The Journal of the Association of Schools and Colleges of Optometry

OPTOMETRIC EDUCATION

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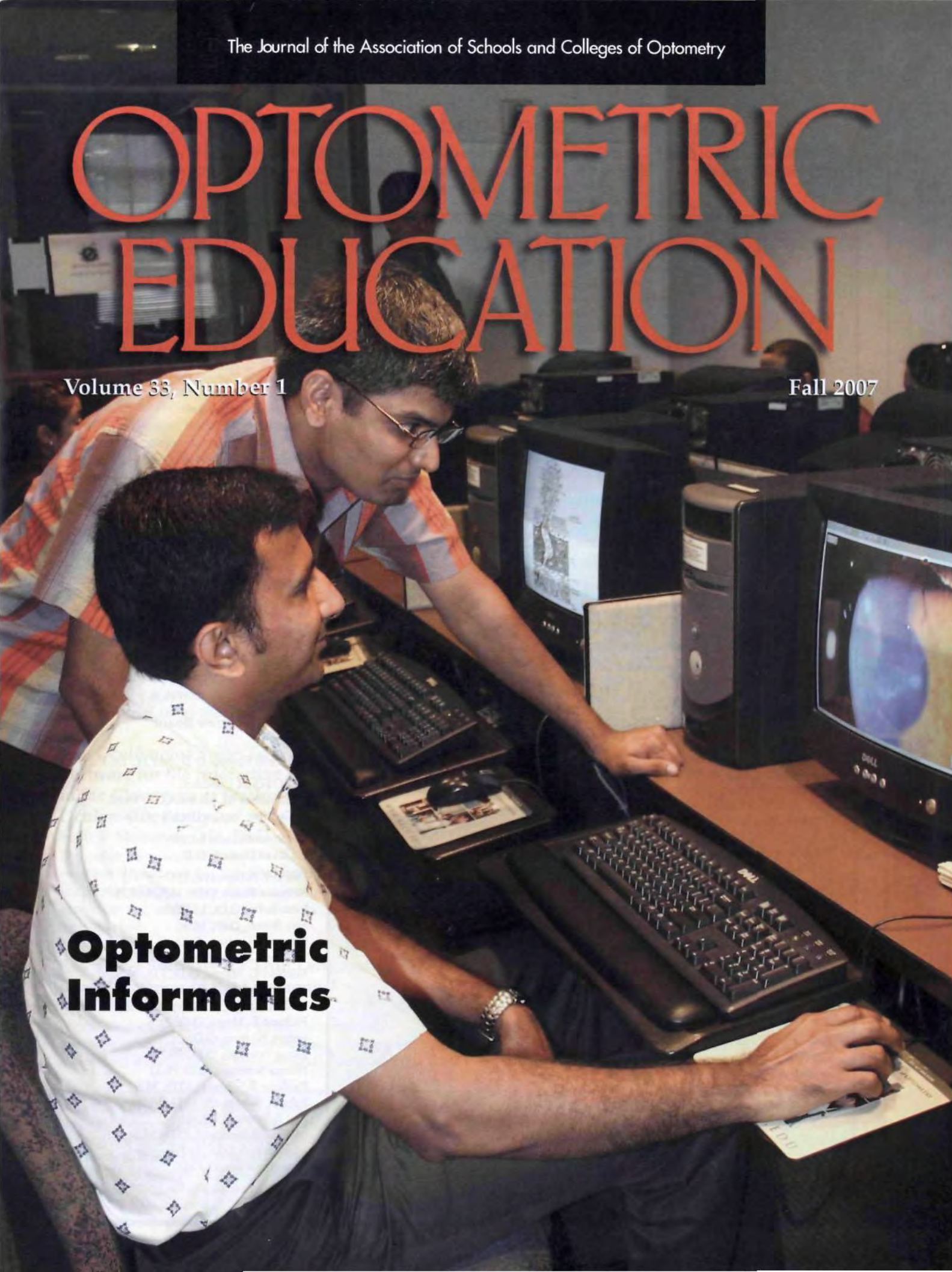

Optometric Informatics

Association of Schools and Colleges of Optometry

The Association of Schools and Colleges of Optometry (ASCO) represents the professional programs of optometric education in the United States. ASCO is a non-profit, tax-exempt professional educational association with national headquarters in Rockville, MD.

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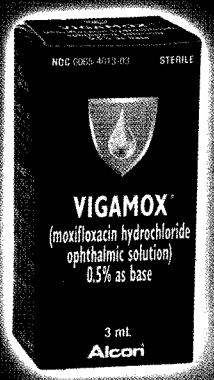

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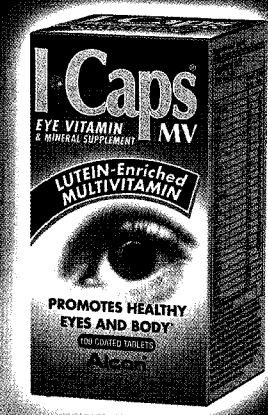

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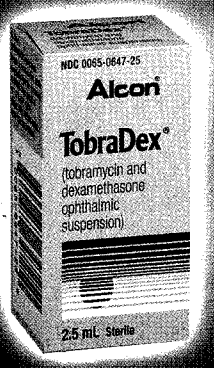

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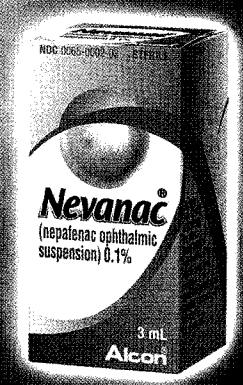

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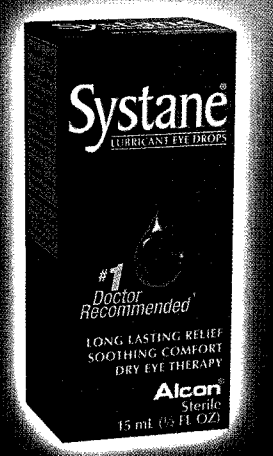

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INDUSTRY NEWS

The following companies support ASCO's national programs and activities benefiting all 17 schools and colleges of optometry in the U.S. and Puerto Rico:*

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CIBA Vision, a Novartis Company
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Marchon Eyewear
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Ophthonix, Inc.
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Safilo Group
Vision Care Institute™ of Johnson & Johnson Vision Care, Inc.

*For July 2006-June 2007.

Ciba Vision, a Novartis Company

With the introduction of Focus® DAILIES® Progressives with AquaRelease™, CIBA Vision now offers presbyopic patients an even more comfortable Focus DAILIES lens that also provides an excellent balance of near, intermediate and distance vision. Focus DAILIES Progressives with AquaRelease is the first and only presbyopic daily disposable lens in the U.S. and also includes a sustained release, blink-activated moisturizing agent, providing great initial and all-day comfort. Additionally, 87 percent of Focus DAILIES wearers are compliant compared to 35 percent of total soft contact lenses wearers, making Focus DAILIES ideal for all patients, including those who are new to contact lenses and those with glasses that get in the way.

The AquaRelease moisturizing agent of Focus DAILIES Progressives may in particular benefit older wearers, who tend to have poorer tear film and drier eyes.

"Presbyopic individuals often avoid contact lenses because they are either unaware that contacts are an option or because of comfort issues when wearing contact lenses," said Rick Weisbarth, O.D., F.A.A.O, vice president and global head, professional development and partnerships for CIBA Vision. "Focus DAILIES Progressives with AquaRelease offers these wearers an excellent option so they can benefit from the freedom, comfort and convenience of daily disposable contact lenses."

Bausch & Lomb

Bausch & Lomb named Joe Barr, O.D., its vice president of global research and development for vision care. Dr. Barr will be in charge of new product development of contact lenses and lens care solutions technologies. Dr. Barr is retiring from his position at the Ohio State University College of Optometry.

Hoya Vision Care

HOYA Vision Care, North America awarded $14,000 in grants and a $6,000 scholarship to students from optometry schools in North America. HOYA representatives presented the awards at the American Optometric Association's annual meeting in Boston.

At the beginning of the 2006-07 academic year, HOYA invited optometry schools in the United States, Canada and Puerto Rico to participate in the grant and scholarship program. Optometry students at each participating university wrote a case study that prescribed a HOYA product to solve a patient vision problem. Faculty at each school chose the winning case study and $1,000 grant recipient. One student selected from all grant recipients also received a $6,000 scholarship.

"HOYA is pleased to sponsor this grant and scholarship program. We are committed to supporting education in North America and helping prepare the optical industry leaders of tomorrow," said Steve Koufos, vice president of marketing and strategic planning for HOYA. Brian Zwanziger, an optometry student at Northeastern State University, received the $6,000 scholarship.

Volk Optical

Volk continues to provide the best quality and value in patented double aspheric optics. Building on the quality and popularity of the recently launched Digital Series slit lamp lenses are two new Binocular Indirect Ophthalmoscopy (BIO) lenses that deliver the highest resolution imaging with the Binocular Indirect headset.

With advanced glass technologies and designs, these 'Clear' (higher resolution) lenses use low dispersion(tm) glass, and deliver superior image quality and clarity compared to traditional BIO lenses across the diagnostic spectrum, with wide field and high magnification views.

The two new lenses are named the Digital ClearField, for mid and far

(Continued on page 31)

EDITORIAL

Informatics in Optometric Education

Michael Fendick, O.D., Ph.D.

It seems appropriate to define the topic of this special issue—informatics—from the extraordinarily popular and occasionally controversial Internet phenomenon, *Wikipedia*:[1]

> Health informatics or medical informatics is the intersection of information science, computer science and health care. It deals with the resources, devices and methods required to optimize the acquisition, storage, retrieval and use of information in health and biomedicine. Health informatics tools include not only computers but also clinical guidelines, formal medical terminologies, and information and communication systems.[2]

The American Medical Informatics Association (AMIA) defines the field more broadly, stating that, "Biomedical and health informatics has to do with all aspects of understanding and promoting the effective organization, analysis, management, and use of information in health care."[3]

The Association of Schools and Colleges of Optometry (ASCO) formally recognized the importance of informatics to optometric education by supporting formation of the ASCO Optometric Informatics Special Interest Group (SIG) in December of 2000.[4] As the definitions suggest, there is a significant overlap of interests between this group and the Vision Science Librarians SIG.[5] Accordingly, the two groups have enjoyed a very close and mutually supportive relationship, with a significant number of members participating in both.

Articles presented in this issue reflect but a small portion of the optometric informatics spectrum of activities. One of the most important activities has been the development of guidelines for the use of information technology by ASCO's member schools and colleges of optometry, recently accepted by ASCO. Douglas Freeman provides a brief summary of the guidelines and their development.

Also in this issue, Scott Steinman describes two professional-quality interactive software applications to aid instruction of optical ray tracing and the diagnosis of ocular motility abnormalities. Scott Hanlon discusses the development of a dynamic, Web-based, clinical performance evaluation system at the University of Houston. Jenna Hildebrand *et al.* detail findings of small focus group interviews involving senior optometry students, which suggest, contrary to popular belief, that our students may not be as "computer-savvy" as many educators expect them to be. Interviewees, after experiencing their clinical externships, expressed a general interest for more exposure and training in information technology within the optometric curriculum.

Optometric education is a relative latecomer to the field of medical informatics. Although informatics has matured into an integral part of medical and dental education, many optometric educators are still unaware aware of the field and its growing importance to clinical practice and education. Nevertheless, every school or college of optometry has a dedicated library staff with training in this area and at least a few faculty members and/or administrators with advanced information technology skills in addition to their clinical expertise. Perhaps, participation of these individuals in the ASCO Optometric Informatics SIG and special issues of the journal, such as this one, will help to advance our profession in this critically important area.

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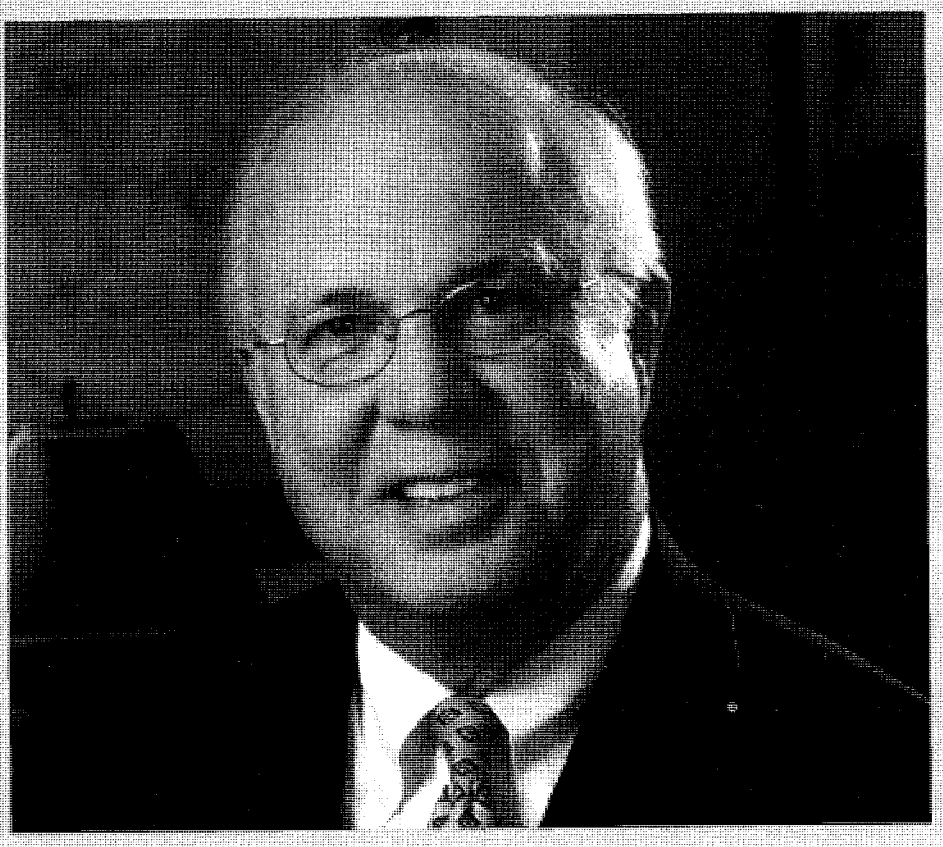
Dr. Mike Fendick earned his O.D. from the New England College of Optometry and his Ph.D. from the University of California, Berkeley. He has worked in research and teaching at Wills Eye Hospital, University of British Columbia Department of Ophthalmology, and Nova Southeastern College of Optometry. Dr. Fendick is currently with Electro-Diagnostic Imaging, Inc., of Redwood City, Ca.

Optometric Education Is Moving Forward with Free Access Online!

Beginning with the Winter 2008 issue, the *Journal of Optometric Education* will be available in an online version only. The Fall issue is the last printed journal issue. No password or subscription will be needed to access the online journal at www.opted.org/publications_main. The ASCO Board is pleased to offer this opportunity to everyone interested in reading the journal.

Spread the Word!

Focus on the President



John F. Amos, O.D., began a one-year term as ASCO's president on June 27, 2007. Dr. Amos is dean of the University of Alabama at Birmingham School of Optometry.

Dr. Amos received his Bachelor of Science and Doctor of Optometry degrees from the Illinois College of Optometry in 1965. Upon graduation, he was an associate in private practice in Wichita, Kansas. He served as an optometry officer with the rank of Captain in the United States Air Force from January 1966 until September 1969.

After leaving the Air Force, Dr. Amos entered the graduate program in the School of Optometry at Indiana University. He was awarded a Master of Science degree in physiological optics in 1972.

He joined the faculty of the Department of Optometry at the University of Alabama in Birmingham School of Optometry as an assistant professor in 1972. He served as optometry clinic chief for the Diabetes Research and Education Hospital, director of the UAB School of Optometry's residency programs and chief of primary vision care services. Dr. Amos was promoted to the rank of professor in 1982. He became chairman of the Department of Optometry and director of the professional program in 1994. He was named interim dean in 2000 and dean in 2003.

Dr. Amos was named the American Optometric Association's National Optometrist of the Year in 1994 and was the recipient of the Distinguished Service Award in 2003. In addition he has received numerous other awards.

OPTOMETRIC EDUCATION: What are the key issues that you hope to emphasize during your year as president?

I have tried to identify several important issues that I believe are of significance to ASCO. These issues include: attempting to attain legislative support for federal funding of optometric education; increasing the applicant pool for optometry professional programs, optometric residency programs and graduate vision science programs; presenting discussion topics of shared resources/best practices at each Board of Directors meeting; gaining a greater familiarity with international optometry especially as it relates to the American model of optometric education; enhanced communication between ASCO and its corporate sponsors; and communicating to the National Research Council the need for a separate category that recognizes vision science as a distinct discipline.

OPTOMETRIC EDUCATION: Who were the people who influenced the development of your educational, administrative, and leadership ideas?

Clearly I have many people to whom I am indebted for assisting me during my career. First is Dr. Dale T. Newland who practiced optometry in

my hometown of Parsons, Kansas. Dr. Newland was a wonderful role model who served to reinforce my selection of optometry as my life's work. I learned many important facets from my colleagues during the several years I was in the USAF as an optometry officer, as a graduate student at Indiana University, and my more than 35 years at the UAB School of Optometry. From an educational perspective I owe more than I can possibly repay to Dr. Jesse Boyd Eskridge, former chair of the Department of Optometry at UABSO. It was his wisdom and guidance that helped to develop my teaching skills.

Any success I have as an academic administrator is due in large part to the advice and mentorship I have received from three very good friends, Drs. Arol Augsburger, Lester Caplan and Thomas Lewis. However, it is important to add that I have learned important lessons and received invaluable advice from colleagues, too many to mention, all along the way.

OPTOMETRIC EDUCATION: What kind of leadership opportunities exist in optometry for someone interested in stepping into a position of dean or president?

First, I am of the opinion that having an O.D. degree, although perhaps not a necessity, offers a clear advantage for the chief executive of any school or college of optometry. Within the profession such positions as the chief academic officer (chair, dean or vice president), chair of a department, chief-of-staff, director of residency programs or a mid-level or senior faculty member active in the committee structure of their institution all present opportunities for significant growth and advancement to administrative and leadership positions.

Outside of optometric education some dynamic deans and presidents have come from regional and national professional organizations. I also believe that optometrists with federal service experience often have the leadership skills to be considered for these positions. However, when leadership opportunities present themselves, there is no substitute for innate values such as common sense and fairness to help address faculty, staff, student and academic issues.

OPTOMETRIC EDUCATION: What gives you the most satisfaction in your position as dean?

I enjoy having the privilege of leading the UAB School of Optometry as it addresses the opportunities it has in providing optometric and vision science education, research, service, and patient care. This requires having a sense of direction, or vision and mission, that is not only the dean's but also involves building, where appropriate, consensus on the part of the faculty, staff and students. I also enjoy having the chance to address specific concerns related to student, staff, faculty and institutional needs. These concerns are quite varied but are interesting and important for the people involved as well as the school, university or organization. I also enjoy representing the school not only to our alumni and friends but to the university, community, profession and beyond. I am honored to have the opportunity to serve my colleagues in this manner.

OPTOMETRIC EDUCATION: What makes the UAB School of Optometry so special?

It has been my observation that each school or college of optometry has unique strengths to offer the profession. The unique aspect of the UAB School of Optometry is the fact that this school was designed from its inception to be an integral part of a public university's academic health center. This relationship provides not only a strong basic science component for the professional program curriculum, but also great advantages for the school and profession both in the community and state.

The school has three programs: professional, graduate and residency. The professional program is fortunate in that it only admits approximately 40 students per academic year. These small class sizes permit the development of close relationships between the students (and future alumni), the advantage of a low student/faculty ratio, dedicated faculty who know every student and play a part in their educational experience, and the participation of a large percentage of graduates who become members of the alumni association and are loyal in their support of the school.

The graduate program educates vision scientists for careers in vision research and the discovery of new knowledge. The residency program provides optometrists with additional clinical education and experience in specialized fields. All of these programs offer and make possible a unique and exciting educational environment.

OPTOMETRIC EDUCATION: What is the single professional accomplishment of which you are most proud?

I believe I am most proud of the fact that the UAB School of Optometry has met its state legislated mandate. That mandate — to increase the optometric workforce in Alabama — was established when the Alabama legislature authorized the establishment of a school of optometry in 1969. The school has alumni who practice and provide excellent eye care in almost every county in the state, as well as every state in the union. It also developed the first school-based one-year accredited residency programs in the profession and has the only vision science graduate program in the southeastern U.S.

Beyond the program accomplishments, UABSO alumni have assumed leadership roles in the AOA, Southern Council of Optometrists and various state optometric associations. I believe a sense of commitment to life-long learning and a responsibility to serve not only patients, but also local communities and the profession, are the best outcomes that the school can provide.

Informatics Experts Discuss How the Field Has Changed Over the Last 20 Years and Predict Innovations for the Next 20 Years

About 20 years ago, medical informatics was a world of computer geeks who wrote their clinical applications in MUMPS (Massachusetts General Hospital Utility Multi-Programming System) programming language, and Medline searchers needed a two-week training at the National Library of Medicine. Now, everyone is involved using and learning electronic record systems, searching for diagnostic clinical information, accessing PubMed to find relevant literature, and communicating with patients via e-mail. Considering how fast the Internet has changed it all, the future will hold a lot of surprises, but clearly there will be more integration of systems so that viewing an electronic medical record of a patient will link to relevant clinical standards, diagnostic information, current research, clinical trials, and more. Open access publishing will have become the accepted standard so that health information is available to everyone. *[Editor's note. As of this issue, Optemetric Education is an open access journal. — SD]*

Cindy Hutchison, MLS
Director of Library Services, New England College of Optometry

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Over the last 20 years, the changes in informatics have allowed higher education to transform from narrow modes of information delivery to widely varying and rich types of information availability. Classrooms have moved from spoken verbal lecture and chalk to multimedia presentations, with video, interactive animations, and the Internet. Limited, paper-based information resources such as books have expanded to include vast multimedia resources, from learning management systems to portable media such as iPods and texts on personal digital assistants (PDAs).

The next 20 years will revolutionize informatics technologies. The user interfaces will become intuitive and transparent, relying on natural interactive behaviors such as handwriting, voice, touch, and even eye movements. Future informatics will allow reliable, universal, and instant access to information. This will permit teaching and access of knowledge in a way that is more consistent with our understanding of learning neurology and that will allow focus on learning at a high problem-solving level spanning an individual's lifetime. The informatics revolution will also allow full access to patient medical records, vast chairside information resources, and improvements in the type and quality of examination data, all providing immense improvements in the quality of patient care.

David D. Castells, O.D. • Associate Professor. • Illinois College of Optometry

Technology has changed not only the face of optometry but also student education. Faculty no longer have to rely on paraprofessionals to type documents, create projection slides, or print transparencies. From office desktops, faculty can produce professional handouts and presentations directly. E-mail and Web content have provided an entirely new, asynchronous mode of communication. The next 20 years will reveal students, faculty, and patients using electronic media to communicate and exchange information. Most common objects will contain electronic components that will be capable of relaying and storing information. People will intuitively interact with technology using voice, touch, and vision. Students will demonstrate proficiency with electronic portfolios, faculty will be promoted and peer reviewed with similar tools, and patients will possess shareable electronic health records.

Geoffrey W. Goodfellow, O.D., F.A.A.O.
Assistant Professor of Optometry
Chief, Pediatrics/Binocular Vision Service
Illinois College of Optometry, Illinois Eye Institute

Twenty years ago the IBM Selectric typewriter was the dominant informatics technology in optometric institutions. The Apple II, early Macs, and particularly the DOS machines were primitive compared with today's technologies, and sharing of digital information was achieved primarily via "sneakernet." It is only in the past 10 years that we have achieved reasonably mature local informatics infrastructures in schools and colleges of optometry.

Twenty years from now, we will face many of the same issues that we face today. Although we may wear our computers, which perhaps will be a combination of PDAs, entertainment devices, telephones, global positioning sensors, cameras, and debit cards, we will still have to contend with:

- Information Explosion - Most biomedical research publications will be issued in digital form only. There will be an overwhelming amount of information available to educators, students, and practitioners, and information literacy will be an integral and essential part of optometric education. The need to critically evaluate information will be emphasized in information literacy classes. It will be even more important than today for students and professionals to understand that information is not necessarily accurate or unbiased just because it appears on the Internet.
- Privacy - The bad guys will still be out there trying to get access to our information, leading to an even greater emphasis on:
- Data Security - Practices such as today's "pod slurping" will be considered primitive compared with the nefarious and sophisticated practices of data thieves in 2027. The need for robust, reliable equipment; secure networks; and stout defenses will be substantially greater than it is today.
- Standardization - Beginning in 2007, annual revisions of the ASCO Informatics Special Interest Group's Informatics Guidelines will aid in orderly progress toward the standardization of patient records and other informatics developments in optometric educational institutions. By the document's 20th revision in 2027, electronic medical records in optometry will be standardized, secure, and widely interchangeable.

—Douglas K. Freeman, M.A., M.L.S.
Director of Technology
Indiana University School of Optometry

Health informatics, or health information technology, has great potential to assist optometrists in delivering optimum eye and vision care to their patients, from decreasing the chance for simple errors—such as transposing the right- and left-eye prescriptions when edging lenses—to lowering the risk of sending illegible prescriptions to the pharmacy and having access to electronic systems that track a patient's full medical history, including prescriptions from other doctors, and automatically alerting the optometrist to drug interactions.

Additionally, a centralized database of the large quantities of clinical data collected by providers from across the country can be exploited to enhance our overall understanding of vision conditions and their successful treatment.

However, these same systems have potential for abuses as well. Simplistic data mining by researchers or government agencies who do not fully understand the limitations under which the data are collected can lead to incorrect conclusions. Recall the excellent Ocular Hypertension Treatment Study that clearly, but incorrectly, indicated that having diabetes lowers a patient's risk for developing glaucoma. Market incentives of product, technology, and pharmaceutical suppliers and third party carriers can also promote conclusions based on incomplete deliberations and premature implementation of policies.

There is a delicate balance between being an innovator of technology who spends too much money for a technology that only partially delivers on its promise and a laggard who misses safe and reasonable opportunities because of fear or frugality. Although stressful, individual practices have the option of following the market and optimizing the timing of a technology's implementation. However, as a profession there is much greater risk of missing an opportunity because it is more difficult to convince government agencies and national corporations to rewrite their systems to add optometry than to be involved during the development of the systems.

Therefore, optometry as an organized profession must be involved in the development, implementation, and continued refinement of health information technology programs. We must assist those agencies and technology developers who are currently creating systems and policies and ensure that they have a complete understanding of optometry's role in the health care system.

Because of this, it is necessary for optometrists at all levels (practitioners; local, state, and regional societies; education and research sectors; as well as national organizations) to invest time and effort into studying, developing, and educating each other about the issues associated with health information technology. Since health information technology will bridge across all aspects of eye and vision care—the doctor-patient relationship, practice management, computer and instrument technology, health care financing, clinical practice guidelines, and patient and provider privacy—each of us needs to make a conscious effort to resist the urge to skip over the health information technology articles and continuing education lectures and instead become aware and active in this aspect of our profession. Educational and research institutions should support and promote studies and pilot programs in the areas of epidemiology and health care administration and policy and coordinate beta tests of technology in their clinical programs with technology developers. Local and state associations should be vigilant about regulations and policies that are being considered and drafted that will affect the current and future practice of optometry.

Mark Swan, O.D., M.Ed., F.A.A.O.
President, Michigan Optometric Association
Member, ASCO Informatics Special Interest Group
Chief of Pediatrics and Binocular Vision, University Eye Center, Michigan College of Optometry

Think Tank . . .

Medical informatics emerged from theoretical work about 20 years ago. The academic disciplines of decision/game theory, "cybernetics," and computer science gave rise to people like Terry Winograd, Octo Barnett, Marsden Blois, and Ted Shortliffe—theorists who explored the possibilities of computation and simulation in health care. Researchers began to define how computers could interact with health care in clinical settings at the dismay of many clinicians. Over the years we have learned that not everything that seems possible with computers is practical or desirable, and we spend time evaluating feasibility and return on investment of information systems. We have learned the value of interoperability, extensibility, usability, and security. There has been much progress, yet we resist and are often blind to the transformation that information systems bring to health care.

In the next 20 years, optometrists will need to learn:

- How to work collaboratively with other disciplines. The team approach to health care is greatly facilitated by easily shared information. Optometrists will apply customized interventions at the point of care that incorporate the input of several other team members as well as decision support tools and guidelines.
- How to interpret and communicate probabilistic models. Clinicians do not speak probabilities very effectively, yet we know that every condition is described by probabilities. The application of genome analysis in health care will greatly increase the need for risk models, not only for treatment outcomes of eye disease, but for prevention as well. These models will need to be delivered and communicated effectively to patients.
- How to work with the complexities of the emerging information infrastructure in health care. This is important for our profession in order to be integrated into this infrastructure, rather than continue as an isolated profession. Until now optometry has not needed more than marginal interaction with health care in general; however, regional health information organizations and greater interaction among professionals via electronic health records and telemedicine will change our requirements.
- Similarly, understanding the diffusion of innovation is something that will be increasingly central to those who are in charge of acquiring technology. Even our prized faculty sometimes make mistakes in choosing technology based on vendor presentations and hearsay instead of understanding basic principles of technological innovation. Do not teach technology, teach how to deal with technology—how to assimilate change, plan for it, and accommodate it to the organization.

Jorge Cuadros, O.D., Ph.D. (medical informatics)
Director of Informatics Research, Clinical Research Center
University of California, Berkeley, School of Optometry

Informatics Guidelines Report

In June 2007, the ASCO Board accepted a report from its Informatics SIG (Special Interest Group) outlining informatics guidelines for the schools and colleges of optometry. A copy of the complete guidelines will be available as a pdf file on the ASCO web site - www.opted.org - at "Publications & Reports".

The document is the result of a seven-year effort by the ASCO Informatics SIG to offer to the schools suggestions for reasonable goals to work toward in a number of areas relating to informatics:

- Budget, administration, and planning
- Online distance learning
- Hardware
- Access to information
- Software
- Clinical informatio
- Staff
- Networking
- Security
- Training/instruction, support
- Web sites
- Academic recognition

The Informatics Guidelines Report is not intended to prescribe precisely what each school's infrastructure should be. Rather, it is an attempt to give the schools general guidelines that they can work toward, hopefully resulting in an overall improvement in the technology infrastructures of optometry schools generally. There is absolutely no expectation that every institution will be able to meet every guideline, and there likely are powerful local reasons why some guidelines either should not or cannot be met.

This project originated at the December 2000 meeting of the ASCO Informatics SIG. Dr. Jerald Strickland of the University of Houston College of Optometry asserted that a need existed to establish informatics guidelines for optometric educational institutions. He argued that members of the SIG had the relevant expertise and credentials to establish and disseminate those guidelines. Since that meeting, the SIG has worked steadily to identify topics to be covered and to refine and update our treatment of those topics. Authors were asked to write sections based on their particular expertise, and an editorial committee (or steering group) was assigned the task of editing and merging section drafts into a coherent document. Serving on the editorial committee were: Bette Anton, Jorge Cuadros, Mike Fendick, Doug Freeman, Cindy Hutchison, Claudia Perry and Scott Steinman.

The guidelines report is not totally unfamiliar to ASCO members. Earlier drafts have been fairly widely disseminated among the ASCO leadership.

The informatics guidelines report is a living document that will be revised annually. Accordingly, it will automatically be part of the agenda at every annual meeting of the Informatics SIG and will be revised and edited as the membership deems appropriate. Changes will be made to accommodate new technology and developments as they arise. New guidelines will be written as required; existing guidelines will be revised or even eliminated as necessary.

We anticipate that these guidelines will be useful for schools attempting to upgrade their technology infrastructures and in preparing to undergo assessment and periodic accreditation. They may be of considerable assistance when attempting to make a case for increased institutional support.

The editorial committee welcomes feedback from all readers of this document. All suggestions for changes and improvement will be addressed at the next SIG meeting.

Douglas Freeman, M.A., M.L.S.
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Evolution of a Dynamic Website for Clinical Evaluations

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Abstract

Dynamic web pages are a new technology for storing, retrieving, manipulating and presenting information that is particularly well suited for instructional uses.

Dynamic web pages have many features beyond simply displaying static information and have the potential for being more instruction-centered. The development, implementation, and refinement of a web-based application for clinical evaluation are described.

Introduction

We often hear the expression that "necessity is the mother of invention," but there are also times when the opposite may be true. Sometimes new technologies cause us to re-evaluate how we teach and we may elect to alter our teaching methods using the new technology, i.e. the "invention" may create the "necessity" for its use. Knowledge of an existing invention or technology may also inspire its use in new ways. Innovations must be approached with some caution. At times it may be tempting to use a "techno centric" approach by centering courses on the currently available technology.[1] We want to avoid the use of technology just for the sake of technology and we must avoid letting technology determine how we teach. Our goal must be to improve the instructional process and not just to add technology.

Course management systems such as WebCT and BlackBoard are designed for educators to display course content and for general course management. Because they are "generic" course templates, they tend to be somewhat techno-centric. These systems essentially function as interconnected dynamic web pages and may be the best option for educators in many cases. However, custom dynamic web pages allow much more freedom in design and are more instruction-centered. They allow one to create tools that are consistent with personal teaching methods.

Educators are in fact dispensers of information and facilitators who assist in the acquisition of knowledge. It is therefore important for us to be always alert to the development of new technology that can be used to make our educational process more effective and more efficient. It seems to be common for educators to post class content in the form of text and images online. However the technology that displays that information is capable of so much more. Dynamic web pages such as those created with application servers, discussed below, have many features beyond simply displaying static information and have the potential for being more instruction-centered.[2]

The purpose of this article is to share my experience in developing and using dynamic web pages with other clinical educators. I believe that the experience that I gained as I developed and utilized dynamic web pages is worth sharing with other educators. The exploration of this new type of technology resulted in the emergence of new instructional uses. Some of the applications that I will describe may in turn inspire new instructional uses for other, similar technologies.

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Background and Terminology

To gain an appreciation of the technology and its applications a quick review of the background, context, and terminology may be helpful. A web server is software that "serves" web pages upon request from a user's web browser. The pages are displayed according to the formatting language (HTML) that constitutes the web page. The server only retrieves the pages and has nothing to do with how the page looks or functions. The way the web page displays is determined by the instructions written in the web page and interpreted by the user's browser. An application server is a preprocessor that processes the content of web pages and then returns the results to the browser (rather than the actual page). This opens the door for almost limitless server-side manipulations such as pulling information from server databases or processing client variables. In this way truly *dynamic web pages* can be created.

Wikipedia defines a dynamic web page as:

> *"Using server-side scripting to change the supplied page source between pages, adjusting the sequence or reload of the web pages or web content supplied by the browser. Server responses may be determined by such conditions as data in a post-*

ed HTML form, parameters in the URL, the type of browser being used, the passage of time, or a database or server state."[3]

Table 1: Some advantages of dynamic web pages:[3]

1. Retrieve data from database
2. Customize responses for specific situations
3. Dynamically populate form elements
4. Created printable content
5. Automatic email generation
6. Data-driven reports
7. Shopping carts
8. Data syndication
9. Guest books
10. Surveys
11. Personalized user pages

In other words, dynamic web pages interact with databases to extract and/or deliver information.[4] Dynamic web pages typically contain very little text since they pull needed information from other applications. Once dynamic web pages are created with any of the server-side languages, the web contents may change through user interaction and the pages are usually easier to maintain. The four most commonly used server-side languages for creating dynamic web pages are ASP, ColdFusion, Perl and PHP.[2]

ColdFusion (available from Adobe) is a complete web application development platform - a programming language, an application server, a development environment, and a framework for delivering enterprise services. It is preferred by many dynamic web page developers because it is relatively easy to learn its programming language (for those already familiar with HTML), quite powerful, and requires less development time than other languages.[5]

Clinic Evaluations Development and Implementation

Several years ago, when the first portable wi-fi devices became available, two other clinical instructors (Deborah Currie, O.D. and Kim Lambreghts, O.D.) and myself set out to develop a method of inputting our clinic evaluations online using the pocket PC as the primary data entry device. I had some prior experience with dynamic web development with ColdFusion programming and volunteered to write the program while the other two provided advice on content, functionality and user interface. At that time, a typical semester of third year evaluations would generate about twelve thousand pieces of paper that had to be filed and summarized. The goal was to eliminate the manual filing and summarizing. The development process began with the simple intent of re-creating the existing paper form electronically and storing the data on a server database with the ability to generate summative reports.

The resources for this project came largely from a grant from the University of Houston department of Educational Technology and University Outreach. This grant provided the funds to purchase computer workstations, the ColdFusion server, pocket PCs and a stipend for time spent programming and developing systems. This portion of the project resulted in the first workable version, which was little more than web-based forms that looked similar to the paper forms we had been using. For the first two semesters only four faculty members were chosen to use the 'beta' version of the online evaluation system as it was being tested. The time was spent de-bugging the software and making improvements in functionality through comments from the users. All of the four faculty members were very enthusiastic about the system and provided many suggestions for enhancement.

Although the ability to use a pocket PC was one of the original incentives for development, it was soon abandoned as the means for faculty to input student evaluations. We found that it was very time consuming to enter comments using the onscreen keyboard of the pocket PC. Even portable keyboards that connected directly to the pocket PC's, or through BlueTooth connectivity, were neither efficient nor convenient. Faculty members now use desktop workstations or laptop computers for submitting their evaluations. The pocket PC remains as an optional means for students to input new patient demographic information.

Our clinic evaluations system evolved through experience that I gained with programming ColdFusion markup language and from valuable feedback from users. The core of the web-based system was developed around the ColdFusion application server and ColdFusion markup language. There are other application servers or preprocessing languages but I chose ColdFusion primarily because of its similarity to HTML and the fact that I had some minimal experience with it. The original version of this project utilized ColdFusion as the application server and included ColdFusion programming language as well as HTML and Javascript. Flash was used to create the graphical user interface. As a result of the recent upgrades to ColdFusion the latest version of this project uses ColdFusion programming language almost exclusively and also includes embedded ActionScript statements.

The implementation process was slow and cautious. After the initial phase with four faculty users, we added other faculty users as they asked to use it. There were very few who were reluctant to use the online method. As new faculty members were hired, they were introduced to the system for online evaluations and began using it from the beginning. The first mandate was for all final evaluations to be submitted online by all clinic faculty, and finally it was required that all daily, midterm and final evaluations be submitted online.

The clinic course masters, who have the task of reviewing the evaluations, assigning grades and awarding letters of excellence, were enthusiastic about the online system from the beginning. Their job was immediately made easier. Students, who had the experience of using both the paper forms and the online forms, were also enthusiastic. With the information being online, they were able to view their evaluations at any time from anywhere and the evaluations were completed in a more timely fashion. At first there were programming glitches that occasionally lost data. This caused a few faculty members to be understandably reluctant to input data online, but as the system became more dependable, that issue virtually disappeared.

During the implementation process, more suggestions for improvement were received and more de-bugging was required. Changes were made in the code frequently during the first few semesters. The program was completely re-written twice to incorporate new features and improve functionality. Then in May 2006 we received another grant from the University of Houston

to purchase additional hardware and to re-build the entire system. In addition, it was decided to add more features to our system such as a record scanning and a means for faculty members and individual students to communicate online. Workstations with high-speed duplex scanners for scanning and automatic uploading of the patient records to our server were installed in the Family Practice Clinic in the University Eye Institute. Faculty members may now quickly review patient charts, sign them and return them to medical records. By reviewing the record online they can then complete the evaluations at any time. Most importantly it now allows students to see the actual patient record at the time that they review their evaluation comments.

Patient confidentiality was maintained and HIPAA regulations were adhered to in the following manner: the clinic evaluations site includes scanned copies of the patient record that are viewable by the attending faculty at any time (password protected) and the record is viewable by students only on the first time that they view their evaluation of that patient, and not subsequently. Utilizing Protected Health Information (PHI) in this manner is consistent and allowable within "Healthcare Operations," according to University of Houston's College of Optometry HIPAA expert.

Through user feedback, advances in technology and programming experience, the online system evolved into a much more complex and comprehensive system then originally conceived. The way data are collected and processed provides not only time-saving and convenience benefits but also provides feedback and summary benefits previously not possible. It is an evolving process that continues even now, five years later.

How the current version of the clinic evaluation site is used:

Figure 1 shows a schematic diagram of three portals that connect to the online database. The numbers in the figure refer to example screen shots in the addendum. A working demonstration version of the website is at: http://clinic.opt.uh.edu/demo. An individual user can log in as: (1) student; input new patient, review daily midterm and final evaluations, check for messages, change personal information, link to seminars and rounds. (2) attending faculty; evaluate individual patient encounters, enter mid term or final evaluations, change personal information, modify schedule of assigned students, review student summaries. (3) clinic course master; review evaluations for individual students, review clinic summary of all students in rank order for current or past semesters, add new clinic faculty.

After logging in, the individual maintains a connection with the database through a session portal. The user only has access to web pages that he/she is authorized to view. Some pages are for viewing only, some are for submitting data only, and some are for both viewing and updating information. Ten computer workstations are distributed about the eye institute, with four being designated specifically for students to input new patients and to scan records. Typically, it takes the students only 3-4 minutes to input the patient information and scan the complete record. We have not had any problems with students having to wait to use a computer. Faculty may use computers in the eye institute to complete their evaluations with the patient record in-hand or, if they may review the records online and complete their evaluations from any computer with web access.

Table 2 includes a partial list of current features of the evaluation system, which continues to grow as users of the system continue to make helpful suggestions. This list is the result of creating our own system. These are the features that have evolved into being part of our web-based evaluation system in order to be able to perform the functions that we wanted in the evaluation system. I am not aware of any software that we could use to do what we do with our system, even with significant modifications. That is the primary advantage of having a system that evolved out of our usage.

Other uses for dynamic web pages:

The relatively simple beginning started me on a journey that has expanded my knowledge of online databases and dynamic web pages and opened my eyes to ways to incorporate that technology into courses that I teach and courses taught by others. This "spill over" allowed me to incorporate dynamic web sites for collecting and retrieving data, which I find to be an integral part of my teaching.

One example of how I have used this technology is my seminar and lab groups. The website for this course

Figure 1: The numbers on Figure 1 correspond to the numbered screen shots (see addendum). Some of the screens have more than one form showing at one time (e.g., #4 & 5) and others have tabs to view different forms (e.g., #2a and #2b).

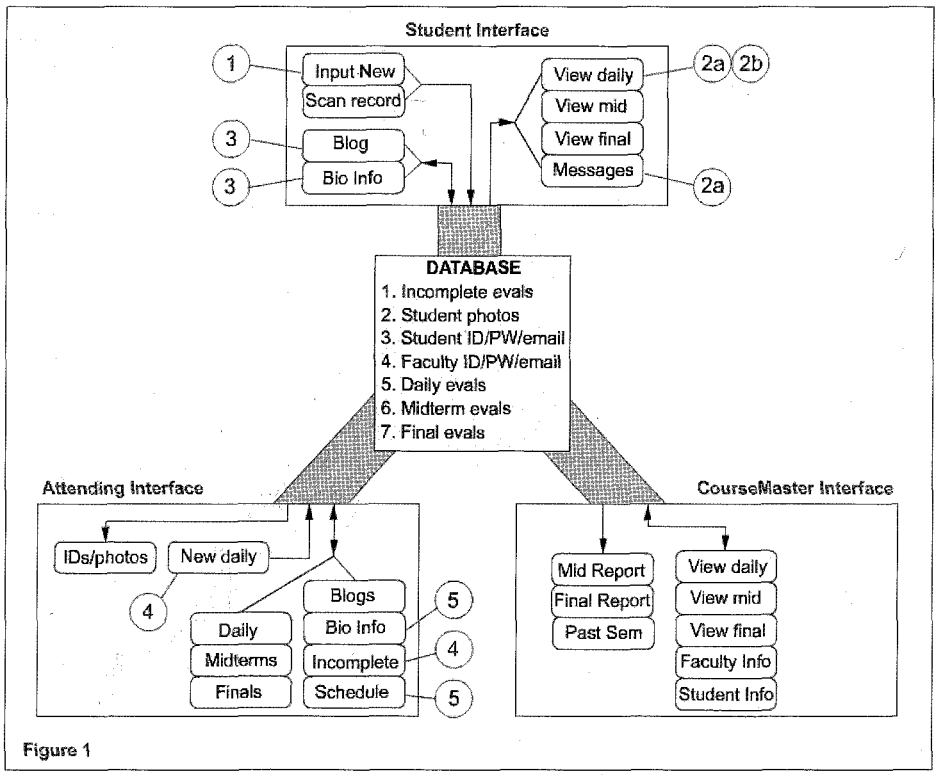

Figure 1

Table 2: Partial list of features of latest version

- Records scores and comments for each daily patient encounter as well as midterm and final evaluations
- Temporary holding for incomplete evaluations until finished
- Displays student photo on each evaluation
- Uses a portal login feature (single login for multiple pages)
- Faculty summaries for daily, midterm and final evaluations; also indicates if student has reviewed them;
- Faculty can send message simultaneously to all his/her students, or to individual
- Student may send response back to faculty regarding comments on a patient encounter (blog-style)
- Extensive summaries for the clinic coursemaster including tracking missing evaluations
- Automatic email generated to notify faculty members of missing evaluations
- A scanned copy of the patient record is included in the evaluation
- Students can view a cumulative summary of all their patient visits

contains all of the didactic information and instructions for performing the required clinical procedures; no handouts are given. Students must take the 20-question quiz for each topic online prior to coming to class. At the beginning of each class session I take roll using a pocket PC that records the date to the online attendance roll. When each student has demonstrated acceptable skill level on the clinical procedures for that day, I check the procedure off again using my pocket PC. After a student has attended a seminar session he/she can no longer take the quiz for that session. Each quiz can only be accessed after the student has attended the previous class session. This helps to assure that students come to lab prepared and requires them to follow the sequence of topics. In addition, I have a summary form that contains all of the scores, check offs, and attendance dates for each student. That form also has a list of all the patients that those students have seen during the current semester. As I click on any given record, it opens up a copy of the patient record in *.pdf format so that we can discuss the case in class. I don't know of any packaged software that would perform these tasks the way that I use them.

I could have used packed management systems for some of my courses, but after my experience in developing the clinic evaluations system I preferred the freedom of creating my own course websites. However, for performing the task of clinic evaluations we really had no other option than to build our own.

There have been several other occasions where I was able to use my experience to create websites for the college. Here are some examples:

1) Each of our fourth year students makes a grand rounds presentation and is required to submit the abstract, paper and photos to our server. This has produced hundreds of excellent cases that are now available online and may be searched by keyword, ICD number, or author.
2) We now gather patient encounter information from all of our extern students and provide student and site summaries for the extern director and for site preceptors. This is quite different than the clinic evaluations system used for our in-house students.
3) Patient encounters seen by our residents are also tracked with a dynamic web site and provides summary information. This site also has online continuing education modules built into it.
4) I have used the same technology to create a web site for the ASCO Informatics SIG, which is a repository for software created by and for optometric educators.

Conclusion

The online clinic evaluations project turned out to be much larger and comprehensive than first imagined but the end result has been a system that works well for us. The administration at my college has recognized the value in this project and has allowed me release time to develop and implement. In addition, the experience gained has been used many times in other endeavors. For me, the biggest reward of all has been the personal satisfaction of learning about new technology and solving programmatic problems while developing tools that have been affectively utilized by my students and the college as a whole.

I am not suggesting that all instructors spend the time and effort to learn the details of creating dynamic web pages, but knowing the capabilities of this technology may inspire their use in creating effective learner-centered teaching tools. My personal experience was that the initial project was no more complicated than learning to use WebCT, which I have worked with on a few occasions. Anyone who has an interest in computer programming, even with very little experience, or has IT support personnel, may want to consider using, at least, some of the basic functionality of dynamic web sites. Many schools and colleges do have instructional designers or IT personnel who could assist with the development of instructional dynamic web sites.

A number of insights were gained along the way and should be considered by anyone contemplating the use of this type of technology. First, before embarking on the project, it is very important to carefully design the database. A careful consideration of all appropriate data fields on the front end will maximize the end product's usefulness and efficiency. A second important suggestion is to ensure that the server used is reliable. Because large amounts of data and information will be involved in the project, the server must be both reliable and secure. A third key point is to make sure that the infrastructure is available to fully support the project. Computers used to enter the data must be accessible. This may involve the purchase of hardware, adding new space or reconfiguring existing space, and may also require the allocation of additional support personnel. As has so often been said, "Garbage In = Garbage Out." To eliminate data entry errors an important fourth consideration is to recognize the programming challenges required to create error traps. As a final consideration, it is important to realize that the process is never ending. As you utilize the technology, you will discover that there are always ways to improve upon the previous version.

Dynamic web pages provide a communication medium that is limited only by our innovation and cre-

ativity. The technology for storing, retrieving, manipulating and presenting information is particularly well suited for instructional uses and I would encourage educators to explore this emerging technology.

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4 Forta B, Camden R. *Macromedia ColdFusion MX7 Web Application Construction Kit.* Berkeley, Macromedia Press, 2005.

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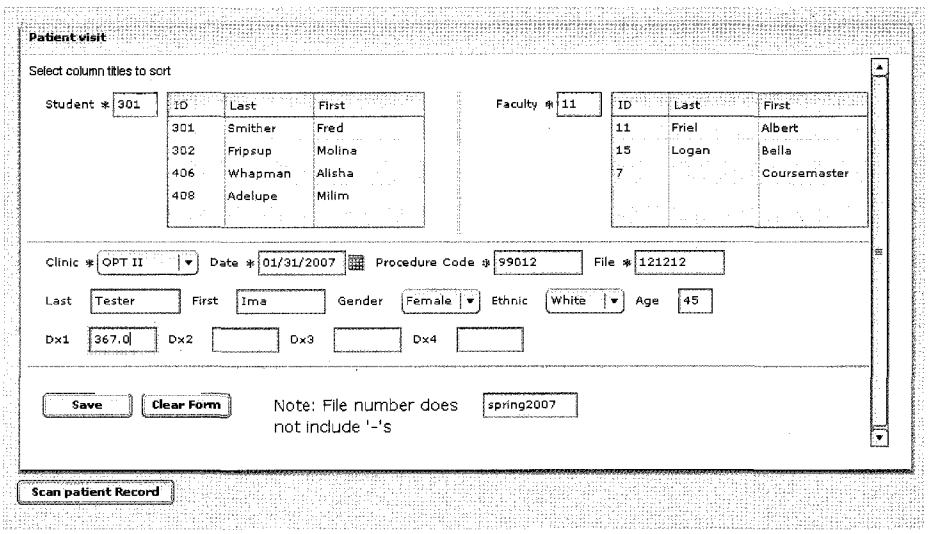
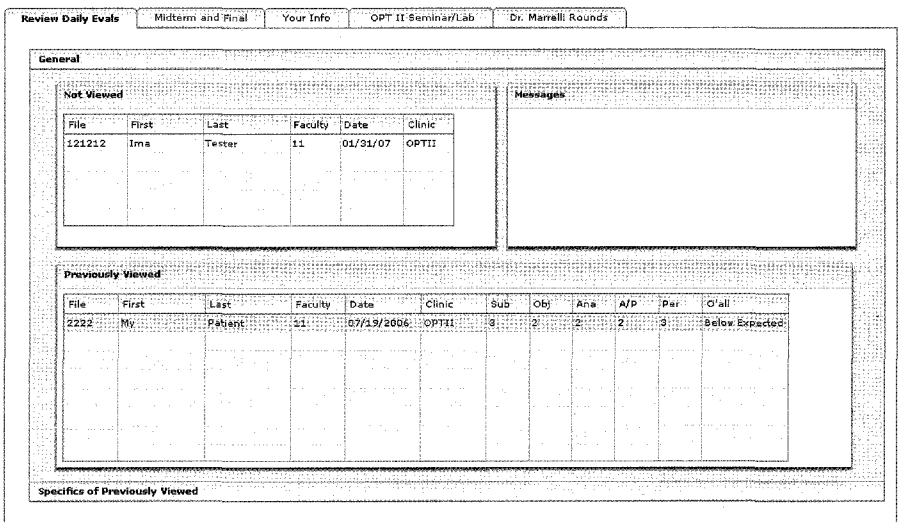
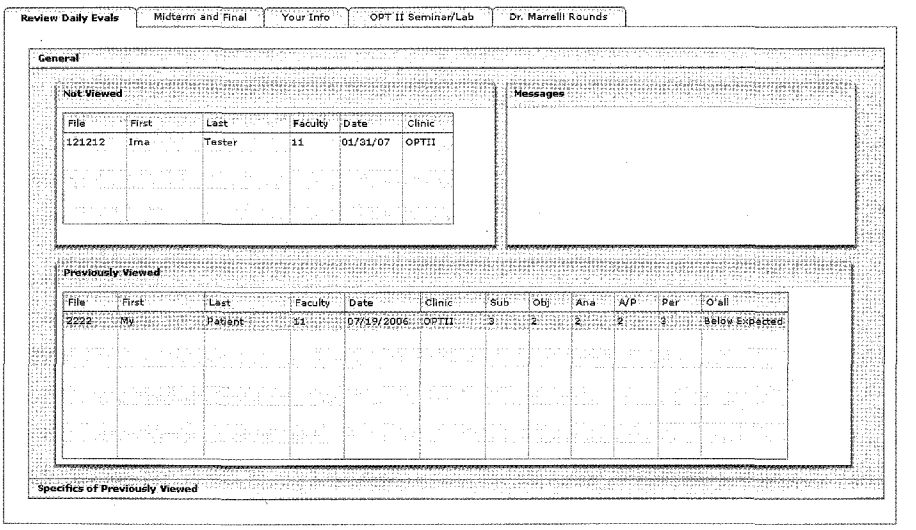
Addendum:



1 - Entering a new patient into the temporary folder for faculty to evaluate

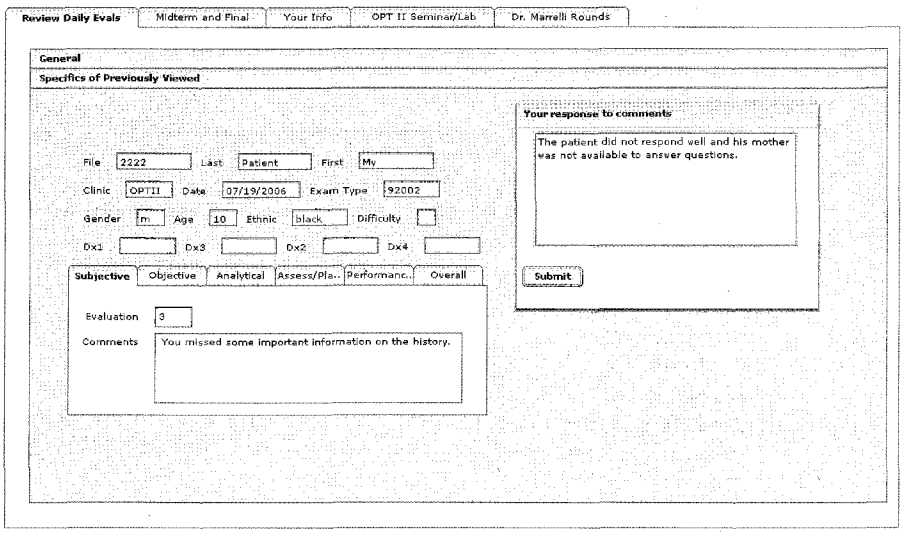


2a - Summary of patients separated by those previously viewed or not. Once a student views the evaluation, it is marked as "viewed" in the database and then is moved to the lower section.

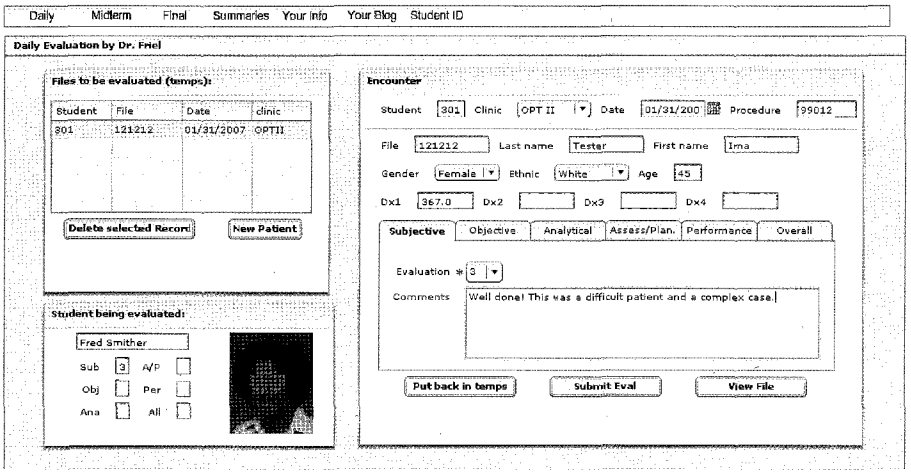


2b - Details of the evaluation that was selected in screen #2a. Included is the ability to respond to the comments by the evaluator.

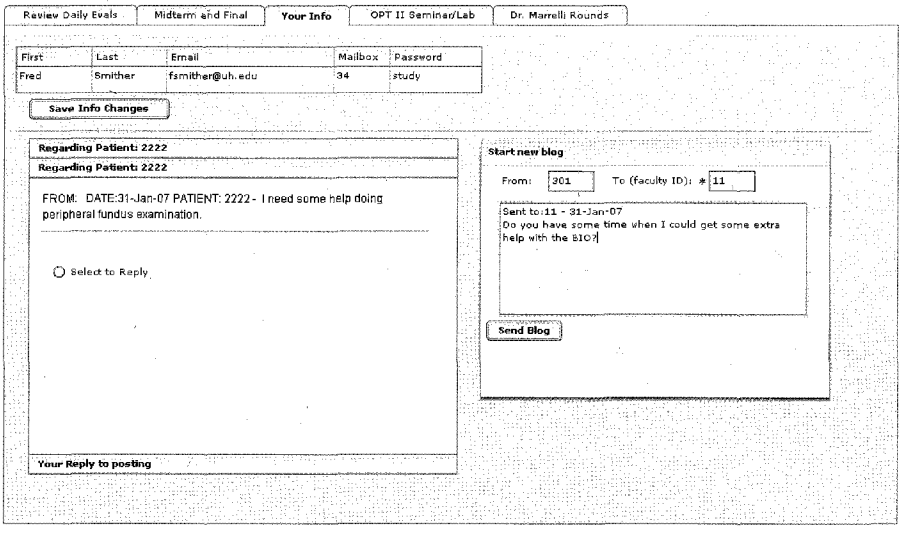
3 - Student personal information can be edited, blogs viewed, blogs responded to and new blogs started.



4 - Faculty forms for viewing the incomplete evaluations and for completing the evaluation. As a file is highlighted in the "temps" grid in the upper left, the student information is displayed in the lower left, and the patient encounter information is filled in on the form on the right, where the scores and comments are added.



5 - Faculty personal information can be edited in the upper form. The bottom section is for the faculty member to enter his/her assigned students for the semester.



Senior Optometry Students' Experiences With Information Technology in Optometric Practice

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Abstract

There is increasing use of health information technology (IT) in optometry practice. We sought to understand the perceptions of the current use of IT in optometry practice gained by optometry students during their practicum experiences. Six fourth year students, who had taken part in Canadian and American practice settings, participated in a focus-group interview. The students described varying degrees of IT use in optometry, as well as conditions that facilitate or challenge IT use in optometric practice. The students identified a need for greater preparation for the use of IT in the optometry curriculum.

Keywords: *information technology, optometry, clinical informatics, academic computing, optometric education*

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Introduction

As in other health care fields, there is increasing use of health information technology (IT) in optometry practice. Although computing skills have increased among optometry students[1] and prospective students may enter optometry school better prepared to use technology,[2] there is still a need for improvement in preparing optometry students for the technology challenges they will encounter as future practitioners.[2] After graduation, information technology and computing resources can play a major role in optometric practice.[3] Some optometry schools have increased the use of technology in their programs;[1,3,4,5,6] however little is known about the perceptions of optometry students on the use of IT in optometry, or about how optometry students should be prepared to build, and practice in, technology-enabled optometry practices.

Methods

In this study, a single interviewer conducted one 45-minute focus group interview with six fourth (final) year optometry students enrolled at the University of Waterloo, School of Optometry. The interview process followed current accepted focus group practices.[7] Briefly, focus groups use a focused interview process, using predetermined questions, to obtain qualitative data from a small group of similar participants. The aim is to find a range of perceptions and opinions, rather than to achieve consensus or make decisions.[7] Our focus group questions were aimed at understanding the perceptions of the current use of health information technology in optometry practice gained by senior optometry students during practicum experiences and the implications of these experiences for potential modifications to the optometry curriculum. The specific questions that were used in the focus group interview are provided in Table 1.

Students (3 female, 3 male) were recruited who had recently completed practicum experience in Canada and/or the United States and were soon to join the profession of optometry. Upon receiving consent from all students, the focus group interview was audio-recorded and transcribed to ensure the analysis accurately reflected the student's input. In reporting the results, all names and references were rendered anonymous by assigning numerical identifiers. The transcribed interview was inductively analyzed via a constant-comparative approach consistent with grounded theory methodology.[8] In this approach, commonalities among responses are identified by categorizing, coding, delineating and comparing each response. The participants' experiences with information technology in optometric practice emerged from their narratives.

This study was reviewed and approved by the Office of Research Ethics at the University of Waterloo.

Results

Description of Externship Clinics

Among the fourth year optometry students, there was a range in experience from having worked in clinics located in very small rural towns to those located in large metropolitan cities. All of the students had experience working in optometric clinics within Canada and half (three students) reported also working in practices located in the United States. The Canadian clinics included solo practices, partnerships and a group practice of four optometrists. Those with clinical experience in the United States reported working in clinics located in larger metropolitan areas

Table 1: Focus Group Interview Guide

1. I'd like to begin by asking each of you to say a few words about your primary care externship experience - where it was located, and what kind of practice it was.
2. How would you describe the use of information technology in this practice? Would you say that these practices are making extensive use of new technologies, or would you say their use of information technologies is fairly limited?
3. Were there some areas where you were surprised to see new information technologies or computerized systems being used?
4. Were there some areas where you were surprised that information technologies or computerized systems were NOT being used?
5. What do you think are some of the conditions that are facilitating or encouraging the use of information technology in optometry practice?
6. What do you think are some of the conditions that are barriers or challenges that are hindering the use of information technology in optometry practice?
7. What do you see happening over the next 10 years in terms of the use of information technology in optometry practice - what are some of the areas where you see IT increasingly being used?
8. Do you think that your experiences and training in use of information technologies, including pre-Optometry, in the OD program, and elsewhere, have adequately prepared you for use of information technologies in your practice?
9. What additional experiences or courses related to IT do you think would better prepare you for use of IT in your practices?
10. Do you have any other comments? Is there something any of you wanted to say on any of these questions that you haven't had a chance to say yet?

with a relatively larger patient base. The clinics located in the United States were comprised of both optometrists and ophthalmologists.

Use of IT in Optometric Practice

Information technology was described as serving a variety of functions in optometric practice. The optometry students indicated the following types of IT were used at their externship sites: desktop personal computers, intercom systems, Eyemaginations™ and Visulex™ software programs, internet and tablets. In one clinic, an intercom system was used as a means of communicating with staff. This form of message communication made things "a lot quicker." Software programs, such as Eyemaginations™ and Visulex™, were used in some clinics as a means of educating and counseling patients. Student 1 noted:

"Most of the technology was used for patient education so they did use Eyemaginations in one of them for patient counseling and education... they both had computers in the rooms so they would pull up the retinal photos or anterior seg. photos and be able to show them to the patients and reference that way..."

Comments made by the students suggested that the internet serves a variety of functions in optometric practice. In addition to educating patients about their diagnosis, the internet is used for billing, inter-professional communication and continuing education. Other functions of information technology in optometric practices reported by the students included computerized patient booking/scheduling and record keeping.

Varying IT usage patterns among externship sites, ranging from very minimal use to clinics having specialized technology, was evident. Some students were particularly surprised when a clinic demonstrated shortcomings in technology use. Acknowledging the lag in technology in one office, Student 3 noted, *"I was surprised to see DOS in one office...I guess it was a little PC and they didn't use any technology...they just loved the DOS-based."* Reinforcing this idea, Student 1 explained:

"I visited a practice, I didn't work at it but I visited one where there wasn't a computer in the entire place, they had their own edging lab, they had everything, it was a one doctor practice, and everything was manual, even on the secretary's desk, there was no computer. I don't know how she wrote reference letters or whether she took them home to write them up, but there was no computer in the entire office."

Regardless of whether a clinic was well or newly established, comments made by some students suggested that computerizing a clinic and familiarizing staff with information technology was not necessarily an extremely difficult task. During one externship, Student 6 witnessed the implementation of a computerized booking and dispensary system. Student 6 explained:

"The staff was pretty frantic for a while...But it worked out well and there weren't really a lot of glitches. Initially they found it was slower and then things started to pick up once they figured out how to use the system ...I mean within a couple weeks for most of the staff, they were able to do what they wanted to do with the system — they didn't really have a lot of troubles. There were one or two staff members who spent weekends working on it and getting really proficient at it, so if there was trouble, they were there to help people out."

Student 1 added:

"...at the place I was at, it was all new staff and all the booking and billing and dispensary was all electronic and there was a lot of new staff and they picked it up right away. Luckily the optometrist knew all the stuff they'd be doing so if they had any questions, he was able to answer them, but they picked it up really quickly."

In general, solo practices, consisting of more than one optometrist and/or ophthalmologist, used less information technology in their practices compared to larger scale practices.

Benefits and Conditions Facilitating the Use of IT in Optometric Practice

The students were asked about the benefits of IT use, and whether they felt there were conditions or factors that encouraged, supported or facilitated the use of information technology in optometric practice. The students' comments suggest patients appreciate optometrists using IT as an educational vehicle. Student 5 explained,

"I think patients really appreciate when you have the computer in the room and they ask you a question, if you don't know, or if you know but want to show them a picture, or give them a slightly better definition or description, you can look it up right there for them, and show them. Like we were saying before, they really like that and I think the patients really appreciate it."

Student 3 added,

"Even the prescription - when you can show them all the different prescriptions over the last few years, the different appointments, they get a feel of why it's

changing - if you have a cataract or something - and give them a better explanation about the numbers, right on the screen, all in a nice kind of layout."

In addition to educating patients, the students pointed out that using IT may add value to their service as optometrists. Student 6 stated, *"I think they're mostly value added, you know like if the patient sees you're using the new, the newest technology then they might perceive greater value in your service"*

Inter-professional communication was also recognized as a benefit of using IT in optometric practice, especially for those practices located in rural communities. Student 2 described:

"Even video feeds, like I know now they say you can send videos of VAIO over the internet to ophthalmologists and stuff like that so they can be watching you as you're hooked up to the camera through the VAIO kind of thing. I can see that in a rural setting where the patient may be, it's not easy to go three hours to get in to an ophthalmologist, that's something that could be done more."

The idea of having permanent patient records was also viewed as an important benefit of using IT in practice. Student 4 explained.

"I think the biggest aspect I ran in to was recording, if you don't have like a fundus camera, you don't have a slit lamp camera, recording just based on your words, where scars are or what have you without drawing anything, it's tough especially where I was because the doctor would switch every week who was coming up. So if you were following up patients you had no one that saw that patient last and all you had to rely on was what someone typed in as far as recording."

In agreement with Student 4, Student 5 noted:

"I think just having a permanent record, like photos, I think that really adds to quality of care, especially if you're in a practice where there might be different people seeing the patient different times. It's nice to have that permanent record instead of just drawing, so that's where technology comes in..."

The students also acknowledged the time saving advantage of using IT in practice. Student 4 pointed out:

"I'm all for technology and I think it's great that optometry is on board and it's good. In the paperless office, it's a much more effective system and you're so much faster with everything that it just makes everything a little bit more smooth, once everyone understands it, especially for contact lenses and lenses. You can actually, just right off the computer, submit your request for a trial pair of torics - it's so much faster even than to go to the secretary."

Challenges Associated with Using IT in Optometric Practice

Although the students recognized the advantages of using information technology in optometric practice, associated challenges did not go unnoticed. One area of concern focused on the initial investment and operating costs associated with implementing information systems. Acknowledging cost as a major concern, Student 6 explained:

In the paperless office, it's a much more effective system and you're so much faster with everything that it just makes everything a little bit more smooth...

"Cost is a big one, yeah. I mean, I was trying to persuade some of the guys in City X to think about getting a retinal camera or something like that and they're like 'No, that's too expensive - if I buy a camera I'm going to have to buy a computer, and that means in four or five years I'm going to have to buy another computer, and another computer' and I'm like, 'They're not that expensive', but I can see their point."

Another issue raised was patients' perceptions of higher exam fees, especially in rural clinics, where patients may believe technology is not necessary. Student 2 makes reference to this issue stating:

"I think in a lot of rural settings there's a lot more hesitation because patients aren't as willing to pay for this kind of technology. Even in Town Z, they'd rather you not charge more and you know, have all the technology. I mean they're more the type that 'I want the toughest glasses on the wall', you know what I mean...it's the idea that even in a small town you don't drive a fancy car..., everybody knows everything, so it looks like you're - I don't know - maybe making too much money if you've got too much technology in your office."

Although time was viewed as a benefit of using IT in practice, it was also a limiting factor. As one students mentioned, *"When our server went down too we couldn't do anything, just sit around and wait for the computer guy to come."*

Although some of the students' experiences suggested that implementing an IT system was not extraordinarily difficult, there was also an indication that the time commitment necessary to computerize and transfer paper records to a computerized system could be a concern. Student 1 explained:

"I think part of it, you know it was what was mentioned before, if you've got an established practice with paper records and that's how you've been doing it for a long time and it's a system that works for you, to actually overhaul everything and to make that big change to go to electronic record keeping or something like that, it's a huge undertaking. So it's something that you don't really know whether the benefits and the efficiency are going to be worth the time it takes to make that big switch."

The final challenge associated with using IT in optometric practice related to the age of the support staff who worked in the clinics. The students indicated that older staff members are more resistant to change and some may even fear technology. Student 3 remarked, *"They're great with the current system, it's just a resistance or a fear maybe of moving towards something."* Adding to this idea, Student 6 explained:

"We had one staff member that hated the computer, like hated the computer and she was older, very, very senior, probably the most senior member of the staff except for the OD. And she really had to be sort of persuaded gently into starting to use it, so from what I hear now she's doing really well with it, still doesn't use it as much as everyone else and prefers to write up the orders rather than put them in the computer, but she's coming around."

Future Use of IT in Optometric Practice

During the focus group interview, the students commented on what they foresaw happening in terms of the use of information technology in practice

over the next ten years. One concern expressed was security and privacy issues. With the emerging trend of transferring patient information through email, or potentially electronic records, some students feel the need for stricter laws to protect patient privacy. The students anticipate the eradication of fax machines in labs and dispensaries because of the time and cost efficiency of using email. The students also mentioned that inter-professional communication through the internet will become much more prevalent, especially in rural clinics where specialists may not be readily accessible. Student 4 noted:

"Inter-professional communication, being able to send things back and forth, getting second opinions by email, and sending photos, if protected properly, that kind of thing."

Educational Experiences and Future Recommendations

Another area of interest was whether the students felt their experience and training, either before or during the optometry program, or anywhere else, adequately prepared them for the use of information technology in optometric practice. The general consensus among the students was that they did not have enough experience with or exposure to information technology during their academic career. Contrary to popular thought, even though today's students are from a more technologically advanced generation, one should not assume that everyone is computer savvy. Student 6 explained:

"I personally don't feel like it has, I think one of the things that the school doesn't use here all that much are ways, for booking or something like that, we're not all that exposed to it, and so with that, not that much and then personally in my undergrad experiences, I've kind of had a very limited experience with it, so when I was on my externship, the optometrist would kind of assume because I'm the younger generation that I would be up on everything, and I'm not really, so I don't feel like I have the advantage over anybody 20 years my senior really."

Agreeing with Student 6, Student 1 mentioned:

"In our program we don't get really any computer exposure, it's almost kind of scary when you start doing group projects and stuff with people and then we do PowerPoint and then learning how little people actually know in our program about computers and even how to do the simplest things. I don't know if any of us come from a computer background in our class, it doesn't seem the trend for computer savvy people to be in optometry, we don't really have any. We don't really have any training in the program with it either, so I think that, that and my other group, are really lacking."

The students were asked to comment on what additional experiences or courses related to information technology they felt would more adequately prepare optometry students for "real-world" practice. The school-based optometry clinic is in the process of implementing an electronic record system,[9] and students felt that its introduction in the pre-clinic (the training clinic for optometry students) was a positive change for the optometry program. *"I think its going to be good when they have the free clinic computerized, I think that will be really good for people to just play around on and experiment with and sort of, I think it's a good idea"*. The students felt they needed more hands-on experience working with information technology, but acknowledged the challenge of becoming familiar with the variety of clinical software programs available. Student 2 pointed out:

"I question whether we really need a specific course, I think it's more about just using the programs say in the pre-clinic or whether it be in a clinic in the future. I think that, someone made a good point, I mean they're so different, I saw three different systems in three different clinics - I mean to think that just because you use one that you'd be good at using the other, I think you should have some exposure."

I think its going to be good when they have the free clinic computerized, I think that will be really good for people to just play around on and experiment with...

Suggestions to familiarize students with software programs included lecture based instruction as well as access to computers equipped with trial software. Student 5 suggested:

"Or I mean even in 4th year when we have all the different companies come in, maybe if a couple of them wanted to come in and give a one hour presentation on their different versions of products, just so that we're aware of what's even available to us. Because I don't think a lot of people know what's out there, you know, there are so many programs."

Student 1 added:

"Or even just having one computer or a couple computers somewhere where you could just play around with it yourself and just you know, see if it was something you would want to do, just being able to actually get your hands on it and mess around in it, that would be useful for our needs."

Discussion and Conclusions

This study is limited by the small number of students interviewed and by the fact that it was carried out in only one optometry school. Although the sample was small, we believe we were able to reflect a fairly representative cross-section of optometry practices, including rural, urban, Canadian and U.S. practices. We also feel that the study has yielded important insights into the current use of IT in optometry practice, and in the preparation optometry students receive in this area.

Even within this small sample, the students described a wide range of IT use in the practices in which they had undertaken their practicum experiences. This suggests that there continues to be wide variability in IT use in optometry, and that optometry practica are unlikely to provide consistent experience or exposure to the use of IT. At this point, it is also clear that there is limited exposure to IT in the coursework and clinical experiences undertaken at the optometry school.

Technology can facilitate the introduction of new material to students in health professions, and can also serve to reinforce concepts taught in the classroom.[3] In addition to having the

proper resources, students must be exposed to and taught how to use electronic information sources before they can effectively use them.[3] Introduction of an electronic optometric record at the University of Waterloo School of Optometry clinic and pre-clinic is seen as an important step in our setting, and increased exposure of this nature is valuable.

The students' comments suggested that persons attracted to the field of optometry are not necessarily computer savvy, and their introduction to technology may need to include basic computer skills, as well as the use of advanced clinical technologies. Today's optometry students may represent a transitional generation with respect to computer use;[4] therefore one might expect that future students will be better prepared to meet the challenges associated with information technology in practice. The students noted a challenge in the large number of different IT systems that are available and that use of one system may not provide specific preparation for all systems they may encounter. Nonetheless, there are likely to be advantages of sensitizing students to IT use, regardless of the system used. Perry has pointed out that "the development of informatics instruction in optometric curriculum can broaden awareness of the importance of pro-active information seeking by optometrists, and of the existence of skills and tools to actively support health professionals' pursuit of lifelong learning."[2]

The use of IT may be a key element in the future success of optometry practices, in an increasingly competitive marketplace. This study has pointed to the need for increased exposure to the use of IT throughout the optometry curriculum.

We are continuing to study the current and future use of IT in optometry practice. The focus group interview results have been used to help guide the development of a survey questionnaire on IT use that we plan to distribute to a sample of Canadian optometrists.

Acknowledgments

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The Oculomotor Suite: Educational Software for the Interactive Demonstration in the Classroom of Strabismus and Oculomotor Paralyses

Scott B. Steinman, O.D., Ph.D.

Introduction

Eye movement testing is an integral part of the complete optometric examination,[1] and is especially important for the diagnosis of vergence anomalies and oculomotor paralyses. The basic science optometric curriculum therefore includes the actions of the extraocular muscles and neurological bases for eye movement control, while clinical courses cover clinical techniques for assessing eye movements, including the cover test, oculomotor testing in the six diagnostic positions of gaze, and the Parks-Bielschowsky three-step test.[2,3]

Unfortunately, students receive little practical training in diagnosing eye movement anomalies because their laboratory courses involve practice solely on young, normal subjects. The students' opportunity to evaluate abnormal eye movements during their didactic training is limited to video presentations of patient examinations during lectures or simulations of comitant strabismus using prisms in the clinical laboratory. Therefore, their first real exposure to performing eye movement testing on individuals with oculomotor abnormalities is when they see patients during their clinical rotations.

Simulations can fill this gap in their education. The Oculomotor Suite, developed by the author with three-dimensional graphics by Dr. Barbara Steinman, is a collection of three computer programs that dynamically and interactively demonstrate eye movement anomalies: *Cover Test* demonstrates how to interpret the cover test in the presence of horizontal and vertical phorias and tropias. *Paralyses* demonstrates standard oculomotor testing procedure in the six diagnostic positions of gaze in the presence of disorders of the cranial nuclei and nerves. *Parks 3-Step* explains the interpretation of the Parks-Bielschowsky three-step test in the presence of vertical oculomotor deficits. The programs are available from the author at www.software-in-motion.com.

Abstract

A complete grasp of eye movement testing, especially as it relates to patients with oculomotor paralyses, is essential for the clinical optometrist. While the cover test, oculomotor testing in diagnostic positions of gaze, and the Parks-Bielschowsky three-step test are taught in eye movement, neuro-optometry and vision therapy courses, students receive little practical training prior to seeing patients because their clinical laboratory courses involve practice on normal subjects. The Oculomotor Suite is a collection of three educational computer programs that interactively demonstrate oculomotor testing using diagnostic positions of gaze, the cover test, and the Parks-Bielschowsky three-step test in simulated patients with strabismus, oculomotor nerve paralysis or cranial nucleus damage. It allows the classroom instructor to explore the following principles about clinical eye movement testing:

- *The unilateral cover test for the diagnosis of horizontal or vertical strabismus or dissociated vertical deviation*
- *The alternating cover test for the diagnosis of horizontal or vertical phoria*
- *The use of the prism bar to measure the angle of deviation*
- *Differentiation between the motion of the covered and uncovered eyes*
- *Determination of the muscle tested in diagnostic positions of gaze via muscle field of action*
- *The effect of eye muscle paralysis and cranial nerve palsy on oculomotor function*
- *Usefulness of ptosis and pupil size in the diagnosis of oculomotor paralysis*
- *Easy diagnosis of vertical eye muscle paralyses with the Parks-Bielschowsky three-step test*

Keywords: *Software, vision science, clinical, eye movements*

Program Features and Application to Classroom Instruction

Cover Test

The Cover Test program (see Figure 1) is a simulation of the unilateral and alternative cover tests. The patient's eyes may be covered by either an opaque or translucent occluder, allowing the student to see the movement of the eye behind the occluder and differentiate between motion of the covered and fixating eyes. The instructor may select a phoria or tropia, or a dissociated vertical

Dr. Steinman is a professor at the Southern College of Optometry.

deviation. The direction and magnitude of the deviation is also selectable. Deviations may be unilateral or alternating. At any time, the diagnosis can be displayed in the window or hidden from the students.

By using this program, the instructor can demonstrate how to diagnose a constant or alternating horizontal strabismus, a vertical strabismus or a dissociated vertical deviation with the unilateral cover test, or a horizontal or vertical phoria with the alternating cover test. In addition, a prism bar may be introduced and moved vertically so that the prism power is varied, allowing the magnitude of the phoria or tropia to be measured precisely.

Paralyses

In combination with the cover test, oculomotor testing in the six diagnostic positions of gaze is the most commonly used optometric procedure for diagnosing neurological oculomotor anomalies. The Paralyses program (see Figure 2) is a simulation of this procedure, using the mouse pointer as the fixation target that is moved in front of the patient's eyes; the user moves the mouse and the eyes follow it. A number of oculomotor disorders may be selected, including paralyses of individual extraocular muscles or paralysis of the third, fourth or sixth cranial nerves. A third cranial nerve palsy may be partial or full, with or without pupillary involvement. When a third cranial nerve palsy includes a ptosis, the ptotic lid may be held open to observe the obscured eye. By including the lid and pupil consequences of a third nerve palsy, students learn to make finer-grained diagnoses.

As the mouse is moved in the typical "H" pattern of the diagnostic positions, the student can be shown into which muscles' fields of action the patient is attempting to make an eye movement. This helps to reinforce which muscles are tested in each diagnostic position of gaze, as well as show which muscle (or combination of muscles) is restricted in action by the paralysis. After observing the eye movements, the instructor may select the Show Diagnosis checkbox and reveal the diagnosis to the students.

In addition to displaying the results of specific palsies, the program allows the selection of a random muscle or nerve palsy, permitting the use of the program as a self-learning and self-testing tool for students.

Figure 1: The Cover Test program.

The patient's eyes may be covered by either an opaque or translucent occluder, allowing the student to observe the actions of both the uncovered and covered eyes. Prism may be introduced and its power changed so that the magnitude of the phoria or tropia can be measured. Vertical and horizontal phorias and tropias of various magnitudes, as well as dissociated vertical deviation, may be simulated.

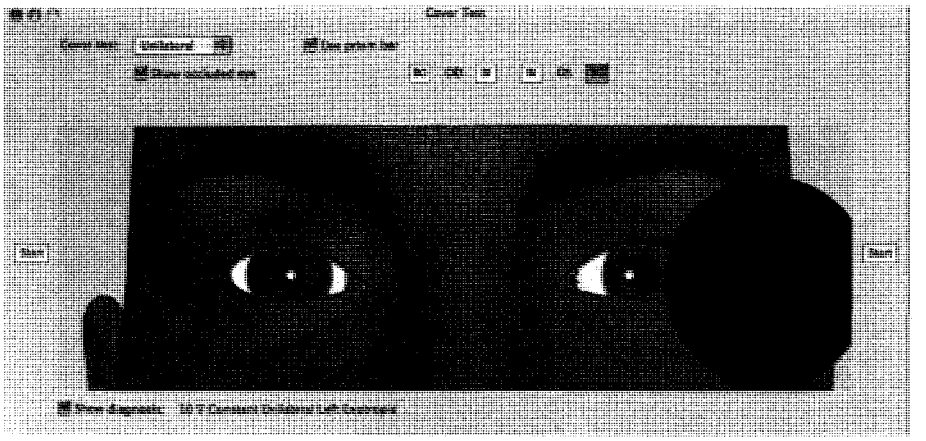
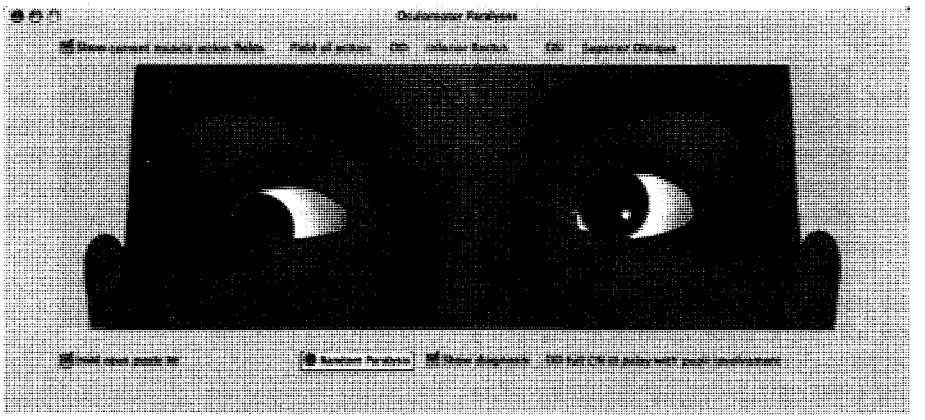


Figure 2: The Paralyses program.

The mouse pointer acts as the target that the patient tracks. The extraocular muscles in each eye whose field of action is entered can be displayed. Involvement of isolated extraocular muscles or lesions of specific cranial nuclei may be selected, or a random condition may be selected to test the student's knowledge. For third cranial nerve palsies, a ptosis is displayed and the presence or absence of pupillary involvement can be selected. When a ptosis is present, the lid may be held open to view the position of the eye.



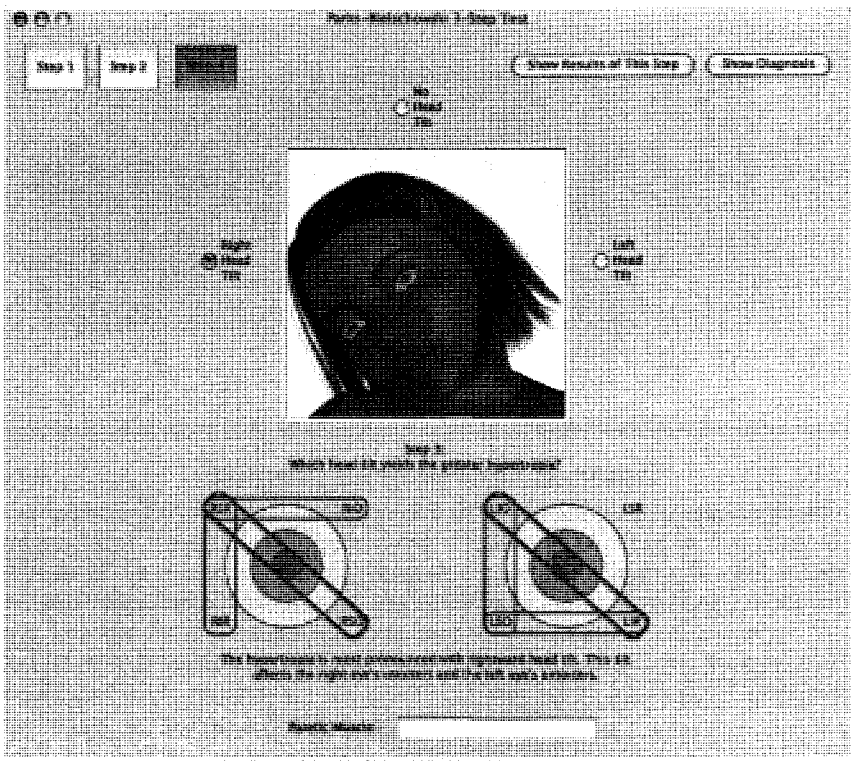
Parks 3-Step

The Parks-Bielschowsky three-step test, while used less commonly in clinical practice, is an indispensable tool for differential diagnosis of deviations due to paralysis of the vertical rectus or oblique muscles. However, optometry students rarely have an opportunity to perform this test on patients with paretic vertical eye muscles. The Parks 3-Step program (see Figure 3) is a simulation of the Parks-Bielschowsky three-step test in the presence of paralyses of the vertical rectus or oblique muscles.

By selecting each successive step of the Parks-Bielschowsky three-step test, the student is shown a patient's vertical deviation in primary gaze, on leftward versus rightward gaze, and on leftward versus rightward head tilt, respectively. No other information is displayed unless the Show Results of This Step button is clicked,

Figure 3: The Parks 3-Step program.

The user selects each step of the procedure in sequence. A child's face, with a vertical deviation, is displayed. The specific muscle affected may be explicitly or randomly selected. In step 2, the eye position is displayed as a function of direction of horizontal gaze; in step 3, the eye position is depicted in the presence of a head tilt. At each step of the procedure, an explanation may be optionally displayed, including a diagram of which eye muscles have been isolated by that step of the procedure and which muscles remain viable suspects in terms of involvement in the disorder. At the end of the test, the final diagnosis may be displayed.



allowing the student to view in the lower half of the window an explanation of the current step, including which muscles are isolated. In the example shown, the third step of the procedure is displayed, in which the vertical deviation is assessed while the patient's head is tilted towards the left or right shoulder. The patient's vertical deviation is greatest on head tilt toward her right shoulder. The explanatory text for this step indicates the vertical eye muscles responsible for the cyclorotary eye movements during the head tilt. In addition, a diagram of the eyes and the vertical eye muscles depicts with black ovals the muscles that have been already assessed by the previous steps of the test, while the red oval indicates the muscles isolated by the present step. This graphical means of narrowing down the affected extraocular muscle is the one commonly used by neuro-ophthalmologists. After the three steps have been completed, the paretic muscle — the final diagnosis — can be displayed both graphically and textually by clicking on the Show Diagnosis button. The specific muscle affected can be randomly selected, allowing the student to test his or her diagnostic skills.

Future Directions

The Cover Test program is currently being revised to include intermitted strabismus and to allow testing in different positions of gaze, therefore adding the simulation of A-V pattern tropias and noncomitant strabismus. Cyclorotary deviations are also being explored. The Paralyses program currently contains simulations of extraocular muscle and cranial nerve paralyses, but a future version will add other eye movement anomalies such as internuclear ophthalmoplegia. A pupil testing program is in the works. Feedback and feature requests from optometric faculty are encouraged.

The Oculomotor Suite represents just three of a collection of fifty computer programs written by the author to demonstrate and simulate vision science, optics and clinical optometric principles in the classroom. While basic science demonstrations and simulations allow students to internalize many of the principles they are learning in the classroom, clinical procedure simulation programs are even more significant because they also help correct a shortcoming in the education of optometry students — the lack of availability of large numbers of patients with specific ocular disorders with whom they may hone their clinical diagnostic skills. Well-designed simulation programs that mimic a patient's response to an optometric examination procedure can allow the student to bridge the gap from the theoretical concepts and instructions on how to perform the mechanics of a procedure to critical thinking and diagnostic application of these procedures to real-life clinical entities. In addition, they may expose the student to a wider gamut of clinical disorders than randomly encountered during their clinical internship. With the widening use of computer technology in all fields of instruction, the future of optometric education depends upon the foresight of optometric administrators to encourage and support the creation of simulation software by basic science and clinical faculty.

Disclosure

The author is the programmer for Software in Motion, a company that provides research consulting, optometric textbook illustration and optometric educational, research and clinical software. To date, all software products have been provided for use by optometric educators at no charge. If, at a future date, software products are sold, disclosure of the costs and educational discounts will be clearly stated on the Software in Motion web site and in articles describing such software .

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Ray Trace: Software for Thin Lens and Thick Lens Refraction in the Classroom

Scott B. Steinman, O.D., Ph.D.

Introduction

A significant topic in geometric optics courses is ray tracing through lenses.[1] Students typically learn about these topics via static PowerPoint slides that display the mechanics of ray tracing through thin lenses at specific object distances such as optical infinity, the focal distance or twice the focal distance. A table then is used to display the different object-image relationships at specific object distances. Students memorize these object-image relationships for later recall on examinations, but do not internalize how object-image relationships continuously change as a function of object distance. A second difficult concept to grasp concerns the changes in the relative positions of the cardinal planes of thick lenses change as lens surface curvature, index of refraction and thickness are modified.[2,3] Here, too, instruction tends to depend heavily on static graphics. Unfortunately, these topics are also difficult or impossible to reinforce with laboratory assignments using optical benches.

Simulation software can greatly aid the demonstration of thin and thick lens optical properties and allow students to interactively observe changes in the characteristics of lenses as lens parameters are modified. Ray Trace is a set of two educational computer programs — Ray Tracing and Thick Lenses — written by the author that graphically demonstrate ray tracing through thin and thick lenses, respectively, at any object distance, for both real and virtual objects, as well as the locations of the cardinal planes of thick lenses of various shapes.

Abstract

Optometry students typically learn about ray tracing through static classroom slides that present objects at specific distances from a lens (e.g., within, at, or beyond the focal length, and at optical infinity). This makes it difficult to internalize how the ray tracing procedure works and how object-image relationships change as a function of object distance. Ray Trace is a set of two educational computer programs — Ray Tracing and Thick Lenses — that graphically demonstrate ray tracing through thin and thick lenses, respectively, at any object distance, for both real and virtual objects. A continuous range of object distances may be used and interactively changed, allowing the student to view the changes in object-image relationships as a function of object distance. The calculated image size, distance and magnification as well as the lens cardinal points are also displayed. Ray Trace allows the classroom instructor to explore the following optical principles.

- *The ray tracing procedure for thin and thick lenses*
- *Object-image relationships for real and virtual objects, including image size, distance, type and magnification*
- *The effects of thick lens index of refraction, surface curvature and lens thickness on the location of the front and back surface cardinal points and equivalent power*

Keywords: *Software, optics*

Program Features and Application to Classroom Instruction

Ray Tracing

The Ray Tracing program (see Figure 1) teaches the optometry student how to perform ray tracing with thin spherical lenses. Plus or minus lenses of powers up to 20 diopters may be selected in quarter diopter steps. Changes to the lens power automatically update the positions of the primary and secondary focal points, the principal rays and the object-image relationships, in both the numeric and graphical displays.

What is most important about the program is that the object distance and size can be dynamically and continuously changed, with the resultant changes to the ray trace and the object-image relationship instantly displayed. The object and image properties are displayed in numerical format at the bottom of the window, while the top of the window portrays the ray tracing diagram graphically. The object and image are differentiated by distinct colors — green for the object and red for the image — as are the object-side and image-side focal points and points at twice the focal distance. Real

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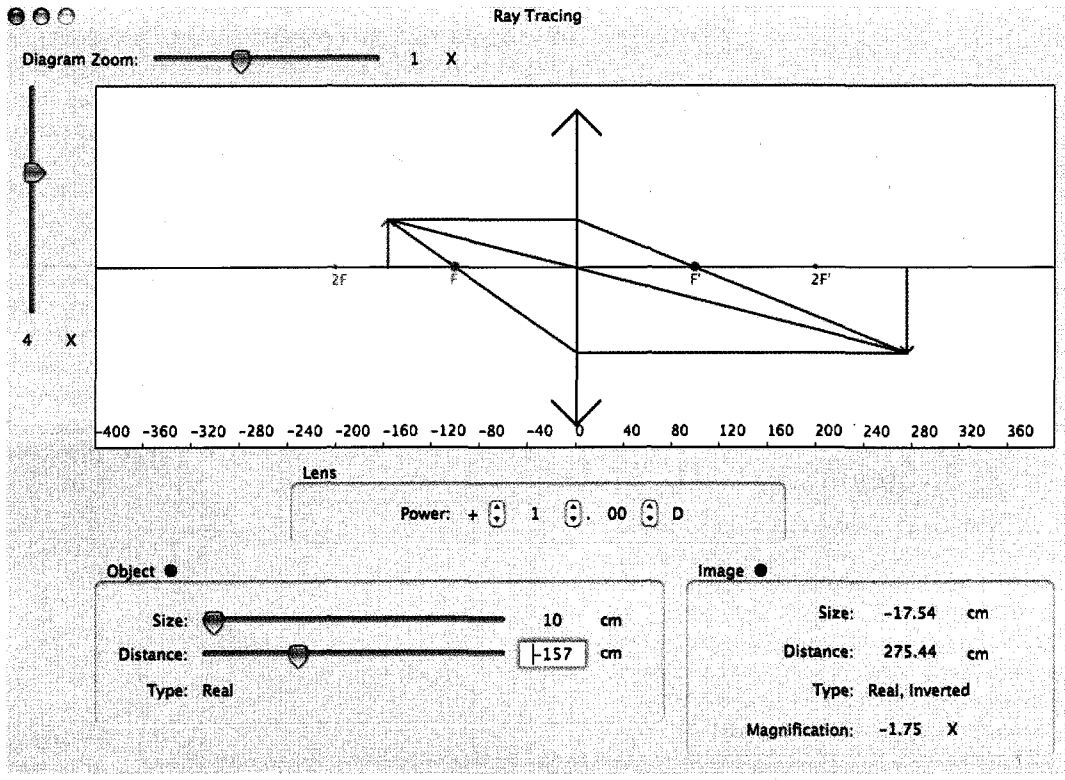
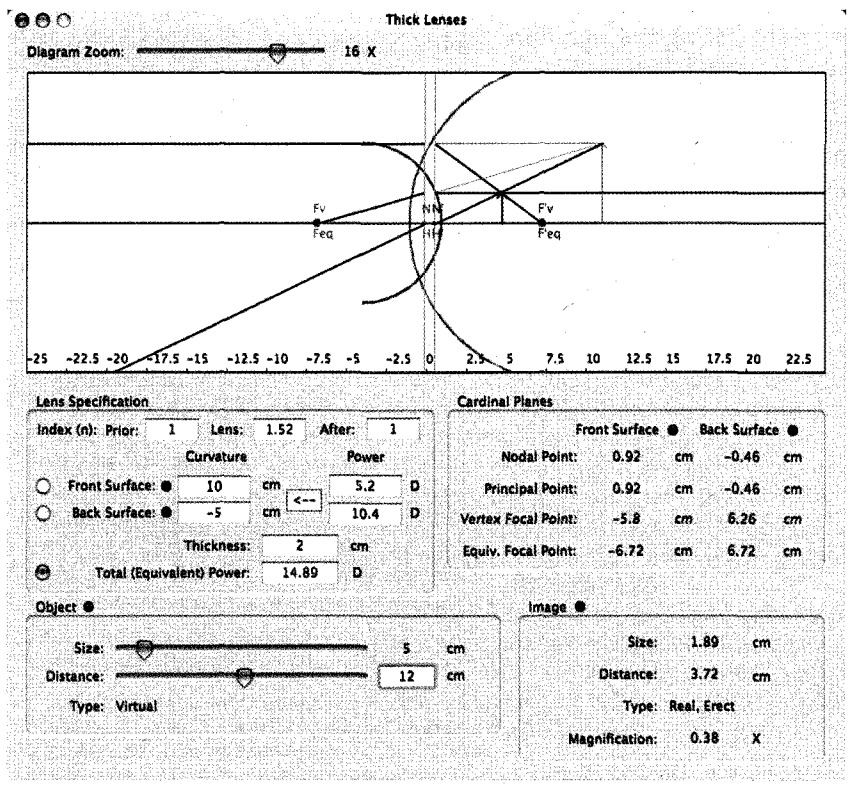
Figure 1



The Ray Tracing program. The lens power may be set to any power up to 20 D, either converging or diverging, with the lens' primary and secondary focal points of the lens indicated as well as twice the focal length. Different colors are used to differentiate the object from the image, including their respective focal points and rays. The object distance and height can be adjusted, as can the horizontal and vertical scale of the ray tracing diagram to allow for the viewing of large object distances or heights. The image position, height, orientation (erect versus inverted), type (real versus virtual), and magnification are calculated and displayed, with the three principal rays though the lens plotted. The object distance can be dynamically changed to view the changes in ray paths and image position, height, orientation, type and magnification as the object is moved from negative infinity to the primary focal point, within the focal point, or beyond the lens (i.e., virtual object).

Figure 2



The Thick Lenses program. All of the capabilities of the Ray Tracing program are also present in the Thick Lenses application, with the addition of calculations and graphical representations of the cardinal planes of thick lenses. The user may calculate the front and back surface radii of curvature from the surface powers, or vice versa. With two of the three values of front surface power (or curvature), back surface power (or curvature), and lens equivalent power, the third value may be calculated using lens thickness and index of refraction relative to the surrounding media in front of and behind the lens. Changes in the lens surface curvatures, lens thickness or indices of refraction will change the displayed positions and values of the nodal points, principal points, vertex focal points and equivalent focal points.

objects and images are distinguished by thick lines and saturated colors, while virtual objects and images are drawn with thin desaturated lines. The principal rays used in ray tracing through the lens center, primary focal point and parallel to the optical axis are drawn in thick blue lines. Where the rays must be projected to meet at a virtual object or image, they are drawn as thin, light blue lines. The graph's scale can be changed in both the vertical and horizontal dimensions to allow the user to zoom into a small object or image or to see the object-image relationships with short object or image distances. Similarly, long object or image distances can be handled by zooming out.

The instructor can demonstrate how the image size (and magnification) and distance change continuously with object distance from negative infinity to the primary focal point, within the focal point, or beyond the lens (i.e., virtual object). Students can also see directly how object distance affects the image type (real versus virtual) and orientation (erect versus inverted).

Thick Lenses

The concepts learned in thin lens ray tracing are built upon when the student encounters thick lenses. However, the student must now also add the concept of cardinal planes, lens thickness and shape, with their effects upon the process of ray tracing. The Thick Lenses program (see Figure 2) has all of the features of the Ray Tracing program, plus special features unique to the instruction of thick lenses.

The Thick Lenses program displays a lens as two spherical surfaces separated by the lens thickness. The user may select the lens surface properties, to be discussed below, lens thickness and the indices of refraction of the lens and the surrounding media in front of and behind the lens. By independently varying the refractive index on either side of the lens, the cardinal planes may be moved so that they are not overlapping and can therefore be appreciated as representing different concepts.

The lens surface curvatures and powers, as well as the total (equivalent) power, can be modified by the user in several ways. The user may select to either: (1) have equivalent power determined by the front and back surface powers, (2) have back surface power determined by the front surface and equivalent powers, or (3) have front surface power determined by the back surface and equivalent powers. In addition, the user may calculate the front and back surface radii of curvature from the surface powers, or vice versa. Changes in the lens surface curvatures, lens thickness or indices of refraction will instantaneously change the displayed positions of the nodal points, principal points, vertex focal points and equivalent focal points on the graphical display, as well as their numeric values in the Cardinal Planes section of the window.

The interactive nature of the Ray Tracing and Thick Lenses programs allows the student to experiment with object and lens properties and immediately see the effects on the ray tracing diagram and object-image relationship.

An object is displayed at a user-selectable distance so that ray tracing may be performed with the thick lens. In this display, the principal rays are traced relative to the cardinal planes. The student therefore can see the similarities between the ray tracing procedures for thin and thick lenses.

The interactive nature of the Ray Tracing and Thick Lenses programs allows the student to experiment with object and lens properties and immediately see the effects on the ray tracing diagram and object-image relationship. The program can therefore be used in either the lecture classroom, as a tool for the laboratory classroom, or as a self-paced learning tool for students outside of the classroom.

Availability

Ray Trace represents just two of a collection of fifty computer programs written to date by the author to demonstrate and simulate vision science, optics and clinical optometric principles in the classroom. The programs are available for both Mac OS X and Windows from the author at www.software-in-motion.com.

Disclosure

The author is the programmer for Software in Motion, a company that provides research consulting, optometric textbook illustration, and optometric educational, research and clinical software. To date, all software products have been provided for use by optometric educators at no charge. If, at a future date, software products are sold, disclosure of the costs and educational discounts and in articles describing such software will be clearly stated on the Software in Motion web site.

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Incorporating Genomics into Clinical Optometric Care — A Necessity

Jerry Rapp, Ph.D.

The author has twice previously[1,2] (the first time over a decade ago) exhorted organized optometry to develop programs that would incorporate an exploding ocular genomics knowledge base into practical clinical care. Now, largely as a result of a series of articles earlier this year in *Archives of Ophthalmology* (Jan. and Feb., 2007, issues), the author is making a third and final attempt to alert the powers-that-be to the importance of this issue and urge that immediate action be taken to implement appropriate programs at our educational institutions and in the delivery of clinical optometric care.

The previous pieces[1,2] concentrated on the utility of incorporating genetic counseling into standard clinical optometric practice and focused on the relationship between genotype and phenotype in autosomal dominant retinitis pigmentosa resulting from mutations in rhodopsin. As the insights into approaching this particular disease[3,4] and other hereditary retinal degenerative diseases[5] from the vantage point of genetics continues to expand, genetic markers for other major ocular diseases are being elucidated as well, including age-related macular degeneration (AMD),[6,7] cataract[8] and glaucoma,[9] to name just a few. Moreover, AMD is emerging as a paradigm for understanding the interplay of nature and nurture and how one may decrease the risk of disease by manipulating modifiable risk factors.[10]

As the area of genetic counseling based on molecular testing continues to expand,[11] it is becoming increasingly clear that in the very near future (within 5 to 10 years by several reputable estimates), molecular diagnostic testing for ocular disease will become a core component of clinical care and will be part of routine practice in predicting risk for and prognosis of disease.[12]

While organized optometry has of late made some movement in the direction of recognizing the value of incorporating genetics into standard clinical care (and any movement in this direction is only to be applauded), what has occurred till now is very little and needs to be greatly amplified. This essay represents a respectful attempt to stimulate such activity. The alternative is the very real risk that optometry's scope of practice will shrink significantly, especially as it relates to ocular disease.

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(Continued from page 5)

peripheral retinal viewing and the Digital ClearMag for detailed optic disc and posterior pole examination. The superior imaging and comprehensive views they deliver help to reduce overall examination time.

Volk Optical is an innovator in the design and manufacture of diagnostic and therapeutic ophthalmic lenses, equipment, and accessories. The company is based in Mentor, Ohio, USA, and has representatives and distributors around the world. To order or obtain more information about Volk products, visit www.volk.com, phone Volk at 1-800-345-8655 (toll free) or 440-942-6161, or contact your Authorized Volk Distributor.

Transitions Optical

To support and inspire the next generation of optometrists, Transitions Optical, Inc., has announced a new scholarship initiative that will reward ten outstanding students for their vision to promote healthy sight to patients.

Supported by the Transitions® Healthy Sight for Life Fund, the Optometry Scholarship Program encourages students to create projects exploring this year's theme, *Healthy Sight Counseling*. $500 Scholarships will be awarded to students who demonstrate a clear knowledge of the integration of vision care, vision wear and education into everyday practice.

Students are encouraged to submit projects of any length and format by a deadline of Oct. 11 - World Sight Day. Winners will be announced by December 2007. For more information, contact education@transitions.com.

To help eyecare professionals further integrate *Healthy Sight Counseling* into practice - especially with younger patients - Transitions will soon be releasing a clinical review paper entitled *Healthy Sight Counseling and Children*. The paper outlines the basics of healthy sight and the need to screen children for ocular disease and refractive error at an early age.

For more on *Healthy Sight Counseling*, visit the For Professionals Partners In Education section of the Transitions Web site.

Ophthonix

Nearly seven years after founding Ophthonix, Andreas Dreher, Ph.D. has decided to leave Ophthonix where his most recent positions included chairman of the board and chief technology officer, the company announced today. Dreher will be leading another early stage company in a non-competitive ophthalmic area, but will continue to assist Ophthonix in its strategic and technological development as a consultant.

Dreher founded Ophthonix in December 2000 with technology originally created during the U.S. government's Strategic Defense Initiative (SDI), or "Star Wars" program, and an understanding that these technologies had the potential to revolutionize vision correction.

"I am extremely grateful to Andreas for bringing his vision to life with Ophthonix. He had the foresight to bring distinct technologies together and create the iZon eyeglass lenses that enable people to see like never before," said Stephen Osbaldeston, chief executive of Ophthonix. The company plans to seek a replacement to fill the chief technology officer position.

Ophthonix's Z-View® Aberrometer employs proprietary wavefront technology to map a patient's eye for higher order aberrations, or irregularities, which can cause vision problems such as distortions, glare, halos and starbursts around lights.

The company's proprietary iZon® High Resolution Lenses are manufactured based on this map or iPrint™, which is unique to each person's eye much like a fingerprint. As a result, iZon Lenses provide patients with improved contrast acuity, improved night vision, generally sharper vision and the ability to see color with greater richness and intensity-much like the difference between regular and high definition television.

Coopervision

CooperVision announced that its Biofinity™ silicone hydrogel contact lenses are now available for daily wear in the United States. Designed with patented Aquaform™ technology, Biofinity monthly replacement lenses are made with a unique lens material offering higher water content, a lower modulus, and high oxygen transmissibility. These characteristics translate into maximum comfort, optimal health, and excellent performance for the patient.

Biofinity lenses use CooperVision-patented Aquaform technology to create a naturally wettable silicone hydrogel contact lens. Aquaform minimizes concerns over lens dehydration because it establishes hydrogen bonds with water molecules to create a naturally hydrophilic contact lens that retains water within the lens. In addition, wettability is inherent within the material itself, eliminating the need for additives, coatings, wetting agents, or surface treatments.

Aquaform technology also incorporates longer-chain siloxane molecules, which means less siloxane needs to be incorporated into the lens material to achieve high levels of oxygen transmissibility. The result is a softer, more wettable material that gives better all-day comfort. The aspheric front surface lens design improves visual performance, and the single base curve and back surface design enables fast, easy alignment and a quicker fitting process. A patented molded round edge reduces conjunctival interaction, resulting in continuous wearing comfort for the patient.

Biofinity is manufactured from comfilcon A material. The water content of Biofinity is 48 percent, Dk is 128, and Dk/t is 160. The lens features sphere powers from -0.25 to -6.00D, a base curve of 8.6, and a diameter of 14.

CooperVision recently introduced Proclear Multifocal XR contact lenses, offering extended sphere and ADD powers that allow eye care practitioners the ability to fit a wider range of presbyopes in a monthly modality. Proclear Multifocal XR is a made-to-order lens available in sphere powers up to +/- 20.00 with ADD powers up to +4.00.

Proclear Multifocal XR features the same Balanced Progressive™ Technology design as Proclear Multifocal. The system combines spheric and aspheric optics and unique zone sizes to produce a "D" lens for the dominant eye and an "N" lens for the non-dominant eye. The two lenses work together to provide exceptional distance, intermediate, and near vision.