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Abstract

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The Computer in Optometry: an Overview of it's Uses To Date and it's Potential in Didactic and Clinical Optometric Education

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Over the past several years, due to advances and innovations in technology and marketing, the computer has become a driving force in American business and industry. Vast increases in available information storage and data manipulation capabilities, packaged in ever smaller, inexpensive, and easier to use systems have placed computer technology within the reach of anyone with a desire to to take advantage of the computer's inherent power. The excitement surrounding the computer industry has been phenomenal, and it is only the rare individual who has not, in some way, been introduced to the changes that this technology has brought about.

The highly accelerated evolution of the microcomputer and it's component parts has at times had a less than positive effect on the consumer. Newly developed systems fast follow each other into the market place, each decrying it's superiority and attended by the now expected hoopla of advertising, promotion, and fantastic claims. The result has been that many institutions and individuals that could benefit greatly from computer technology have taken a wait and see attitude or have made only tentative and undirected movement toward full and productive use of a very powerful tool. Optometry, especially the institution of optometric education, falls into this category.

It would be unfair to say that optometric education has totally ignored the microcomputer; that is far from the

truth. However, it is fair to say that, as evidenced by the lack of information to the contrary in the literature, there seems to be no consolidated and well thought out plan by any of our schools or colleges of optometry to integrate the computer into the every day didactic and clinical curriculum. If optometric education is to take fullest advantage of computer technology now and in the future, this trend needs to be reversed.

For optometry school administrators to decide what goals and directions to take in curricula integration of computers, it is helpful to look at how computers are now being used in optometry, both in individual practice and in education, and to review the attitudes and methods of educators and educational administrators at the secondary school and undergraduate college level. Armed with this over view, it then becomes possible to develop and implement a program to suit an individual school's needs.

CURRENT COMPUTER APPLICATIONS IN OPTOMETRY

Optometry has made use of computers in a more or less indirect manner for some time, as evidenced by their applications in scientific research (1,2). This has directly affected the student and practitioner by expanding the body of optometric knowledge available to them, but it

has been only a small and elite group of individuals who have had access to the computer hardware, or the expertise needed to actually put it to use.

As the microcomputer has become less expensive, more powerful, and more openly available, much of the emphasis on systems marketing has been aimed directly at small businessmen. Practicing optometrists have found that, with some manipulation, computer systems can be valuable practice management tools, and it is this influence that has produced the largest body of popular literature on optometric computer applications. Articles have addressed several related subjects: The basics of what a computer is and how it works (3,4), how to decide if a practice is ready for computerization (4,5,6), what system is "right" for an individual office (7,8,9) and what areas of office management are best suited for, and in most need of computer assistance (4,6,7,8, 9,10,11,).

Other areas of microcomputer usage developed by practitioners, like vision training (12), low vision (13), and behavioral visual analysis (14) receive periodic treatment in the literature, showing that available computer systems definitely do have uses in practice beyond the business of management. As more of these systems are put on line, we can expect to see a broadening of the scope of computer usage. Optometric educational administrators must decide if our schools are going to rely

on the private sector to develop these areas, or if they are going to take an active and directed role in that development.

Professors and students at optometric institutions have reported on specific instances where computers have been used in practice applications (15,16,17). Nussenblatt (16) has attempted to give a limited overview of computer use in optometry schools, and has done work on optometric office simulation programs for teaching (18). Larson (19) has reported on the use of computers and automation for more efficient teaching in laboratory settings. These articles give evidence that the computer is gaining popularity in optometric educational settings, but also support the fact that computers have not reached total acceptance. There have obviously been efforts to date by individuals working within the educational setting, but there has been nothing published to show that they have been working within the guide lines of any specified long-range institutional plan.

ATTITUDES OF EDUCATORS

As mentioned earlier, confusion brought about by the accelerated evolution of the computer industry is one of the reasons that optometric education has been slow to

endorse this new technology for use in full curriculum teaching. Other doubts center around questions about the viability of the technology itself. Educators justifiably feel a need to be certain that computers are, indeed, the learning tool of the future before they lead their institutions into a long and costly commitment. Have computers really become the driving force that they are represented to be, and, if so, how are they to be best put to use in didactic and clinical teaching?

At a recent government sponsored conference on computers in education, Herbert A. Simon, professor of computer science and psychology at Carnegie-Mellon University referred to the computer as a "one-in-several-centuries innovation", not to be likened to the revolutions in technology and science that we have become accustomed to reading about almost daily (20). He feels that the "computer revolution" can best be likened to the early years of the automobile; in it's horseless carriage phase at present, but likely to impact on society and education in ways that we are unable to comprehend today.

Another prominent educator, Edward Tenner, science editor at Princeton University Press, places the computer and it's potential influence on learning at a level of importance between the invention of moveable type printing and the development of written language (21). Mr. Tenner likens educators' computer objections to Plato's criticism

of writing when he proposed that: "it is a counterfeit of human intelligence, it weakens the mind's memory and capacity for work, it cannot explain itself, and it cannot discuss or debate". He points out that Plato may have had basis for his criticism, but no one would seriously question the value of written language or it's positive impact on learning.

One of the more powerful arguments for computers in optometric education is the sheer number of the systems that are already in place in primary and secondary schools throughout the nation. The very students that form the future applicant pools for optometry and other professional schools are being exposed to computers early in their education, and will expect continuing availability of that technology, especially at the post-graduate and professional level. Computer numbers in grades K through 12 were estimated at somewhat over 100,000 in the spring of 1984 (21), had increased to over 300,000 by late that fall (22), and are projected to double yearly. It has been proposed that it would take $10 billion to adequately insure that all of our nations students have good access to computer hardware during their educational experience, but when put in the perspective that this would amount to a one time expenditure of less than one-tenth the United State's total annual cost for education, the possibility becomes at least feasible (20). On this point alone, one of

competition for an ever decreasing qualified applicant pool, optometric education is going to be forced to re-evaluate it's current policies.

Much of the debate that has surrounded the computers in education question has centered on the subject of computer assisted teaching (CAI). Educators are often led to believe that computers have opened up a whole new teaching method, will revolutionize the educational process by their mere presence in the classroom, and are disillusioned when they discover that this is not the case. Computers have that potential, but it will take great steps in artificial intelligence technology and software development before we actually reach that stage (23). At present, CAI, with the exception of computer simulated experiences, is basically limited to the same teaching methods that have been used for years: presentation, repetition, and drill and practice. The current power of the systems is that, with adequate numbers of machines to insure students' individual use on demand, these tried and proven methods become more valuable. Computers never tire. If programmed correctly they never make incorrect statements, and they can be used at the student's individual pace and according to his individual schedule. Improved CAI will certainly come as more machines are put into the hands of the people who will develop the programs, the educators and students, but the present strength of microcomputer systems is sufficient to

warrant their full use in all aspects of optometric didactic and clinical instruction.

It can be easily argued and generally accepted that professional school is, or at least should be, a different learning situation than students have been exposed to in earlier academic experiences. For the most part, they have already learned adequate study habits and have demonstrated an above average ability to deal with the demands of a conventional educational system. At this stage of their academic careers, students would welcome new, exciting, and innovative methods of instruction, but they have proven that they don't necessarily need them. What they do need is a method to cope with the vast amount of information that they will be expected to assimilate, master, and apply to problem solving in a clinical setting.

In his report to the government research conference on computers in education, Raj Reddy of the department of computer science at Carnegie-Mellon university points out the fact that the world is experiencing an "information overload": To master any subject now takes 3 to 5 orders of magnitude more information than it did in the 19th century (24). This huge growth of the knowledge base has had the effect of increasing the trend toward specialization by students and new graduates of optometry school, a trend that is not in standing with the image of the optometrist as an individual already specializing in

one aspect of human psychology and physiology. How specialized can optometry afford to become before it looses it's unique identity within the health care system? Fortunately, the portable microcomputer systems available today are well suited to mass handling and manipulation of data and information.

Dr. Michael Hoban of the Borough of Manhattan Community College (25) feels that the microcomputer's greatest role is to be used as a tool in accomplishing other goals. The huge amounts of data storage capacity that portable microcomputers now have (capacity that is vastly increased when they are networked with an institution's mainframe or mini computer system), combined with their ability to manipulate data at a rate far exceeding other methods, make them indispensable tools for professional education. No longer is it necessary for an individual to assimilate and remember the minutia involved in a professional discipline. She need only know how to find the information and it will be instantly available to her. Nor does this access to information detract from the fact that she must be knowledgeable in her field. She must still know the correct questions to ask, and must, more importantly, know how to apply the information that she is given. The argument that computers will in some way detract from the professional quality of the individual using them is a fallacy. In actuality, they enhance the professional

ability of the person using them by allowing more accurate and logically based solutions to a much wider range of clinical and didactic problems than is now possible.

PUTTING SYSTEMS IN PLACE

Once it has been determined that it is imperative for computers to be integrated more fully into optometric education, the problem of how best to accomplish the goal arises. A main consideration to keep in mind when trying to develop a computer integration program for professional college and graduate level work, is to keep the system as flexible and accessible as possible, allowing the greatest range of applications to the student. Most schools today are making use of microcomputers, either free standing or networked to a central mini or mainframe system.

Networking allows the user to have the flexibility of a portable system that can be taken with her as the task at hand demands, and gives the addition of a much larger data base than would otherwise be available. A further, and very powerful advantage, is the ability to utilize the system as a central clearing point for information dissemination by faculty. Assignments, lectures, solutions to problems, grades and other information and can easily and quickly be made available at the professors'

discrimination, and students can use the system to work on problems on a group or individual basis, as they choose.

Another important point that faces administrators is to determine the optimum number of terminals to be made available, who they will be made available to, and how they will be provided. Henry Jay Becker of John Hopkins University (26) sees the computer as a very possible replacement for the text book, which is characteristically used by one person at a time. If his argument is accepted, it follows that each student and faculty member needs to be provided with a microcomputer for her own use. This is the approach that is being taken at Carnegie-Mellon University in Pittsburgh, Pennsylvania (22,27). Richard M. Cyert, Carnegie-Mellon's president, has put together a program with IBM that will link each of the universities 8000 students with a campus computer network.

The Carnegie-Mellon project, which Cyert sees as essential to combat problems of slowness of computer response time and user access, is expected to cost in the neighborhood of $15 to $20 million before it is completed, is hoped to be operational for the entering class of 1986, and will require each student to purchase his own microcomputer through the university. Another university, Drexel, has established a less ambitious program that will entail far smaller expenditures by the school, but has also taken approach of having entering students purchase

microcomputers when they enroll for classes (22).

The idea of mandatory computer purchases by students may seem an anathema to professional school administrators, but they must keep in mind that the price is relatively small when compared to the over-all cost of a graduate school education. There are many compact and powerful portable microcomputers available at retail for under $1500, and with expected volume discounts to institutions and possible special programs like those that have been offered by IBM and Apple (28,29), the student is in a much better position to make the necessary capital expenditure than is the institution. Of further value to the school, is the fact that each year's entering class will have the newest and most up-to-date technology, insuring that any obsolescence built into a program will be kept to a minimum. This does not relieve the school from the responsibility of placing on line the required support systems for the program, but it does put the integration of the technology into the curriculum well within their reach.

CONCLUSION

It has been shown that microcomputers are powerful tools that are currently being used in optometry on a limited basis, but whose use should be expanded. The present uses

of computers in optometric education were explored, and the attitudes and methods of prominent educators and institutions on a secondary and undergraduate school level were reviewed. It can be argued that computers, at their present level of evolution, should be introduced into our schools and colleges of optometry for use in all aspects of the didactic and clinical curriculum, and that students in ever greater numbers are going to come to expect that computer technology be used extensively in professional school settings. If students are to get full benefit of this technology once it is in place, it is important that they have easy and unlimited access to terminals and support systems, and it is recommended that the best way to accomplish this goal is through mandatory computer purchases by each year's entering students at the time of their enrollment.

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