups had limited knowledge, favorable opinions, and little experience. However, student opinions were found to suggest a readiness to explore both generic computer applications and specific dental informatics applications.

The opinions of dental faculty have not recently been investigated. However, a survey of associate deans of North American dental schools explored the extent to which different instructional technologies were used.³ Respondents from most schools judged the administration at their schools to be supportive of the development of instructional technology but, in general, did not consider faculty to be enthusiastic about or rewarded for developing innovative methods. The most common computer-based application involved testing and record keeping, both of which were used extensively in about half of the dental schools. Schools with available support services

applied certain technologies to a significantly greater extent than did schools without available support services. It should be borne in mind that these results were generated from a single administrative respondent at each institution.³

This report describes the experiences and opinions of faculty and students on the use of computers and CAL in three dental schools on two continents.

Methods

A survey was developed with 49 questions for faculty and 39 questions for students. In both surveys, 39 questions were identical for faculty and students. Almost all questions were precoded, except those requiring specific comments. Of the 39 entries, 28 had a "yes-no-maybe" response format. The questions addressed experience using computers, familiarity with computer systems, access to computers, opinions about the use of computers in learning, exposure to the use of computers in dental education, opinion of the potential of CAL programs, and priorities for the further development of CAL programs. A draft version was tested among some faculty members and a few students before the final text was established.

The committee or person in charge of CAL in each of three dental schools was involved, as well as the dean, in developing the questionnaires and seeking cooperation. The schools were the College of Dentistry, University of Kentucky, U.S.A. (LEX); the Turner Dental School, University of Manchester, U.K. (MAN); and the College of Dentistry, University of Nijmegen, The Netherlands (NIJM). Faculty received the questionnaire with a cover letter from the dean, and a reminder was sent two weeks after the initial mailing. The survey forms for each class of students were distributed at the end of a lecture in April, June, and October 1994 in Manchester, Nijmegen and Lexington, respectively. Although the sample obtained was biased for class attendees, this approach was chosen for convenience and to maximize the response rate.

Results

The response rates and age and gender data appear in Table 1. The response rates were highest for LEX students and lowest for NIJM students. The fourth-year students tended to have a lower response rate than the first- and second-year students. Response

Table 1. Response rates, age and gender of student respondents by school*

Class/Year		LEX		MAN		NIJM	
		N	%	N	%	N	%
1st	Total N	53		70		73	
	N Respondents	53	100	56	80	60	82
2nd	Total N	51		71		53	
	N Respondents	44	86	53	75	52	98
3rd	Total N	50		50		56	
	N Respondents	49	98	37	74	21	38
4th	Total N	43		52		99	
	N Respondents	33	77	39	75	43	43
Total	Total N	197		243		281	
	N Respondents	179	91	185	76	176	64
Percent Female			39		44		47
Average Age		24.2±2.8		21.1±2.2		22.6±3.4	

* LEX= Lexington, University of Kentucky, USA;
MAN=University of Manchester, United Kingdom;
NIJM=University of Nijmegen, The Netherlands

rates, age, and gender data for faculty are presented in Table 2.

In LEX both students and faculty were older than those in the other two schools. For students this difference can be explained by the difference in educational system by which students enter dental school at a later age than in Europe. Gender distribution was similar in the three schools for students and for faculty. These figures may be relevant in view of the assumption that male students reportedly are somewhat more computer-literate than female students.¹⁴ The response rate for faculty, although low compared to the students, was considered to be acceptable.

About half the students had access to a computer at home or at the dental school (Table 3). Use of computers at home has to be interpreted as use at the students' dormitories, at parents' homes, or with friends.

Table 2. Response rates and age and gender distributions for faculty respondents by school*

Faculty	LEX	MAN	NIJM
Total N	104	100	90
N Respondents	40	42	41
	38%	42%	46%
Percent Females	8%	26%	15%
Average age in years	48±7.1	42±8.5	43±8.7

*LEX= Lexington, University of Kentucky, USA;
MAN=University of Manchester, United Kingdom;
NIJM=University of Nijmegen, The Netherlands.

A large number of faculty of the three schools had access to a computer at home and/or at school, although the NIJM faculty percentages tended to be lower.

LEX and MAN students and faculty were more familiar with CD-ROM and network systems than were NIJM students and faculty. CD-interactive was a little-known medium in all three schools. Students in LEX and MAN were more likely to report experience with more self-instructional learning, and LEX students and faculty had more experience with interactive multimedia than those in MAN and NIJM.

The experience of students with computers for evaluation was limited. In MAN computer use focused almost entirely on multiple-choice based, text-only programs, whereas in NIJM there was more experience with evaluation through question-based programs composed of text, pictures, and graphics. A few students had been exposed to multimedia programs involving animation (vision, sound) in the dental curriculum.

The opinions of students and faculty did not differ concerning the use of a computer for learning purposes (Table 4). The majority held that the use of computers for learning is not impersonal, nor difficult, but challenging, motivating, and stimulating. The majority of both students and faculty also were of the opinion that CAL programs have value in learning and teaching activities, although the groups differed somewhat in which activities received endorsement most frequently. These differences are also apparent

**Table 3. Experience of students and faculty in using computers for learning and teaching.
Percent of respondents answering "Yes" for each Dental School.**

	Students			Faculty		
	LEX	MAN	NIJM	LEX	MAN	NIJM
Do you have access to computers at :						
Dental School	56	36	43	88	83	47
Home	48	52	42	82	67	48
Do you have familiarity with:						
CD-ROM	30	38	9	50	45	37
CD-interactive	11	9	6	22	7	12
Network (e-mail, library)	35	45	10	70	48	34
Do you use computers for:						
Self-Instructional learning	55	44	27	48	33	32
Interactive multi-media	22	8	7	48	12	12
Have you used CAL programs in dental school with:						
Multiple choice based systems	18	82	28	*	*	*
Question based with pictures	15	19	36	*	*	*
Question based with animation	18	14	9	*	*	*

*Question not asked.

**Table 4. Opinions about the use of computers in learning.
Percentage of respondents answering "Yes" for each Dental School.**

	Students			Faculty		
	LEX	MAN	NIJM	LEX	MAN	NIJM
The use of computers in learning:						
Impersonal	33	34	29	28	31	42
Difficult	32	32	24	8	24	7
Challenging	63	46	34	70	74	56
Motivating/Stimulating	60	44	44	65	74	58
CAL-programs have value for:						
Lectures	41	37	27	62	40	44
Reading	52	40	62	55	55	83
Instruction/Demonstration	77	51	69	78	79	71
Clinical demonstration	61	38	29	42	40	37
Self-assessment	63	89	60	*	*	*
Testing	60	84	65	90	71	80
Include in top three priorities for CAL development:						
Administrative purposes	19	20	28	20	26	15
Lectures	17	13	7	35	14	12
Reading	22	14	26	20	31	49
Instruction/Demonstration	52	23	24	52	71	46
Clinical demonstration	33	14	6	25	26	10
Self-assessment	37	60	15	-	2	41
Testing	29	44	42	35	59	37

*Question not asked.

when students and faculty were asked whether program development was a first, second, or third priority for these same learning and teaching activities.

Assuming that a separate budget would be available for computers and CAL, faculty were asked about how they would spend it. LEX and MAN faculty opted for a mix of both buying and developing programs, whereas most NIJM faculty would buy existing programs. In contrast to LEX and NIJM, MAN faculty would favor more programs for practical skills and less for administration of exams. There was good agreement that if a program is to be bought or developed, it should be a combination of text, images, and sound (multimedia).

Discussion

In considering the results of the present study, it is considered important to assume that current philosophies and strategies regarding the use of computers and CAL in the schools investigated must have influenced the opinion of students and faculty. It is therefore pertinent to preface the discussion of the results with details of the use of computers in the three schools.

The University of Kentucky College of Dentistry in Lexington has several areas in which computers provide essential support. The college has an IBM RISC 6000 computer system used to support a number of administrative tasks such as monitoring clinical income, patient appointments, treatment plans and student progress. All written multiple-choice tests are graded electronically using Scantron forms and subsequent statistical discriminant analysis of the test is provided to the course director. CAL has received limited use in this college, primarily in the restorative area and in pharmacology. Most full-time faculty have a desktop computer with a large majority (about 90 percent) of the users having an MS-DOS/Windows system. By December of 1994 all faculty had an ethernet (network) connection, allowing high-speed data transfer. Faculty also have access to the MCFACS center where leading computer technology can be viewed and tested. Students have access to a computer learning center in the health sciences learning building. The center is open during working hours with word-processing, graphics and printing facilities. Both faculty and students have access to MEDLINE and other educational databases, faculty through the network and library and students primarily through the library. External network access is also

available through modem.

The Turner Dental School, University Dental Hospital of Manchester, has a computer-based patient administration system that deals with all aspects of clinical activity except student appointments in certain clinical areas. A network has recently been installed to enable all faculty to communicate electronically and to access e-mail, MEDLINE, and Internet facilities. Students have access to a computer cluster within the school where they can use word-processing, computer-based library services and related computational activities. Most full-time and many of the part-time members of faculty have desktop computer facilities available in their offices. Typically, members of faculty have an IBM-compatible computer, most using Windows and linked to a LAN/WAN for e-mail, MEDLINE, and CAL packages. In addition to certain student assessments being computer based and a number of multiple-choice CAL programs, students are exposed to computers in their instruction in research methods, notably statistics.

The University of Nijmegen College of Dentistry has a computer-based system operational for the administration of most clinical and preclinical courses. Moreover, all written exams as long as there are precoded questions (multiple-choice type or others) involved, are processed electronically using Scantron forms. CAL programs are in use in six areas: general anatomy, histology, dental radiology, tooth anatomy, statistics, and a problem-based compact-disc interactive program on diagnosis of endodontic pain problems (10 cases). In general, full-time faculty have either MS-DOS, Macintosh-based computers, or Powerbooks™ at their disposal (with the split about 50:50). Faculty members and students can communicate via a computer network and they have e-mail and Internet facilities. Students have access 14 hours daily to a computer learning center in the basic medical science building (courses for anatomy, histology) and in the dental college (8 MS-DOS workstations). Students also have text-editing and printing facilities available and in the library they have access to MEDLINE.

Another important factor in interpreting the results is the level of response. For students the response was acceptable, and the findings may therefore be considered to represent the opinions of the student body in the three schools. However, faculty response was different. With a response of about 40 percent it might well be that only those respondents reacted who are very interested in the subject matter,

or who are against any change. A silent majority of faculty exists whose opinion is not reflected in the results. This is all the more important in view of the fact that teachers should set an example for their students in being up-to-date professionally and should also be leading in the use of advanced and high-quality learning programs. There is evidence that CAL is effective^{9,15} and even more effective than traditional learning. Students could therefore reasonably be asked to participate in the development of CAL. It may be anticipated that in the near future the choice of students for a particular dental school may also be influenced by the reputation of the school as far as the availability of CAL programs is concerned.

The results of this questionnaire, when compared to earlier reports,^{5,13,16} confirm the expected increase in the use of computers by students and faculty. Students with such experience will be familiar with and expect programs with sophisticated presentations, graphics, and relatively high interactivity that is typical of most computer games and some readily available software packages. Students will expect sophistication because they are exposed to sophistication in presentation every day through television. For CAL to be successful in dental education, the programs will need to share such sophistication. Yet it is an open question whether dental schools are able to provide such facilities or whether CAL in dental education is destined to be an attractive but unaffordable luxury. Currently it would seem that the availability of CAL programs is not keeping pace with the increase in computer literacy of students and faculty in the dental curriculum.

Three factors may play roles in the apparent difficulty in developing CAL programs by taking advantage of present-day multimedia technology. First, there is the growing gap between the teacher in need of a program and the experts (both educational and technological) in program development. This implies that the development of multimedia CAL programs is increasingly a matter of teamwork as contrasted to the solo activity of a teacher putting together a straightforward lecture slide-series. This situation creates a barrier. Second, there are the rapid changes in knowledge, science, and technology. What has been developed today with great time and cost investment may be out-of-date tomorrow. Third, there is the time and money factor itself. More and more dental schools have to maintain their functions within reduced budgets. Taking into account the total cost of one substantial multimedia program, it is unlikely that any

dental school on its own can develop programs to cover a wide range of subject matter in the primary dental degree program. Of course, CAL programs developed for the undergraduate students may also be of use for continuing education. It has been shown that the majority of dentists rate CAL for postgraduate education as more useful than videos, audiocassettes, journals, and books, and consider it valuable for administrative as well as clinical subjects.¹⁷

A major development effort at the international level through the consortium approach³ may offer the best solution. Such an approach will be difficult to realize but will give the best guarantee that what will be invested will lead to a product that will be used in more than just one dental school, thus increasing its cost-effectiveness. However lessons learned from the Project ACORDE^{18,19} experience should be kept in mind: "... based on discussions with faculties and administrators, it appears that there is relatively little sharing of ACORDE materials among dental schools and that the philosophy of reinventing the wheel still persists. Fiscal restraints in the 1980s may have significant effects on the production, use, and sharing of learning materials."²⁰

The results of the questionnaire and the issues addressed above suggest that dental schools should develop and introduce training programs for students and faculty on the use of computers in general, including use of existing programs for word processing, learning, and (self) testing. Also, it would seem that an international consortium could be established for the development of CAL based on an inventory of existing CAL programs and a strategic plan for developing programs.

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