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Utilization of Technology in Optometric Education: Moving from Enhancement to Transformation

Diagnosis and Management of Residual Amblyopia in a Non-compliant Patient: a Teaching Case Report

The Student Learning Objectives Initiative in a Doctor of Optometry Degree Program: a Report of Student and Faculty Perceptions

ALSO INSIDE

Editorial: A Look Back: Celebrating Women in Optometry

Industry News

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Optometric Education: Volume 44 Number 2 (Winter-Spring 2019)

Table of Contents

Articles

Effect of Room Illumination on Manifest Refraction

Utilization of Technology in Optometric Education: Moving from Enhancement to Transformation

The Student Learning Objectives Initiative
 in a Doctor of Optometry Degree Program:
a Report of Student and Faculty Perceptions

Features

A Look Back: Celebrating Women in Optometry

Industry News

Articles

PEER REVIEWED

Effect of Room Illumination on Manifest Refraction

Heather M. McLeod, OD, FAAO, and Elyse L. Chaglasian, OD, FAAO | Optometric Education: Volume 44 Number 2 (Winter-Spring 2019)

Abstract

Purpose: *To determine whether room illumination affects refractive results and to determine how room illumination for refraction is being taught at schools and colleges of optometry.* ***Methods:*** *Subjects were refracted in two rooms, brightly illuminated and moderately illuminated, using a computerized visual acuity chart. Subjects were surveyed about lighting preference. Teaching institutions were surveyed on room illumination and the visual acuity chart used during refraction.* ***Results:*** *No significant difference between refractions was noted. Schools using computerized charts teach students to use moderate or bright room illumination.* ***Conclusion:*** *Room illumination no longer plays a critical role in refraction due to use of computerized visual acuity testing systems. This should impact how refraction is taught in the optometric curriculum.*

Key Words: *manifest refraction, subjective refraction, visual acuity, illumination*

Background

Visual acuity (VA) is the most frequently assessed visual function in the clinical setting. Optimal refractive correction and the subsequent VA is essential for quantifying sensory function, detecting and monitoring ocular disease affecting central vision, and conducting clinical research. However, research on lighting conditions and how they affect VA and refractive error has rarely been performed and has produced conflicting results. A study by Wozniak et al. examined the effect of room illumination on VA measurements. Results showed that VA was reduced in non-emmetropic subjects when refraction was performed in non-illuminated rooms compared to when it was performed in illuminated rooms using a retro-illuminated Snellen chart.[1] In contrast, Chen et al. compared results of VA testing with room light and without room light using three different VA charts and found no difference in VA due to room illumination. The three different types of charts used were a projector letter chart, a wall-mounted letter chart and an internally illuminated rotatable Snellen chart.[2] An early clinical finding by Wiseman in 1956 was that subjective refraction in dark and bright room illuminations produced similar prescriptions using projector VA charts.[3] Another study by Chen et al. compared subjective refraction results in two different room illuminations using the same three VA charts. This second study found no statistically significant difference in subjective refraction with and without room illumination.[4] Many parameters of measuring VA have been standardized, including chart distance, optotypes, chart luminance, instructions on testing procedures, and scoring the VA result, but little attention has been paid to room illumination and its effect on refractive results.[5,6]

A search of the current literature on how to refract reveals a lack of updated research and recommendations on the best lighting conditions to use with computerized VA charts. Many textbooks are devoted to the topic of the subjective manifest refraction. However, one key element to this process appears to be missing or outdated. Standardization of the lighting conditions in the examination room during the subjective refraction has not been addressed for computerized VA charts. Commonly used textbooks for teaching optometric students how to test VA and perform subjective manifest refraction have variable recommendations for room illumination. Some only address room illumination as it relates to projector VA charts.[7,8] Others recommend the room be dimly illuminated for projector charts and computerized charts alike.[9, 10] Another text has specific recommendations on chart luminance ranges with only a generalized recommendation that room lighting be moderate unless the correction will be used primarily in dim or dark surroundings.[11]

Observation of students' clinical exams at ICO revealed that various levels of room lighting were being used during manifest refraction and binocular balance. Illumination ranged from full brightness to total darkness. The amount of variation was surprising because the students are taught to use moderate room illumination in their first year at ICO. The wide variation led the authors to survey ICO faculty and alumni about their own lighting preferences. The survey indicated that lighting preferences for manifest refraction vary in both academic and clinical optometric communities. The majority of ICO faculty 79% (30/38) and alumni 73% (190/260) reported using dimmed medium illumination during refraction. The majority of ICO faculty who refract in dim illumination reported that they were concerned that too much room illumination reduced contrast on the chart. The majority of alumni who refract in dim conditions reported it was their preference not to work in a totally dark room and that a dim room most closely simulated real-life conditions. Both ICO faculty and alumni who reported a preference for refracting in bright illumination stated that this lighting simulated real-life conditions.[12]

Due to the current lack of information in the literature on standardization of lighting conditions for computerized VA charts, this study was undertaken to determine whether room illumination affects the final refractive outcome after subjective refraction and binocular balance and whether patients have a preference for either setting. Also, due to the wide variation in light conditions used by ICO faculty and alumni for subjective refraction, a survey of the members of the Association of Schools and Colleges of Optometry Special Interest Group (Clinical Optometric Methods & Procedures Instructors) was conducted. The survey was used to determine the illumination conditions for refraction currently being taught at different optometric institutions, reference material used to teach refraction, prevalence of computerized VA charts, and whether their use has affected how clinical faculty members instruct optometry students on room illumination.

Methods

Seventy-one subjects were recruited from the staff, student body and faculty of ICO. Each subject had undergone a comprehensive eye exam in the last 24 months. Any subject who presented with amblyopia or ocular disease, except for mild dry eye syndrome, was excluded. The age of subjects ranged from 23 to 59 years with a mean age of 27 years. All subjects were correctable to 20/30 or better. Informed consent was obtained from all subjects before participation in the study. The protocol was approved by the Institutional Review Board of the Illinois Eye Institute.

The subjects were refracted by two different doctors in adjoining, identical (except for illumination level) exam rooms on the same day. Each examiner performed the subjective refraction followed by binocular balance on each subject in the same manner. The examiners were masked from the refractive results of the other examiner to avoid bias. Subjects were randomly assigned to start in either room to avoid bias or tiredness that might affect the reliability of the results. The entire procedure took 30 minutes. Nidek Tonoref II autorefraction measurements were used as the starting point for both refractions. Subjective manifest refraction including binocular balance was performed in both rooms with an M&S Technologies Smart System 2020 computerized VA chart with an LCD monitor. The letters on the chart were randomized to prevent memorization.

Examiners were randomized to either a brightly illuminated examination room or a moderately illuminated examination room for each patient. One exam room was brightly illuminated using overhead room lights to 320 lux while the other room was moderately lit to 3.5 lux by using a 60-watt bulb stand lamp positioned behind the patient's head with the overhead room lights off. A Sekonic L-758Cine DigitalMaster light meter was used to control the amount of light in each room. Each subject's pupil size was measured prior to the refraction in each of the exam rooms using an infrared Colvard pupillometer after he or she adjusted to the room's illumination for approximately 30 seconds. The subjects viewed the computerized VA chart while the pupil sizes were measured.

After the testing, subjects were asked to complete a three-question survey inquiring whether they were more comfortable in a particular lighting condition, why, and under which lighting condition they felt their vision was clearest **(Appendix A)**.

A paired T-test was performed to compare the spherical equivalent refraction and the spherical and cylindrical components of the final binocular balance result of the right and left eyes in the bright illumination and the moderate illumination. The pupil sizes of right and left eyes in the bright illumination and the moderate illumination were also analyzed with a paired T-test.

A second survey **(Appendix B)** was created for the members of the Clinical Optometric Methods & Procedures Instructors Special Interest Group of the Association of Schools and Colleges of Optometry (ASCO). This group consists of faculty members from the 23 ASCO member schools and colleges who instruct students on how to perform subjective manifest refraction. The survey consisted of six questions and was administered using Survey Monkey software. The purpose was to determine the illumination conditions for refraction currently being taught at optometric institutions, what reference materials are used to teach refraction, and the prevalence of computerized VA charts and whether their use has affected how clinical faculty members instruct optometry students on room illumination for subjective refraction.

Results

A total of 142 eyes of 71 patients were tested. The spherical equivalent of the subjects' refractive error for OD and OS ranged from +1.25D to -13.25D. Average spherical refraction was -3.04D in bright illumination and -3.06D in moderate illumination, OD, and -2.99D in bright illumination and -2.98D in moderate illumination, OS. A spherical equivalent change of +/- 0.50D was considered a clinically significant refractive difference. Paired T-tests to compare the spherical equivalent binocular balance revealed no significant difference between the two illumination conditions for either eye (OD: $p=.40$ and OS: $p=.92$) **(Figure 1)**. Paired T-tests to compare the spherical and cylindrical components of the binocular balance between the two illumination levels also revealed no significant difference for either eye (OD sphere: $p=.26$, OS sphere: $p=.36$, OS cylinder: $p=.58$, OS cylinder: $p=.72$) **(Figure 2)**. As expected, pupil size in the two illumination conditions was significantly different ($p<0.001$). The mean pupil size in the brightly illuminated room was 5.1 mm and the mean pupil size in the moderately illuminated room was 6.7 mm.

Figure 1. Click to enlarge

Subjects were asked to comment on which of the lighting conditions they found to be most comfortable and which lighting condition provided them the clearest vision. The post-refraction survey revealed no single patient preference for light level when evaluated for comfort. The patient preference was divided with 29% preferring bright, 36% preferring moderate, and 36% reporting no preference. Subjects' responses also differed regarding the lighting condition that provided the clearest vision with 29% stating bright illumination, 39% stating moderate illumination, and 33% stating that the lighting conditions did not affect their clarity of vision.

Seventy percent (16/23) of the surveyed members of the ASCO Special Interest Group responded to the survey. One respondent completed five of the six questions. The majority (11/16, 69%) reported that their optometric teaching institutions use computerized VA charts in their clinical teaching laboratories, and 31% (5/16) reported that their institutions use projector charts.

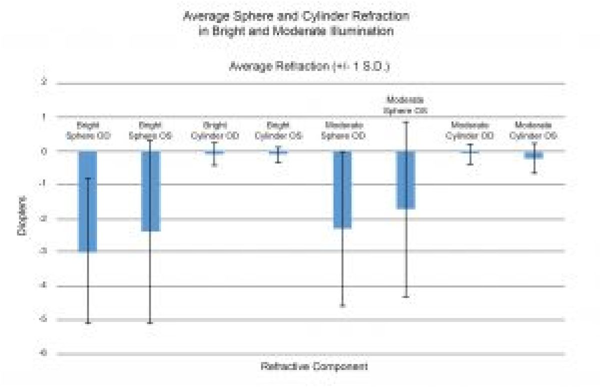

Figure 2. Click to enlarge

Of the schools using computerized VA charts, 50% (5/10) said they instruct their students to use moderate room illumination. The other half (5/10) said they teach their students to use bright illumination. Responses indicated that no institution teaches students to refract in a dark room or that it is acceptable to refract in any room illumination. Among the schools and colleges currently using computerized VA charts, 36.4% (4/11) reported changing the illumination levels they teach students for refraction when they switched from projectors to computerized VA charts, and 36.4% (4/11) reported no change in instruction. The remaining 27.2% (3/11) of schools with computerized VA charts reported never having taught students with projector charts. One of those three optometric schools is newly established.

The survey also found that every institution currently using projector VA charts (5/16) instructs its students to use moderate room illumination for refraction. The majority of respondents (63%, 10/16) said that 15 years ago, when projector VA charts were most likely the standard, their school taught students to use moderate room illumination. In addition, the survey found that six reference books are being used to teach refraction at 14 of the 16 respondents' schools. The most commonly used books are “Clinical Procedures for Ocular Examination” by Nancy Carlson and Daniel Kurtz (69%, 11/16) and “Primary Care Optometry” by Theodore P. Grosvenor (50%, 8/16). Two of the optometric institutions created their own material in the form of a textbook or iBook with no outside reference material recommended to students.

Discussion

Research on appropriate lighting and how it affects refractive error has rarely been performed. There is a trend toward increased use of computerized VA charts, and the current literature lacks updated recommendations on the best lighting conditions to be used with these charts. Our survey to the ASCO Special Interest Group (Clinical Optometric Methods & Procedures Instructors) revealed that when institutions switched from projector to computerized VA charts, half (4/8) did not change their instructions on room illumination for refraction. The other half (4/8), who did update their instructions, changed the room illumination from moderate to bright. According to the survey results, no optometric school or college that uses computerized VA charts teaches students that either moderate or bright room illumination is acceptable for refraction. This is significant because this study revealed no clinically significant difference in the outcomes of subjective refraction and no patient preference for either moderate or bright room illumination.

This study had several limitations. One limitation was the subjects were all correctable to 20/30 or better and without significant ocular disease. The majority of subjects were also optometry students who were familiar with refraction. This familiarity with the procedure may have influenced the lighting preference reported on the post-refraction survey. The survey's mixed results on lighting preference may be explained by the subjects' biases prior to the study. Another limitation of the study was the use of a single computerized VA chart with a standardized LCD screen. The M&S Technologies Smart System 2020 monitor is calibrated to the luminance recommended by the International Organization for Standardization's "visual acuity testing – standard and clinical optotypes and their presentation" standard. This standard allows for luminance to range from 80-320 cd/m2.[13] Due to the range of recommended luminance, other computerized VA charts may not be equivalent.

Anecdotal clinical experience and past practices reported by those who refract with a projector chart appear to reinforce the recommendation to use moderate illumination when refracting with a projector chart. By controlling room illumination, glare and reflection are minimized, which optimizes image contrast. Glare from overhead lighting degrades the contrast of the image from a projector chart. Light falling on the chart from the room illumination can reflect into the patient's eye and degrade the contrast of the image on the chart, but it is not practical to refract in a dark room.[14,15] That is why it is important to develop standardized room illumination levels.

Another problem that can arise with projected VA charts is that projectors tend to decrease in illumination over time due to the incandescent bulbs they use. Incandescent bulbs lose light output as dust collects on the bulb and as the bulb ages due to the thinning of the filament.[16] The image can then become blurred due to defocus of the projector. The projected image can also be negatively impacted due to dust collected on the lens or a misalignment with the screen or mirrors.[17]

Computerized VA charts have many advantages over projector charts. They provide better contrast and more diversity compared with projected charts. Computerized VA charts meet the ISO standards for luminance, contrast and color temperature. Computerized VA charts allow the examiner to randomize optoypes to prevent patient memorization of the chart. The computerized systems offer a variety of VA charts such as Snellen, Lea, ETDRS and Tumbling E. The examiner has the ability to alternate quickly between the different types of charts. The examiner can isolate a letter or line that appears in the middle of the screen. Videos and pictures that aid with patient education can also be added. Due to the reduced cost of computerized VA charts and the many advantages they have over projector charts, the sales and utility of projector charts have been on the decline.

Many projector charts remain in use, but there has been an increasing trend toward computerized VA systems. During the 1990s and early 2000s automatic projectors made up about half of projector sales. In 2006, the first Windows-based computerized VA charts came on the market. In the mid-2000s the cost of automatic projectors was similar to the cost of computerized VA charts, and by the end of the decade more computerized VA systems were being sold than manual projector VA charts. Currently, computerized VA systems dominate the market with 75%-95% of sales.[18,19]

Our survey revealed that the majority of optometry students, 70%, have been instructed throughout their lab courses and clinical exam experience to use moderate room illumination for subjective manifest refraction. This originates from the previously standard utilization of projector charts. However, in today's practice, computerized VA charts dominate examination rooms and clinical teaching labs at the majority of optometric institutions, yet no teaching institution using computerized charts has made a change to instructional standards based on our research. Our findings are consistent with an earlier study by Chen et al. that room illumination does not have a statistically significantly effect on subjective refraction.[4] Our study is unique because it evaluates refraction with computerized VA charts, the new standard, instead of wall-mounted charts, internally illuminated charts, or projector charts. The findings of this study — that there is no significant difference in the outcome of subjective refraction and no patient preference for any room illumination — should impact how the procedure is taught in optometric curricula and how it is performed in clinical practice.

Conclusion

Obtaining an accurate subjective refraction for patients is an essential component of quality care in clinical optometric practice. In the past, it was commonly believed that room illumination played an important role in obtaining an accurate refraction with projector VA charts. With the use of computerized VA charts, room illumination no longer plays a critical role. This study determined that the final refractive outcome of the binocular balance does not significantly differ whether it is obtained in bright or moderate room illumination when utilizing a computerized VA chart. These findings should impact how the procedure is taught in optometric curricula and how it is performed in daily clinical practice.

References

1. Wozniak HP, Kelly M, Glover S, Moss ND. The effect of room illumination on visual acuity measurement. Australian Orthoptic Journal. 1999;34:3-8.
2. Chen AH, Norazman FNN, Buari NH. Comparison of visual acuity estimates using three different letter charts under two ambient room illuminations. Indian J Ophthalmol. 2012;60:101-104.
3. Wiseman K. The level of illumination during subjective refraction. Australas J Optom. 1956 Dec;39(12):558-559.
4. Chen AH, Norazman FNN, Buari NH, Ahmad A, Omar WEW. Comparison of subjective refraction findings in two different levels of room illumination using three different types of letter charts. J Korean Oph Opt Soc 2010;15(1):67-71.
5. Ferris FL, Kassoff A, Bresnick GH, Bailey I. New visual acuity charts for clinical research. Am J Ophthalmol. 1982;94(1):91-96.
6. Johnson CA, Casson EJ. Effects of luminance, contrast, and blur on visual acuity. Optom Vis Sci. 1995;72(12):864-869.
7. Grosvenor T. editor. Primary Care Optometry. 5th ed. Boston, MA: Elsevier; 2007.
8. Eskridge JB, Amos J, Bartlett JD. editors. Clinical Procedures in Optometry. Philadelphia, PA: Lippincott; 1991.
9. Carlson NB, Kurtz D. Clinical Procedures for Ocular Examination. 4th ed. New York, NY: McGraw-Hill Education; 2016.
10. Rosenfield M, Logan N, Edwards K. editors. Optometry: Science, Techniques, and Clinical Management. 2nd ed. Edinburgh, Scotland: Elsevier; 2009.
11. Benjamin WJ, Borish IM. editors. Borish's Clinical Refraction. 2nd ed. St. Louis, MO: Butterworth Heinemann; 2006.
12. Chaglasian E, McLeod H. Room illumination preferences for manifest refraction by faculty and alumni of the Illinois College of Optometry. Am Acad Optom. 2011; Program 115209.
13. International Organization for Standardization. (2017) Ophthalmic optics -visual acuity testing – standard and clinical optotypes and their presentation (ISO 8596:2017). Retrieved from: https://www.iso.org/standard/69042.html.
14. Norton TT, Corliss DA, Bailey JE. The Psychophysical Measurement of Visual Function. Amsterdam, NL: Butterworth-Heinemann; 2002.
15. Richard OW, Roth N. Lighting an examination room to avoid error. Am J Optom. 1973;50(6):452-7.
16. Agrawal DC, Menon VJ. Lifetime and temperature of incandescent lamps. Physics Education. 1998;33(1):55-58.
17. Kniestedt C, Stamper RL. Visual acuity and its measurement. Ophthalmol Clin North Am. 2003 Jun;16(2):155-70.
18. Lombart representative (personal communication), June 3, 2015 and Dec. 9, 2015.
19. Star Ophthalmic Instruments (personal communication), Dec. 11, 2015.

Appendix A. Click to enlarge

Appendix B. Click to enlarge

Dr. McLeod [hemcleod@ico.edu] is an Assistant Professor and the Coordinator of the Primary Care and Ocular Disease Residency Program at the Illinois College of Optometry (ICO) and an Attending Optometrist in the Primary Care, Advanced Ophthalmic Care, and Urgent Care services at the Illinois Eye Institute. Dr. McLeod received her optometric degree from ICO and completed a residency in Ocular Disease and Special Testing at the State University of New York College of Optometry.

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PEER REVIEWED

Utilization of Technology in Optometric Education: Moving from Enhancement to Transformation

Christopher E. Woodruff, OD, MBA, and Heidi Wagner, OD, MPH | *Optometric Education: Volume 44 Number 2 (Winter-Spring 2019)*

Abstract

This paper examines the history, utilization and assessment of educational technology and offers some guidelines for implementation. We review Puentedura's SAMR (Substitution, Augmentation, Modification, Redefinition) model of technology integration and its potential alignment with the more familiar Bloom's Revised Taxonomy of educational objectives. We discuss the current state of educational technology in the profession, particularly in the context of emerging technologies and how innovative educators can use technology to transform optometric education.

Key Words: *educational technology, SAMR model, optometric education, Bloom's Revised Taxonomy*

Introduction

We live and work in a world of constantly changing technology. As optometric educators we are part of an industry that interfaces with emerging technologies including digital mobile devices and computer-simulated reality. Within this context — and knowing that our students are accustomed to 24-7 access to anything and everything using their mobile devices — it is natural for educators with an interest in technology to find ways to utilize these resources to enhance student learning and engagement. As educators, we need to use information and communication technology in a manner that helps students acquire the professional skills necessary to succeed in a rapidly changing digital society.

As we implement new technologies in optometric education, we should keep in mind the following advice about integrating educational technology into teaching designed for K through 12 educators:[1]

- Educators usually do not develop technology (software or technology-based materials)
- Technically possible does not equal desirable, feasible or inevitable
- Older technologies can be useful
- Educators will always be more important than technology

Keeping this advice in mind, our goal as educators should be to align technology with curricular goals in a manner that is consistent with what we know about student learning. To this end, this paper examines the history, utilization and assessment of educational technology and offers some guidelines for the implementation of educational technology in optometric education.

A Brief History of Educational Technology

In order to promote student learning, successful educators often embrace innovative strategies that aim to be more efficient, engaging and collaborative than previously used methods. We can classify these methods as technological if they involve the application of scientific or other organized knowledge to enhance teaching, learning or assessment. These innovations can be further classified as either hard technologies (materials and physical inventions) or soft technologies (work processes or instructional templates applicable beyond a single case), both of which have the potential to improve student learning.[2] Thus, educational technology is defined as "the study and ethical practice of facilitating learning and improving performance by creating, using and managing appropriate technological processes and resources."[3]

The modern era of educational technology began in the late 19th and early 20th century with educators using projected visual images to supplement lectures. This initially expensive technology became more affordable and widely used with Thomas Edison's invention of incandescent lighting in the 1890s. This milestone was followed by the introduction of silent instructional film (early 1900s), radio (late 1920s), sound film (early 1930s) and television (1950s).[4] As the 20th century progressed, educators continually employed new technologies emerging from the radio, television and motion picture industries.[1] For example, the U.S. military developed training films for soldiers and the general public as preparation for their respective roles in the war effort. During peacetime, the U.S. military released these media innovations into the public domain, providing civilian educators with additional resources.[4]

In particular, the computer has been central to the evolution of educational technology. Just as the variety of technologies usable in education has increased, so too have the uses of computer-assisted instruction (CAI). Notably, the initial focus of CAI was drill-and-practice rather than the broader applications available today.[2] The earliest uses of computers in education involved mainframe computers whereby the machine quizzed the students on material presented by the teacher. Using punch cards as input, these computers were expensive and cumbersome to use. Since then, the use of integrated circuits led to the development of computers that are smaller and more accessible to teachers and students, representing the first milestone and major turning point in the use of computer technology in education.[2]

The use of computers in education increased dramatically with the commercialization of microcomputers in the late 1970s and early 1980s. Models manufactured by International Business Machines (Armonk, NY), Apple (Cupertino, CA) and RadioShack (Fort Worth, TX) entered the classroom. In 1982, Time magazine's tradition of "Man of the Year" was replaced by the personal computer as "Machine of the Year,"[1] illustrating the microcomputer's prominence in daily life.

Personal computers had a profound impact on the information environment of the 1980s, but their sway increased even more with the advent of the Internet in the 1990s. With the rapid increase in connections to the Internet as the decade progressed, the potential for sharing information at a distance increased and began influencing education in a significant way by lessening students' and teachers' reliance on physical resources in the classroom.[3] Thus, the introduction of the World Wide Web defined a second milestone in the history of computer technology in education.[1]

In 2005, the term Web 2.0 was coined as a way of characterizing the shift from the more static early web to an Internet that included interactive, user-centered web-based tools. Newly available tools included wikis, blogs, image and video sharing and podcasting. A new category of mobile devices was born in 2010, with the introduction of the Apple iPad, which allowed users to download books, videos and much more with a large, high-resolution touchscreen. The New Media Consortium, a not-for-profit organization that explores the impact of emerging technologies, declared tablet devices to be a completely new technology rather than simply a new kind of lightweight laptop computer.[5] The tablet, along with the wide adoption of the smartphone,[6] brought new resources to the classroom and clinical teaching environment. Today, innovative educators are using Web 2.0 tools and mobile devices to create engaging student-centered learning environments.[7,8]

Educational Technology in Higher Education

Higher education is in transition. With changes in the needs of the 21st century learners, educators are shifting from paper-based to technology-integrated classrooms. In parallel with these changes, the

National Education Association developed a framework of skills for contemporary learning. Specifically, students today need more than the three Rs (reading, writing and arithmetic); they also need the four Cs (creativity, communication, collaboration and critical thinking).[9,10] Other authority figures have described the educational priority in higher education as "deep learning" defined as the "mastery of content that engages students in critical thinking, problem-solving, collaboration and self-directed learning."[11]

With the ability to electronically access textbooks, e-mail, learning management systems and the Internet, the nature of teaching and learning will forever be changed and transformed.[12] While it is intuitive to experiment with and adopt new technologies, especially for educators with a special interest and affinity for computer technology, it is important to focus on the application of educational tools rather than the actual educational tools that are available.[1] The implementation of educational technology must include careful consideration of how best to apply these tools and materials to existing curricular goals. Evaluation of any new educational tool or process can be challenging. The Substitution Augmentation Modification Redefinition (SAMR) model of technology integration in education offers one way to evaluate the implementation of educational technology.

The SAMR Model of Technology Integration

Popularized by Ruben Puentedura, the SAMR model has been adopted by educators involved in teaching students at levels from kindergarten through higher education. SAMR was created by Puentedura as a response to his experience at Harvard University as a graduate student.[13] The SAMR model is used to describe a hierarchy of integration of technology from Enhancement (substitution and augmentation) to Transformation (modification and redefinition). Puentedura's challenge for educators is to find ways to use technology that do not merely enhance learning but rather transform learning. This model has been used in universities for evaluation of the use of mobile devices for teaching[14] and other learning technologies.[15] It provides a framework to evaluate how computer technology potentially impacts teaching, learning and student engagement.

Substitution

At the first level of the SAMR model, technology is used as a simple substitution for a more traditional educational tool, activity or teaching method. At this stage there is no change in the process or results through the inclusion of technology. In substitution the benefits for students are modest; the new technology may provide a practical benefit such as lower cost or improved efficiency. An often-cited example is the use of a computer and word-processing software instead of paper and pen to complete a writing assignment. An elementary example that is ubiquitous within health education programs is the provision of digital course notes rather than paper copies. Other examples that have been utilized in optometric education include recorded lectures or podcasts (digital audio files) to replace traditional lectures.[16,17] Podcasts have been shown to be a popular supplement to conventional teaching in an optometric clinical environment. Perceived benefits include mobility and flexibility.[16] Substitution typically involves a switch from analog to digital technology that generates no functional change.[18]

Augmentation

At the augmentation level, use of technology leads to a functional improvement to the teaching, learning or process that provides a benefit to the student. Videos created to supplement and reinforce course material presented in a traditional lecture, rather than simply replacing the original lecture, exemplify augmentation. Similarly, social media has been used to provide students with additional course resources and access to the instructor outside the classroom. For example, Facebook (Menlo Park, Calif.) was chosen as a supplement to an optometric ophthalmic optics course because of the high proportion of students with an account. A separate Facebook page was created for the course. Students were notified when new materials (summaries, study guides, additional problem sets) were posted and given the opportunity to post comments and questions. The increased collaboration between instructors and students was attributed to students' high interest in social media and frequent access to this platform.[19] Secured testing administered on a student's personal electronic device is an example of augmentation (rather than substitution) if it provides additional benefits to the learning community such as the integration of multimedia into the examination, immediate student feedback of exam performance, or robust analytics for faculty and administrators. Computer assessment software (Examsoft, Delray Beach, Fla.) has been adopted by multiple schools and colleges of optometry, and portable electronic devices are increasingly being used in healthcare and education.[20,21]

One such institution surveyed student experiences with assessment and reported that most students preferred pencil and paper exams. However, the authors partially attributed this perspective to students' unfamiliarity with the software as compared to traditional testing methods. Additionally, they acknowledged that students may not initially recognize commonly reported benefits of computer-based assessments such as more specific feedback and faster scoring.[22]

Modification

A significant change in technology adoption in the classroom occurs at the modification level. The use of, and access to, technology facilitates the redesign of educational assignments and assessments. Modification allows students to analyze their work and their learning process through the lens of technology. An example of modification is the use of collaborative document editing to promote student team work and facilitate real-time communication. We recently observed such collaboration in a capstone course where optometry students analyzed optometric cases to further develop clinical diagnostic and management skills as well as integrate basic science with clinical problem-solving.[23] Google Docs (Google LLC, Mountain View, Calif.), a web-based document management application system, was employed to collaboratively create and edit documents online. A further example is the use of a note-taking app on a mobile device that allows annotation, audio recording, indexing and sorting. Such technology is useful in professional programs such as optometry where the lecture volume is high and time management skills are critical to success.

Redefinition

Redefinition, the final level of the SAMR model, allows significant changes and transformation to occur in the experiences of both students and educators. In Puentedura's conception, technology facilitates the "creation of new tasks, previously inconceivable."[24] The intent is to change traditional tasks and goals through the incorporation of technology in the classroom.

In contemporary illustrations of redefinition, the focus of instruction frequently shifts from the instructor to the student, and the collaboration between peers increases. Examples include student-generated media such as a blog or e-portfolio. Such media could be incorporated into case-based critical thinking exercises described above if it culminates into a student presentation. These resources lend themselves to problem-based learning exercises and case presentations that are common in the optometric curriculum. Alternatively, student e-portfolios can be monitored by faculty during the clinical rotation to ensure that educational objectives are being met, as reported recently by faculty overseeing an emergency medicine clerkship.[25]

Educators can also create new learning tasks, assignments and assessments using a digital platform to create a more immersive experience with virtual reality (VR) or augmented reality (AR).[17] Schools and colleges of optometry are currently using VR simulators for training diagnostic skills such as binocular indirect ophthalmoscopy. Virtual patient encounters and other VR/AR apps have been incorporated into health training programs and are potentially applicable to optometry.[26]

This final level of the SAMR model is difficult to describe because what is possible with technology is constantly being redefined.[27] The distinction between the levels evolves as the perception of what is "inconceivable" changes with the educator's awareness of new technology and its implementation over time. The final level of SAMR might be viewed as a paradigm shift whereby education has been transformed using technology.

The SAMR Model and Bloom's Taxonomy

As the foundation of many teaching philosophies, Bloom's Taxonomy is familiar to many optometric educators.[28] Bloom's Revised Taxonomy of educational objectives (Remember, Understand, Apply, Analyze, Evaluate, Create) expands upon the author's original work and provides a framework for teaching, learning and assessment.[28] It provides direction for curriculum development in that it emphasizes higher-level thinking while acknowledging multiple dimensions of learning. The taxonomy has frequently been presented as a hierarchical framework, proceeding from simple to complex. Alternatively, the taxonomy has been displayed unranked, as illustrated by Alan Carrington's padagogy wheel of mobile educational apps.[8] Coupling the SAMR model with Bloom's, as originally recommended by Puentedura, may be useful for educators who are familiar with Bloom's Revised Taxonomy but less experienced with implementing technology in the classroom **(Figure 1)**.

Figure 1. Click to enlarge Puentedura's SAMR model of technology integration (a) aligned with Bloom's Revised Taxonomy of educational objectives (b) to illustrate moving from enhancement to transformation (c) in optometric education.
For a more detailed illustration applied to mobile devices, see Carrington's Padagogy wheel V4.0.

According to Puentedura, the goal of an educator is to construct a SAMR ladder that is coupled to Bloom's Revised Taxonomy.[24] Substitution and Augmentation are coupled with Remember, Understand and Apply, resulting in what Puentedura terms *enhancement*. Modification and Redefinition are coupled with Analyze, Evaluate and Create, culminating in *transformation*. At the transformation stage, deeper learning occurs, consistent with Bloom's Revised Taxonomy. Thus, the model facilitates the integration of technology with teaching and promotes learning at a higher level.

Applied to optometric education, electronic flashcards help the student *remember* while viewing lecture excerpts from a video-enhanced lab manual help the student *understand*. Electronic assessment with meaningful feedback potentially helps the student to *apply* the information learned in class to a problem set or case-based learning exercise. Student response system apps used with synchronous classroom discussion potentially support the student's ability to *analyze* in problem-based learning. Asynchronous discussion boards promote student collaboration and the opportunity to *evaluate*. Synthesizing data using a collaborative online white board provides the opportunity to *create*.

Criticism of the SAMR Model

While the SAMR model has been embraced and adopted by many educators, it is not without criticism. It has been noted that, despite its increasing popularity among educators, critical evaluation in peer-reviewed literature is lacking.[13,18] Further criticisms of the SAMR model include the absence of context, rigid structure, and a concern about product over process. We include these criticisms to inform educators of potential pitfalls and to help them apply the SAMR model in a thoughtful manner.

In the field of education, context refers to the characteristics of the learning environment. Specific criticisms of the SAMR model's absence of context refer to lack of recognition for technology infrastructure and resources, community buy-in and support, and instructor knowledge and support for using technology. Access to the technology does not necessarily lead to its widespread use.[18]

The rigid structure of the SAMR model also concerns some educators who worry that by categorizing technology integration into one of four categories the model dismisses the complexity of teaching with technology. Critics are concerned that there is an emphasis on moving along a hierarchical continuum and this minimizes the important focus of using technology in ways to change pedagogy or classroom practices that enhance learning.[18]

Finally, the concern is that with the SAMR model, products remain the focus as one attempts to move to higher levels from enhancement to transformation.[18] Critics warn that educators should not get caught up in the act of adding technology that does not enhance the course or lesson, especially if the instructor has not done his or her due diligence in planning and testing the technology.[29] There are occasions when simply using substitution can achieve an educational objective.

Future of Educational Technology

According to the New Media Consortium Horizon Report, the key trends accelerating technology adoption in higher education are: advancing cultures of innovation, deeper learning approaches, growing focus on measuring learning, redesigning learning spaces, blended learning designs, and collaborative learning.[30] The mention of deeper learning approaches and collaborative learning is consistent with the integration of Bloom's and SAMR discussed previously. Educators are increasingly interested in tools that will allow them to assess student learning. This trend manifests in optometry's recent adoption of computerized assessment and associated analytical tools. Universities are also beginning to redesign learning spaces (the physical environment) to accommodate strategies that incorporate digital strategies and more active learning. These changes are occurring as more educators are accepting the role of online learning and demonstrating increased support for blended learning that combines online learning with traditional classroom methods. Collaborative learning, which involves students or educators working together on group activities based on the idea that learning is a social construct, is also becoming more accepted in higher education.

What tools will be used to support these changes in the use of technology in higher education? Some potential technologies include: AR, VR, artificial intelligence (AI), adaptive learning, Internet of Things, next generation learning management systems, and natural interfaces.[30,31] VR replaces the real world with a simulation while AR provides a real-world environment with digital information overlaying the participant's view. VR can bring the outside world into the classroom, while AR can provide additional information as a student moves through the real world. AI is being used to create intelligent machines that resemble humans in the way they function. Some potential uses of AI in higher education include personalized learning, curriculum evaluation and use of intelligent tutoring systems.[31] AI algorithms are utilized in adaptive learning technologies, which can adjust course content based on ability and skill attainment. Utilizing machine learning, adaptive learning technology adapts to the student in real time.[30]

The Internet of Things is a term used to describe devices connected to the Internet and each other, enabling them to exchange data. We are surrounded by these devices in the form of smart watches, smart TVs, smart thermostats and other networked appliances. Applied to the education sector, this technology enables textbook enhancements, student assessment, individualization of content delivery and group collaboration. In the optometric environment, this could be reflected by further augmenting class assignments or assessments with audio and video using networking devices.

Learning management systems (LMS) are software applications that are used to deliver online course content and monitor student participation. Current LMS place more emphasis on the administration of learning than the learning itself. The next generation LMS will support personalization and play a larger role in formative learning assessment.[30] Natural user interfaces are most commonly found in tablet and mobile devices that respond to taps, swipes and other touching for user input. iBooks with interactive optometric content and clinical resources are currently available.[32,33] Technology is in development that will allow more interaction with smooth glass surfaces, such as a tablet's display, that will create the feel of a textured surface. This will allow more user sophisticated interaction with applications such as electronic textbooks including direct manipulation of three-dimensional images.[19]

Awareness of the history of educational technology is only useful if we apply what has been learned from the past to decisions about the future. As educators we need to be cognizant of the relationship between pedagogy, technology and student learning. The field of educational communications and technology has a history characterized by adopting changes in technology as they become available. From visual, to audio-visual, and then to computer and web-based instruction, educators have been attracted by the opportunity to enrich the learning experience through involvement of the senses.[1] It is an exciting time to be involved in optometric education, especially for educators interested in finding ways to adopt and implement new technologies.

References

1. Roblyer MD. Integrating educational technology. 4th ed. Upper Saddle River, NJ: Pearson Prentice Hall; 2006.
2. Molenda M. Historical foundations. In: Spector JM, Merrill MD, Merrienboer JV, Driscoll MP, eds. Handbook of research on educational communications and technology. 3rd ed. Abingdon, United Kingdom: Routledge; 2008:3-20.
3. Januszewski A, Molenda M, Harris P. Educational technology: a definition with commentary. New York: Routledge Taylor and Francis Group; 2008.
4. Reiser RA. A history of instructional design and technology: Part I: a history of instructional media. Educ Technol Res Dev. 2001;49(1):53-64.
5. Johnson L, Adams S, Cummnis M. The NMC horizon report: 2013 higher education edition. [Internet] c2013 [Cited 2018 May 9]. Available from: https://www.nmc.org/system/files/pubs/1360189731/2013-horizon-report-HE.pdf.
6. Mobile fact sheet. Internet and technology. [Internet] c2018 [Cited 2018 May 9]. Available from: https://www.pewinternet.org/fact-sheet/mobile/.
7. Cochrane T, Bateman R. Transforming pedagogy using mobile Web 2.0. IJMBL. 2009;1(4):56-83.
8. Carrington A. The padagogy wheel V4.0. [Internet] c2015 [Cited 2018 October 27]. Available from: https://tinyurl.com/padwheelV4.
9. Dimond B, Bullock A, Lovatt J, Stacey M. Mobile learning devices in the workplace: 'as much a part of the junior doctor's kit as a stethoscope'? BMC Med Educ. 2016;16:207.
10. Preparing 21st century students for a global society: an educator's guide to "the four Cs." [Internet] c2012 [Cited 2018 May 9]. Available from: https://www.nea.org/assets/docs/A-Guide-to-Four-Cs.pdf.
11. William and Flora Hewlett Foundation. Deeper learning defined. [Internet] c2013 [Cited 2018 May 9]. Available from: https://www.hewlett.org/library/deeper-learning-defined/.
12. Wakefield J, Smith D. From Socrates to satellites: iPad learning in an undergraduate course. Creative Education. 2012;13(5):643-648.
13. Green LS. Through the looking glass: examining technology integration in school librarianship. Knowledge Quest. 2014;43(1):36-43.
14. Engin M, Atkinson F. Faculty learning communities: a model for supporting curriculum changes in higher education. IJTLHE. 2015;27(2):164-174.
15. Laurillard D. Rethinking university teaching. 2nd ed. London: Routledge; 2002.
16. Hamilton-Maxwell K. A pilot study of optometry student perceptions, acceptance and use of podcasting. Optometric Education. 2016;41(2):29-36.
17. Romrell D, Kidder LC, Wood E. The SAMR model as a framework for evaluating mLearning.

JALN. 2014;18(2):79-93.
18. Hamilton ER, Rosenberg JM, Akcaoglu M. The substitution augmentation modification redefinition (SAMR) model: a critical review and suggestions for its use. TechTrends. 2016;60(5):433-441.
19. Woodruff CE, Rumsey JM, Fecho GM. Social media in optometric education. Optometric Education. 2012;37(2):73-77.
20. Ozdalga E. The smartphone in medicine: a review of current and potential use among physicians and students. J Med Internet Res. 2012;14(5):e128.
21. Chase TJG, Julius A, Chandan JS, et al. Mobile learning in medicine: an evaluation of attitudes and behaviours of medical students. BMC Med Educ. 2018;18:152.
22. Fecho GM, Althoff J, Hardigan P. Assessing student performance in geometrical optics using two different assessment tools: tablet and paper. Optometric Education. 2016;42(2-11).
23. Good G, Earley M, Nichols KK. Teaching clinical decision making: the keystone experience. Optometric Education. 2011;36(3):152-159.
24. Puentedura R. SAMR and Bloom's taxonomy: assembling the puzzle. [Internet] c2014 [Cited 2018 May 9]. Available from: https://www.commonsense.org/education/blog/samr-and-blooms-taxonomy-assembling-the-puzzle.
25. Cevik AA, Shaban S, Zubeir ME, Abu-Zidan FM. The role of emergency medicine clerkship e-portfolio to monitor the learning experience of students in different settings: a prospective cohort study. Int J Emerg Med. 2018;11:24.
26. White CB, Wendling A, Lampotang S, Lizdas D, Cordar A, Lok B. The role for virtual patients in the future of medical education. Acad Med. 2017;92(1):9-10.
27. Keane T, Keane WF, Blicblau AS. Beyond traditional literacy: learning and transformative practices using ICT. Educ Inform Tech. 2014;21(4):769-781.
28. Arasian P, Kruikshank KA, Mayer RE, Pintrich P, Raths J, Wittrock MC. A taxonomy for learning, teaching, and assessing; a revision of Bloom's taxonomy of educational objectives. Complete ed. New York: Addison Wesley Longman; 2001.
29. Harris L. Embracing the world of online teaching and instructional design. Critique of TPACK framework and the SAMR model. [Internet] c2015 [Cited 2018 April 10]. Available from: https://gradgirl149.wordpress.com/2015/09/02/critique-of-tpack-framework-and-the-samr-model.
30. Adams BS, Cummins M, Davis A, Freeman A, Hall GC, Ananthanarayanan V. NMC horizon report: 2017 higher education edition. Austin, Texas: The New Media Consortium; 2017.
31. Newman D. Top 6 Digital transformation trends in education. [Internet] c2017 [Cited 2018 April 27]. Available from: https://www.forbes.com/sites/danielnewman/2017/07/18/top-6-digital-transformation-trends-in-education/#221f92472a9a.
32. Webber A. Rutstein's atlas of binocular vision, Robert P. Rutstein. Optom Vis Sci. 2015;92(2):e62.
33. Ridgeview Publishing: education for the next generation. Available books. [Internet] c2015 [Cited 2018 October 27]. Available from: https://ridgevue.com/?page_id=16.

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PEER REVIEWED

The Student Learning Objectives Initiative in a Doctor of Optometry Degree Program: a Report of Student and Faculty Perceptions

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Abstract

This study reports on the perceptions and opinions of Doctor of Optometry students regarding use of student learning objectives (SLOs), prediction of exam questions based on SLOs, use of SLOs by teachers, helpfulness of SLOs, and alignment of exams with SLOs. From the teachers' perspective, this study reports on the perceived difficulties of constructing SLOs, their actual use, delivery of information about them, and instructions to students about using SLOs. A majority of students utilize lecture-based SLOs for exam preparation and report SLOs are most valuable when they are specific and linked to exam questions. Most faculty find writing SLOs easy and the majority linked their exam questions to SLOs.

Key Words: *learning objectives, course objectives, Doctor of Optometry students, student perceptions, optometry curriculum*

Background

The concept of student learning outcomes, also known as student learning objectives (SLOs), behavioral objectives, learning goals, goal focusing, or relevance instruction, has been discussed in higher education for many decades.[1-7] SLOs are short statements directing students' attention to the salient points that the teacher wants them to master from lectures, reading assignments or other learning materials and activities. Setting student learning outcomes is the first step in a five-step process of making changes to a course to improve student achievement.[8] This is followed by the teacher referring to the outcomes during each class and writing assessments that directly link back to the learning outcomes.[9] Benefits are gained when students test themselves utilizing the lecture-specific learning objectives as they prepare for examinations.[10,11]

In Academic Year 2015-2016, Western University of Health Sciences College of Optometry launched the student learning objectives (SLOs) initiative. The SLOs initiative required faculty to provide to students learning objectives for each and every lecture. In contrast to course learning outcomes, which define on a macro level what students should be able to do at the end of a course, lecture-specific SLOs define what students should be able to do at the end of a lecture (topic), the instructional intent being at a more micro level.[12] A number of observational and experimental studies have demonstrated the usefulness of objectives to enhance the depth of learning,[13] or the efficiency of discovering what should be learned.[14] If the instructor can articulate what he or she wants students to gain from various learning opportunities, students can either acquire those facts, skills or attitudes at a higher level or acquire them more efficiently than students whose learning is not influenced by SLOs. Often, teachers inform students of expectations in a course and the means by which students can achieve the learning outcomes by including learning outcomes in their syllabi.[4] When SLOs are incorporated into a syllabus, they can be taken directly from the syllabus as a learning resource for each class meeting.[15]

As part of ongoing faculty development, faculty members were provided with specific guidelines, rubrics and advice to facilitate the construction of high-quality SLOs **(Appendix A)**. The SLOs were based on a pyramid of learning outcomes. The foundation of the pyramid is the eight Western University of Health Sciences Institutional Learning Outcomes (ILO). These are aligned with 27 Program Learning Objectives (PLO), which are based on the desired Attributes of Students Graduating from Schools and Colleges of Optometry promulgated by the Association of Schools and Colleges of Optometry in 2011.[16] Each of the 27 PLOs serves as the foundation for Course Learning Outcomes (2 to 5 per course credit hour, a required part of each course syllabus), which form the basis for the requirement of 3 to 6 SLOs provided by each instructor for each hour of lecture.[17,18] Faculty were advised to include the lecture-specific learning objectives in the first slide of each lecture. If faculty incorporated SLOs into the syllabus, for each class meeting the SLOs could be taken directly from the syllabus as a student learning resource. Finally, in the ideal case, the instructor aligns every examination item with one of the lecture-specific SLOs. The ultimate objective of this initiative is to enhance students' knowledge, skills and attitudes, as articulated in the PLOs and ILOs.

A year after the initiation of the student learning objectives initiative, the effort is highly successful. Virtually all lectures include learning objectives. We now seek to better understand how students and faculty are using the SLOs. The specific aims of the project are: (1) increase understanding of how graduate health professional students utilize lecture-based SLOs in their examination preparation, (2) increase understanding of the process and obstacles in having faculty include SLOs for every lecture, and (3) measure how well the course assessments reflect the SLOs in terms of percentage of test questions.

Methods

All didactic courses administered in the fall of 2015 for the first, second and third years of the Doctor of Optometry curriculum were evaluated for inclusion of student learning objectives for every lecture. Courses with student learning objectives for every lecture were included in the study. Student learning objectives were identified from review of lecture materials posted on the college's course management system. Sixteen of 18 courses met the criteria.

One study investigator performed an independent evaluation of all exam questions and SLOs for each of the 16 courses to identify the following parameters: total number of SLOs, number of SLOs tested, number of test questions not linked to a SLO, and number of questions for each SLO.

Courses covered various disciplines, including basic biomedical science, vision science and clinical science. We utilized a mixed method research method. Two surveys were developed, a student survey and a faculty survey consisting of qualitative and quantitative questions. The student survey asked if students used the learning objectives, liked using learning objectives and found them beneficial for test preparation. The faculty survey asked how they utilized lecture SLOs in their courses, and what if any obstacles they encountered in writing SLOs. Questions asked in the survey were specific only to courses students had already completed that had listed student learning objectives.

The study received approval from Western University of Health Sciences' Institutional Review Board. The participants were provided a description of the study and informed consent was assumed if the participants completed the survey. Survey participants were informed their participation was voluntary and they could withdraw at any time without retribution. All participants were assured their responses would be kept confidential and data would be reported in aggregate form in future presentations and publications. The surveys were administered via e-mail to students and faculty from March 1 through March 30 to accommodate absences from campus during spring break. All courses included in the survey were completed during the prior fall semester. The questionnaires included both closed and open-ended questions to provide an understanding of perspectives as well as to corroborate the findings of the survey results. The student survey was administered online via Qualtrics to all first-, second-, and third-year students (n=244) enrolled in the courses included in the study. The faculty survey was administered online via Qualtrics to faculty (n=13) who teach the courses included in the study. Faculty members were asked in their survey to select ordered responses on a five-point Likert scale in response to how difficult or easy it was to write student learning objectives for their respective courses. The survey also prompted faculty to provide comments to the questions, but comments were not mandatory.

Students were asked to select ordered responses on a three- and five-point Likert scale for five questions that included whether they used SLOs in exam preparation, if SLOs were included in their courses, and whether they were able to predict exam questions from the SLOs provided. The student survey also asked for comments about their learning experiences in the courses that included student learning objectives for each lecture. A simple descriptive analysis was used to report the results of the quantitative portion of the survey. A qualitative method of content analysis was used, classifying texts referencing distinct ideas with code names and grouping similar codes to define themes. The clustered frequencies were grouped as themes describing the range and relative weighting of students' comments. The aim was to illustrate and complement the results of the quantitative analyses using corroboration to confirm the consistency of students' perception.

Results

The response rate for the student survey was 82.8% (N=202) and the response rate for the faculty survey was 100% (N=13), resulting in a representative sample of respondents.

Student survey

Figure 1.
Click to enlarge

Figure 2.
Click to enlarge

Students were asked to respond to survey questions about SLOs provided in their courses on the ordered Likert scale. Figures 1 and 2 show the results. **Figure 1** shows the responses to the first three questions. **Figure 2** shows the responses to the last two questions condensed into three categories from five.

Student survey comments

A total of 96 comments were received. Three themes revealed included the usefulness/non-usefulness of SLOs, the non-use of SLOs and non-alignment of test questions to SLOs. The following are highlights from the survey relative to these themes. Thirty-nine students stated that when the SLOs were provided they were helpful, albeit in some courses more than others. Their comments indicated that the learning objectives provided were a useful guide for studying and exam preparation. Nine students stated the SLOs were not useful or helpful. Their comments indicated that the SLOs provided were too general and/or too broad. Ten students indicated they did not use the learning objectives provided. There were 19 comments related to test materials not being aligned with learning objectives provided. A sample of students' verbatim comments captured through written responses and relative to these themes is provided in **Appendix B**.

Faculty survey

Table 1.
Click to enlarge

Faculty responses to questions relating to writing SLOs were captured. Forty-six percent reported that it was easy or very easy; 23% reported it was neither difficult nor easy; and 31% reported that it was difficult or very difficult to write SLOs. Faculty responses to four yes-or-no questions are shown in **Table 1**.

Faculty survey comments

The second part of the survey prompted faculty to provide comments related to obstacles in writing SLOs, which they identified as determining the key content vs. the outline, the level of detail to include in the objectives, and selecting the best level of Bloom's Taxonomy to use. Seven faculty members also shared comments about writing SLOs and using them in exam construction. They shared their perceptions about SLOs, how they wrote SLOs, and they provided some reflections about writing SLOs. Verbatim comments are provided in Appendix B.

Review of Learning Objectives and Exam Questions

Table 2.
Click to enlarge

The results from a review of all test questions and how they matched with SLOs for all 16 courses are summarized in **Table 2**. Courses varied from 2 to 4 credit hours. The total number of SLOs for each course ranged from 8 to 183, with an average of 87.8. The percentage of SLOs tested (i.e., there was at least one exam question matched to each SLO) ranged from 26% to 100%, with an average of 63.5%. The total number of test questions per course ranged from 87 to 159, with an average of 101 questions. Of these test questions, the percentage of test questions linked to at least one SLO ranged from 91.7% to 100% with an average of 97.9%. The average number of questions per SLO tested was 2.7, with a range of 1.2 to 12.8.

Discussion

First study aim

The first aim of this study was to further our understanding of how graduate health professional students utilize lecture-based student learning objectives in their examination preparation.

This is the first study to document the use of lecture-specific student learning objectives in a Doctor of Optometry program, and only one of three studies to examine use of SLOs in an active classroom setting. Our study found 87.6% of optometry students utilized lecture-specific SLOs to prepare for examinations either always or sometimes, and 12.4% did not. A study involving medical students that included four years of preclinical and clinical courses included only course learning outcomes, without any lecture-specific SLOs.[19] In that study, 53% of students agreed course objectives helped them to pass tests. A study involving optometry students found 19 of 22 students (86%) who were surveyed utilized the objectives in learning, including for self-testing; however, the results were based on use of objectives in a course manual for one course only, and response rate was low.[14]

In our study, 49% of the students who reported utilizing SLOs for exam preparation found SLOs useful, while 15.4% did not. A similar percentage (50.5%) of students reported the exams were aligned with the SLOs. Students found most helpful those objectives that were not too general or too vague, consistent with other studies.[19] Additionally, 90% of students predicted possible questions on the exam based on the SLOs provided in each lecture. In other words, objectives that are specific and exam questions that are directly linked to those objectives are the ones students find most helpful in guiding learning. By ensuring SLOs and exam questions are aligned, faculty can drive what students study. This finding is consistent with previous findings that students' attention to objectives and their actual utilization of provided objectives varies, with a direct positive correlation to increased attention to objectives that are tested [9,20-23] This has implications for teaching in that the instructors' ability to communicate to students the relevance of the lecture material (i.e., material will be tested) increases student attention and engagement which can result in increased retention of material.[23]

The 12.4% of students who did not use SLOs for exam preparation and the 15.4% who utilized but did not find SLOs helpful in exam preparation reported several reasons: the test not reflecting the objectives, the objectives not being specific enough, and not knowing how to utilize the SLOs. The latter may indicate that students do not always choose learning strategies that benefit them, an observation others have made.[2]

Furthermore, our study found that although 100% of faculty provided learning objectives for each lecture, only 34% of students reported professors sometimes (and 1% reported never) provided SLOs for each lecture, and 77% of students reported faculty directly highlighted to students how exam questions align with the lecture. These results point to the need for faculty to increase student awareness of the existence of learning objectives for each lecture, a point confirmed by Stark[14] in stating student attention to objectives is necessary as a first step to utilization. Another factor to consider is whether students with certain characteristics are more likely to utilize and benefit from learning objectives for learning. Holt has reported that men (more than women) and medical students with sensing-type Myers-Briggs preferences benefitted most from using learning objectives, as measured by test performance.[3] We did not collect this information for this study.

Second study aim

The second aim of this study was to increase understanding of the process and obstacles involved in having faculty include student learning objectives for every lecture.

More faculty found writing SLOs easy (46%) than difficult (31%). Although some faculty members reported that writing SLOs was difficult, a majority of them (85%) reported no obstacles. For the 15% of faculty who reported obstacles, one was determining the appropriate level of detail for guiding student learning while not inadvertently confining the content faculty wished to teach. Faculty have previously reported similar concerns, such as feeling their autonomy is threatened or they are rushed to cover all topics to meet the objectives.[4] Faculty comments in our study also revealed selecting the appropriate cognitive level (Bloom's Taxonomy) for each lecture to be an obstacle. The reported obstacles support the need for more faculty training, and the assistance required by each faculty may vary. Our study is in line with others that have shown higher education faculty are not necessarily trained as teachers and may require extensive training to implement practices that enhance student learning.[24]

Faculty may use lecture-specific learning objectives as a guide for their examination preparation, which doubles as a blueprint to assist students in examination preparation. The majority (77%) of faculty reported they implicitly informed students they will utilize SLOs for exam construction and instructed students to use the SLOs to guide their exam preparation. This was confirmed by a higher percentage (87.6%) of students who reported using SLOs for examination preparation. This is an important point because even if objectives are present, students may not implicitly know how to use them in learning, and thus faculty's role in pointing this out to students is important.[25] Interestingly, 15% of faculty members reported not using their SLOs to write exam questions, which matches the percentage who reported obstacles to writing SLOs. They may or may not be the same faculty members. SLOs should be broad enough only to accommodate changes in course content over time. Providing SLOs that are too general would be hard to measure and not useful in guiding students to obtain the relevant content in the course. Determining outcomes for each lecture can prove challenging and may require several attempts to properly accomplish.

Third study aim

The third aim of this study was to measure how well the course assessment test questions reflected the student learning objectives.

The number of SLOs for a single course ranged from a low of 8 to a high of 183. For a 2-credit-hour course, 90 SLOs are expected (based on a guideline of 3 learning objectives per lecture hour). For a 4-credit-hour course, 180 SLOs are expected. That a course has only 8 SLOs likely means the objectives are too broad, and therefore less likely for students to find them useful for exam preparation.

If student course performance is measured by test performance, it is important for the test items to accurately reflect the student learning objectives.[5] Our study found 100% of test questions were tied to at least one SLO for 7 out of 16 courses. Ninety-eight percent of the test questions were linked to a SLO for 15 of the 16 courses. The high percentage of linkage of exam questions to SLOs provides confidence to the instructors that the material tested reflects the material covered in lectures. Although only a negligible number of test questions (2%) were not linked to a SLO, on average only 63.5% of the SLOs were tested, with a high of 100% to a low of 26% for a single course. A slightly lower percentage (50.5%) of students reported the exams were aligned with the SLOs provided by instructors in each lecture. Additionally, 85% of faculty reported using their SLOs as a guide to write exam questions. Because constructive alignment of learning objectives and test items is important to ensure what is being taught is being measured,[26] faculty whose test items are not 100% aligned with learning objectives may benefit from feedback and support.

This study demonstrates the feasibility of initiating a uniform student learning objectives initiative in an established optometry curriculum. Faculty compliance with this initiative during its first year was 89%. This contributes to the feasibility of analyzing and generalizing the study data. The high compliance rate suggests the faculty development program implemented prior to the SLOs initiative was successful in providing the necessary training in instructional approach, including how best to facilitate the incorporation of lecture-specific learning objectives for exam preparation. On the other hand, the finding that faculty assessed 63.5% of the SLOs indicates the need to provide faculty with feedback for continuous improvement of curricular content.

Strengths and limitations

This study is the first to document use of lecture-specific SLOs in a variety of basic, vision and clinical science courses in a healthcare curriculum across 3 years. Well-written lecture-level student learning objectives have important student learning benefits: they enhance student learning by directing students to the essentials, they help students to focus their study on the material teachers most want students to gain from their courses, and they assist teachers in determining appropriate content for exam questions.

One limitation of the study is that it did not evaluate how students utilized the learning objectives or whether they learned more through this process, only whether they used the objectives or not. This study also does not provide information on whether students with certain personality types are more likely to benefit from using SLOs for exam preparation. Without information on actual test performance or specific students, this study cannot directly confirm or reject these hypotheses.

Future implications

Well-written lecture-specific student learning objectives can be utilized to monitor student performance. This is accomplished by linking specific test items to stated learning outcomes and tracking student achievement. Through this process, strong SLOs can be helpful in identifying redundancies and omissions in the curriculum and for monitoring student learning.

Conclusion

Student learning objectives provided for each lecture assisted approximately 88% of doctorate-level health professions students in exam preparation. Students reported that SLOs were useful as long as they are not too general or broad. Objectives that are specific and linked to exam questions are most valuable in advancing student learning. Almost half of the faculty reported that writing learning objectives was easy, but nearly a third found it difficult, indicating a need for continuous feedback for faculty development. Our study found the majority of faculty utilize specific learning objectives for test construction, and most learning objectives are tested on exams. The incorporation of lecture-level SLOs can be impactful for student learning and is recommended as part of the curricular pedagogy for health professions curriculum. Whether SLOs actually change student learning outcomes needs further investigation.

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References

1. Deterline WA. The secrets we keep from students. In: Kapfer MB, editor. Behavioral objectives in curriculum development: Selected readings and bibliography. Englewood Cliffs: Educational Technology Publications; 1971. pp. 3-8.
2. Abate MA, Stamatakis MK, Haggett RR. Excellence in curriculum development and assessment. Am J Pharm Educ. 2003;67(3):1-22.
3. Holt JT, Ghormoz J, Sung YJ, White MW, Szarek JL. Medical student benefit from learning objectives correlates to specific Myers-Briggs types. Med Sci Educ. 2015;25:249-254.
4. Bahous R, Nabhani M. Faculty views on developing and assessing learning outcomes at the tertiary level. J General Education. 2015;64(4):294-309.
5. Anderson HM, Moore DL, Anaya G, Bird E. (2005). Student learning outcomes assessment: a component of program assessment. Am J Pharm Edu. 2005;69(2):256-268.
6. Prideaux D. The emperor's new clothes: from objectives to outcomes. Med Educ. 2003;34:168-9.
7. Webb EM, Naeger DM, Fulton TB, Straus CM. Learning objectives in radiology education: why you need them and how to write them. Acad Radiol. 2013;20:358-63.
8. Walvoord BE (2010). Assessment clear and simple. A practical guide for institutions, departments and general education. SE Jossey-Bass.
9. Raghubir KP. The effects of prior knowledge of learning outcomes on student achievement and retention in science instruction. J Res Sci Teach. 1979;16(4):301-4.
10. Rushin JW, Baller W. The effect of general objectives defined by behavioral objectives on achievement in a college zoology course. Coll Stud J. 1981;15(2):156-61.
11. Mast TA, Silber DL, Williams RG, Evans GP. Medical student use of objectives in basic science and clinical instruction. J Med Educ. 1980;55(9):765-72.
12. Harden RM. Learning outcomes and instructional objectives: is there a difference? Medical Teacher. 2002;24(2):151-5.
13. McCrudden MT, Schraw G. Relevance and goal-focusing in text processing. Educational Psychology Review. 2007;19(2):113-139.
14. Stark LR. Communicating educational objectives in an optometry course. Optometric Education. 2017;42(3):35-42.
15. Crossman JM. Using your syllabus as a learning resource [Internet]. Faculty Focus; 2014 June 9 [cited 2018 November 4]. Available from:

https://www.facultyfocus.com/articles/teaching-and-learning/using-syllabus-learning-resource/.

16. Smythe JL, Daum KM. Attributes of students graduating from schools and colleges of optometry: a 2011 report from the Association of Schools and Colleges of Optometry. Rockville (MD): Association of Schools and Colleges of Optometry; 2011 October 11.
17. Maki PL. Assessing for learning: building a sustainable commitment across the institution. Sterling, VA: Stylus Publishing, LLC; 2004.
18. Nichols JO, Nichols KW. The departmental guide and record book for student outcomes assessment and institutional effectiveness. 3rd ed. New York: Agathon Press; 2000.
19. Mast TA, Silber DL, Williams RG, Evans GP. Medical student use of objectives in basic science and clinical instruction. J Med Educ. 1980;55(9):765-72.
20. Duchastel P. Learning objectives and the organization of prose. J Educ Psychol. 1979;71(1):100-6.
21. Tobias S, Duchastel PC. Behavioral objectives, sequence, and anxiety in CAI. Instr Sci. 1974;3(3):231-42.
22. Jiang L, Elen J. Why do learning goals (not) work: a reexamination of the hypothesized effectiveness of learning goals based on students' behaviour and cognitive processes. Educ Technol Res Dev. 2011;59(4):553-73.
23. Dew R, Goscinski A, Coldwell-Neilson J. Towards a framework for aligning learning outcomes, academic literacies and assessment criteria. Educ Inf Technol. 2016;21:401-423.
24. Banta TW. Can assessment for accountability complement assessment for improvement? [Internet]. Washington (DC): Association of American Colleges & Universities; 2007 Spring [cited 2018 November 4]. Available from: https://www.aacu.org/publications-research/periodicals/can-assessment-accountability-complement-assessment-improvement.
25. Bain K. What the best college teachers do. Cambridge, MA: Harvard University Press; 2004.
26. Biggs J, Tang C. Teaching for quality learning at university. 3rd ed. New York: Open University Press; 2007.

Appendix A. Click to enlarge

*An Introduction to Bloom's Taxonomy

**Outcome Review Checklist

Appendix B. Click to enlarge

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Features

Editorial

A Look Back: Celebrating Women in Optometry

Aurora Denial OD, FAAO | Optometric Education: Volume 44 Number 2 (Winter-Spring 2019)

Aurora Denial, OD, FAAO

March is National Women's History Month.[1] This observance began as National Women's History Week in California in the 1970s as a way to increase awareness of women's historical contributions to the country. In 1980, President Jimmy Carter formalized National Women's History Week, relaying this message to the country:

"*From the first settlers who came to our shores, from the first American Indian families who befriended them, men and women have worked together to build this nation. Too often the women were unsung and sometimes their contributions went unnoticed. But the achievements, leadership, courage, strength and love of the women who built America was as vital as that of the men whose names we know so well."*[1]

In 1987, by Congressional proclamation, the week-long observance was extended to an entire month.

Trending Up Since 1899

The historical trends of women in optometry and other healthcare professions are interesting and illuminating. The March edition of *Optometric Education* is the perfect opportunity to explore these trends and celebrate contributions by women to the profession of optometry.

Around 1899, Gertrude Stanton was reported to become the first licensed female optometrist.[2] She was soon followed by Millie Armstrong.[2] In 1912, there were 500 female optometrists.[3] In 1898, two women were charter members of the American Association of Opticians, which later became the American Optometric Association.[2] However, by 1968, only 368 women were optometrists in the United States, representing 2.1% of active optometrists in the country at the time.[4] In 1969 only 73 females, 2.9% of enrollees, were optometry school students.[5] The 1970s saw increases in women's enrollment, to 19% by 1979.[5] Despite this trend, women in the 70s accounted for a very small percentage of practicing optometrists.[3] Women faced many barriers, either real or perceived, to pursuing a career in optometry. The barriers included social pressure to pursue a more traditional career such as nurse, teacher or secretary, as well as a lack of role models. A study conducted by the Department of Health, Education, and Welfare (as it was known at the time) identified barriers to the profession as stereotyped opinions, unequal access to participate in the status and other rewards from social organizations, discriminatory experiences, problems of household maintenance, stereotypical concerns with practice patterns, and discrimination in placement activities upon graduation.[6] Despite the barriers, political changes in the country, such as passage of Title IX and new draft laws that no longer allowed full-time students to avoid the military, seemed to open doors for more women to pursue the profession. Additionally, more women were attending college overall in the 70s.[7]

The percentage of optometry school enrollees who were women continued to grow in the 80s, from 19% in 1980 to 44% by 1989.[5] From my observations, several of the barriers identified in the 70s were still present in the 80s. However, women in this decade did benefit from fading stereotypes regarding what careers they should pursue. As far as enrollment in optometry schools, 1992-93 was a pivotal academic year. Women became the majority of students enrolled.[5] They continue to lead in enrollment, at 54% in 1999-2000, 64% in 2009-2010 and 68% in 2017-2018.[5] As faculty members, in academic year 2017-2018 women filled the majority of clinical and didactic positions at the associate, assistant and instructor levels.[8] At the rank of professor, women represented 29% of didactic faculty and 47% of clinical faculty.[8] In 2018, 38% of tenured faculty were female, and 59% of faculty on the tenure track were female.[8] In academic leadership, 43% of chief academic officers are female, and 21.4% of the members of the Board of Directors and Executive Committee (both comprised of deans and presidents) of the Association of Schools and College of Optometry (ASCO) are female.[9]

More women today are also members of optometric professional organizations. The 2018 annual report of the American Academy of Optometry (AAO) noted that approximately 40% of fellows and approximately 63% of candidates for fellowship are female.[14] Role models are often key for women aspiring to leadership roles, and there are more of them today. Dr. Joan Exford became the first female president of the AAO in 1993, followed by Dr. Karla Zadnik in 2011 and Dr. Barbara Caffrey in 2018.[2,14] Dr. Dori Carlson became the first female president of the American Optometric Association in 2011, and Dr. Andrea Thau was elected to the role in 2016.[2] Dr. Jennifer Smythe Coyle became the first female president of ASCO in 2013,[2] and Dr. Elizabeth Hoppe became the first female editor of the ASCO journal *Optometric Education* in 2005.

In other healthcare professions, similar trends have occurred. In 1971, 9.2% of medical school graduates were female.[10] The percentage increased to 23% in 1979, 33% in 1989, and 48% in 2010.[10] Not until 2017 did the number of women enrolled in medical schools exceed the number of men.[11] In academic medicine, 25% of professors, 37% of associate professors, 46% of assistant professors, and 58% of instructors are women.[12] Dentistry school female enrollment increased from 2.7% in 1971 to 19.8% in 1980, 38% in 1990, and 48.8% in 2015.[13] In 2017, 22% of the deans at the 65 dental schools across the country were female.[13]

Beyond the Numbers

In the past 50 years, women in optometry have made huge strides. Women in the 60s, 70s and 80s had few role models and many barriers to overcome. The first female optometric leaders forged ahead in uncharted territory. We should celebrate all of our accomplishments, but not lose sight of remaining disparities or new challenges. As faculty we have the unique role of guiding and influencing cohorts of students throughout the years. Within our institutions, we should foster leadership in all faculty and students while embracing and supporting the profession, women's contributions and the future.

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References

1. National Women's History Alliance. Why March is National Women's History Month, Santa Rosa, CA. 2019 [cited on 2019 February 18]. Available from: https://nationalwomenshistoryalliance.org/womens-history-month/womens-history-month-history/
2. Minnesota's optometrists. Women who have influenced optometry, Bloomington, MN. 2017 [cited on 2019 February 16]. Available from: https://minnesota.aoa.org/news/inside-optometry/women-who-influenced-optometry
3. Schoener B. Women and perceived barriers relative to optometry as a profession. Journal of Optometric Education. 1979 Winter;4(3):8-14.
4. U.S. Department of Health, Education, and Welfare, Public Health Services and Mental Health Administration, Optometrists Employed in Health Services, United States 1968, Washington D.C. Government Printing Office, 1973.
5. Association of Schools and College of Optometry. Archived publications: 1969-2008, annual student data report, from ASCO personal correspondence.
6. U.S. Department of Health, Education, and Welfare, Women's Action Program. An exploratory study of women in the health professions schools, Vol VI: women in optometry. Prepared by Urban and Rural Systems Associates, San Francisco, CA, Washington D.C., Government Printing Office, 1976.
7. Borzelleca D. The male female ratio in college. [cited 2019 February 22]. Available from: https://www.forbes.com/sites/ccap/2012/02/16/the-male-female-ratio-in-college/#6da0d267fa52
8. Association of Schools and College of Optometry annual faculty data report, academic year 2017-2018. [cited 20 February 2019]. Available from: https://optometriceducation.org/wp-content/uploads/2018/04/ASCOAnnFacDataRepforWebsite17-18.pdf
9. Association of Schools and College of Optometry. [cited 20 February 2019]. Available from: https://optometriceducation.org/about-asco/executive-committee-and-board-of-directors/
10. Association of American Medical Colleges, AAMC data book. [cited 22 February 2019]. Available from: https://www.aamc.org/data/databook/
11. Association of American Medical Colleges. More women than men enrolled in U.S. medical schools in 2017. [cited 22 February 2019]. Available from https://news.aamc.org/press-releases/article/applicant-enrollment-2017/
12. Association of American Medical Colleges. Medical school faculty by sex and rank. [cited 22 February 2019]. Available from: https://www.aamc.org/data/facultyroster/453634/faculty-trends-percentages.html
13. Lyon C, Vallee J. Changes in the academe: women in dental education. J Calif Dent Assoc. 2017 Jan;45(1):27-30.
14. American Academy of Optometry. Annual report. Orlando Florida, 2018 [cited 2019 February 20]. Available from: https://www.aaopt.org/docs/publications/annual-reports/aao_annualreport_2018_final_web.pdf?sfvrsn=b68c00a6_4

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Industry News

Industry News

Industry News

Desiree Ifft | Optometric Education: Volume 44 Number 2 (Winter-Spring 2019)

Industry News

The Student Experience at Vision Expo East

Vision Expo continues to offer students the resources they need to help kickstart their careers. Vision Expo East will take place in New York City March 21-24, 2019.

Optometry students can access many benefits and learning opportunities, including:

- free exhibit hall registration ($150 value)
- unlimited free education (students should arrive prior to a course's start time and can attend for free if it's not sold out)
- networking events and programs
- Career Zone, a new destination at Vision Expo East on Level 1 of the exhibit hall, provides the opportunity to meet with optical companies and associations face-to-face and is designed for relaxation, community and learning (In the Career Zone, visit the NewGradOptometry/CovalentCareers booth (C4067) to network and hear panel discussions on hot topics; click here for more information)
- the Career Zone Passport Program provides students and young professionals a card (printed automatically at badge retrieval) that can be stamped by each vendor for a chance to win prizes and gift cards
- at the Owning Your Future session, presented in collaboration with the New York State Optometric Association and SUNY College of Optometry and scheduled for Saturday, March 23 from 1-2:30 p.m., students can learn how to stand out and be an effective leader as well as receive free tickets to the Rockin' For New Eyes party on Saturday night

For more information on benefits for students and young professionals, e-mail Diane Tiberio.

Power of One Program Adopts Broader Focus for Practice Revenue Growth

Alcon's Power of One Program is expanding beyond a contact lens strategy to one that aims to improve overall practice revenue. The new Power of One 2.0 Program is harnessing the power of aggregated consumer health and purchase behavior data to support contact lens penetration as a strategy for improving practice revenue per patient across all goods and services. Toward that goal it will provide best-in-class training.

According to new data from the program, contact lens wearers generate, on average, 123% more per-patient annual revenue for optometry practices than glasses-only wearers. Also, compliant contact lens wearers return to their eyecare professional for routine eye exams an average of three months sooner than noncompliant patients; 87% of daily disposable contact lens wearers replace their lenses as scheduled, while only 34% of two-week replacement contact lens wearers do so; daily disposable lens wearers spend up to 77% more annually on all goods and services sold by optometrists compared with two-week replacement lens wearers; and patients who wear multifocal daily disposable contact lenses spend 285% more than those who only wear glasses.

Taskforce Anchors Myopia Initiative

Responding to the dramatic increase in the prevalence of myopia in the United States in recent years, Essilor has created a partnership with 14 leading vision experts to take immediate action to better treat and manage myopia. The plan includes the creation of a Myopia Taskforce and the establishment of a recommended protocol for comprehensive myopia care as part of the Myopia Initiative in Action (MIA) program.

"The rate at which the prevalence of myopia is increasing is staggering," said Millicent Knight, OD, FAAO, FAARM, Senior Vice President of Customer Development at Essilor of America. "True to our mission of improving lives by improving sight, we are bringing together some of the industry's top eyecare professionals with diverse areas of myopia interest and expertise to address this problem together through new research and open collaboration."

The members of the Myopia Taskforce are:

- Thomas Aller, OD, FBCLA
- David Anderson, OD
- Craig Brawley, OD, FAAO

- Mark Bullimore, OD, PhD, FAAO
- Alan Glazier, OD, FAAO
- John Lahr, OD
- Maria Liu, OD, PhD, MPH
- Pamela Lowe, OD, FAAO
- Moshe Mendelson, OD, FIAO
- Pamela Miller, OD, FAAO
- Yi Pang, OD, FAAO
- Earl Smith, OD, PhD
- Long Tran, OD, FAAO
- David Troilo, PhD

In 2018, Essilor launched an awareness campaign focused on myopia, particularly myopia among children, which educated parents about early indications of nearsightedness and urged them to schedule a comprehensive eye exam for their children.

New Progressive Lens Technology

HOYA

Refining its familiar iD LifeStyle 2, HOYA Vision Care launched iD LifeStyle 3, a progressive addition lens that addresses patients' focal and adaptation issues when they have a different prescription in each eye.

iD LifeStyle is built on Hoya's patented Integrated Dual Side Optics platform and incorporates Binocular Harmonization Technology (BHT). BHT ensures that both eyes receive equal accommodative support, according to the needs of each eye, to achieve optimal binocularity, which helps to ensure easy adaptation. Also, iD LifeStyle 3 has three easy-to-prescribe wearer profiles to choose from. Indoor places emphasis on near vision focus; Urban applies equal focus to all main vision areas; and Outdoor puts its primary focus on distance. Options for varying the corridor are also available.

For more information visit the company's website.

Students Earn Opportunity to Participate in Mission Trip

LUXOTTICA RETAIL

Fifteen optometry students are about to embark on a mission trip to Campeche, Mexico, on the Yucatan

Peninsula in conjunction with OneSight and its founding global sponsor Luxottica. The students were chosen for the trip, scheduled for May 11-18, 2019, based on a variety of criteria including a personal essay. They are: Rebecca Aquije, SUNY College of Optometry; Lindsey Colliver, Indiana University School of Optometry; Sinead Flood, Indiana University School of Optometry; Astiney Franklin, MCPHS University School of Optometry; Tasneem Maner, Salus University Pennsylvania College of Optometry; Angelica McIntyre, Southern College of Optometry; Lindsay Michaud, New England College of Optometry; Kimberly Murray, Nova Southeastern University College of Optometry; Nitya Murthy, University of Pikeville Kentucky College of Optometry; Lily Nguyen, Southern California College of Optometry at Marshall B. Ketchum University; Sarah Oh, University of Waterloo School of Optometry & Vision Science; Aaron Ransome, University of Houston College of Optometry; Brooke Segerstrom, University of the Incarnate Word Rosenberg School of Optometry; Stephanie Shoults, The Ohio State University College of Optometry; and Montana Williamson, Western University of Health Sciences College of Optometry. Three alternates were also chosen: Nigenda Griffin, Northeastern State University Oklahoma College of Optometry; Celesti Hao, University of California – Berkeley School of Optometry; and Sherene Vazhappilly, University of Waterloo School of Optometry & Vision Science.

During the mission trip clinic students will work under the supervision of Luxottica Retail-affiliated doctors performing comprehensive eye exams. They will also help support a core team of Luxottica volunteers in frame fitting and manufacturing and dispensing of new eyewear. The nonprofit OneSight partners with local health organizations, governments, school districts, industry leaders, doctors and volunteers to provide access to quality vision care and glasses in underserved communities worldwide. The National Optometric Student Association supported and promoted this year's application process.

Contact Lens Named Among "Best Inventions of 2018"

Johnson & Johnson

VISION CARE, INC.

TIME magazine named ACUVUE OASYS with Transitions Light Intelligent Technology as one of the "Best Inventions of 2018" in its annual round-up spotlighting groundbreaking innovations worldwide. The two-week contact lenses not only correct vision but also help reduce exposure to bright light indoors and outdoors, including filtering blue light and blocking UV rays that can affect eye comfort and vision. They continuously adapt from clear to dark and back, helping eyes adjust to changing light better than they would on their own.

ACUVUE OASYS with Transitions contact lenses were developed through a strategic partnership between Johnson & Johnson Vision Care, Inc. and Transitions Optical Limited. They're marketed by Johnson & Johnson Vision Care, Inc.

Student Grant Winners Announced

National Vision announced the winners of its 2018-2019 student grant program, which challenged applicants to explore the important role optometrists play in making a positive impact on public health issues. As part of their submissions, students were asked to explain how they planned to combat a national or regional public health issue as a future Doctor of Optometry in a 500-word essay or short video submission. A panel of optometrist judges from National Vision selected the winners:

- first place ($5,000 grand prize), Sherene Vazhappilly, University of Waterloo School of Optometry & Vision Science, class of 2019
- runner-up ($1,000 prize), Astiney Franklin, MCPHS University School of Optometry, class of 2020
- runner-up ($1,000 prize), Natalie Wu, New England College of Optometry, class of 2019

Acknowledging all of the applicants, National Vision's Vice President, Professional Services Alexander Smith, OD, said "The key to almost all health issues is early detection. Because many optometrists are naturally on the first line of defense, we believe that improving public health is one of our core responsibilities. The strong submissions we received this year reinforced that today's optometry students understand this responsibility and are eager to make a difference. While we could only pick three winners, we're confident all students who participated will benefit public health after graduation."

FDA Clears Lens Coating Designed to Improve Wearing Comfort

Bausch + Lomb received 510(k) clearance for use of Tangible Hydra-PEG custom contact lens coating technology with several of its leading Boston gas permeable materials, including Boston XO, Boston XO2, Boston EO, Boston ES and those utilized in the Zenlens scleral lens family. The coating technology gives eyecare professionals the opportunity to enhance contact lens customization for their patients using these Bausch + Lomb lens offerings. In June 2018, Bausch + Lomb entered into a worldwide licensing agreement with Tangible Science, LLC, a company whose mission is to create technologies that improve the contact lens wearing experience. Tangible Hydra-PEG is a high-water polymer coating that is bonded to the surface of a contact lens to address contact lens discomfort and dryness. Click here for more information.

Company Joins Private Equity Firm's Holding Group

Private equity firm Atlantic Street Capital is adding diagnostic equipment supplier Marco Ophthalmic to its Advancing Eyecare Holdings group. The group also includes Atlantic's portfolio company Lombart Instrument as well as Innova Medical and Enhanced Medical Services (EMS). Atlantic aims to create a North American market leader in distribution of new and pre-owned products, services and solutions to enhance and expand the services provided to the eyecare industry.

Upon completion of the transaction, expected by the end of the first quarter of 2019, David Marco will continue as a meaningful investor in the business and will join Advancing Eyecare as Co-Chairman of the newly formed company and help advise the senior management teams.

New Software Packages Enhance Diagnostic Data Processing

Nidek launched two new software packages for use with the NAVIS-EX centralized image filing system, one for the CEM-530 specular microscope and another for the AL-Scan optical biometer. The viewing software packages allow viewing, calculations and processing of data within NAVIS-EX after measurement with either instrument.

With the CEM Viewer, an unlimited NAVIS-EX database is available for reviewing CEM-530 measurement data on an external computer. Data can be reviewed for progression over time and two data sets can be compared for monitoring endothelial changes over time. Images and analyses of the paracentral and peripheral areas can be displayed for a comprehensive image of endothelial cells. The basic functions of the CEM-530 including endothelial cell count can be performed on the CEM Viewer.

Executive Changes at Rev360

Scott Filion has been promoted to CEO of Rev360, the company behind RevolutionEHR and a suite of practice solutions for eyecare professionals. Formerly President and COO, Filion now oversees Rev360's three business units: RevolutionEHR, Professional Eye Care Associates of America (PECAA) and Visionary Partners. The company's founder and former CEO, Scott Jens, has assumed a senior advisor position to the Board of Directors.

In addition, Rev360 named Corey Crawford to the role of Vice President of Operations for RevolutionEHR. Crawford, formerly the Director of Product Management, is now focused on fusing software solutions to create a comprehensive and cohesive experience for customers.

General Manager, India Appointed

Volk Optical appointed Sunil Bharti, MBA, to the role of General Manager, India. In this position, Bharti leads Volk's sales and marketing organization in India and is responsible for establishing and implementing the strategy for continued growth in the region. He works closely with doctors and healthcare institutions to understand the Indian market's unmet needs and provide the best solutions from Volk's portfolio of diagnostic and therapeutic lenses, surgical instruments and ophthalmic imaging devices.

Bharti brings more than 20 years of medical device and life sciences experience to the role. Most recently he served as Deputy General Manager of Sales for Perkin Elmer Genomics-India.

Annual Educator's Meeting and IACLE Americas Award

The annual CooperVision Educator's Meeting took place in Las Vegas on Jan. 24, 2019. This year's meeting was the first to be cohosted by CooperVision North America Professional Affairs and CooperVision's newly formed Specialty Lens Division, led by Juan Carlos Aragon, OD. Along with a think-tank competition and presentations on the myopia epidemic and myopia control, the meeting featured several updates, including that the CooperVision Adopt-a-Patient program is expanding to include specialty lens division products.

Lyndon Jones, PhD, DSc, FCAHS, FCOptom, FAAO, Professor and Director of the Centre for Ocular Research & Education at the University of Waterloo School of Optometry and Vision Science, received the International Association of Contact Lens Educators' 2018 Americas Contact Lens Educator of the Year Award, which was presented to him by Michele Andrews, OD, Sr. Director of Professional and Academic Affairs for CooperVision.

Results from the Annual Employee Perceptions of Vision Benefits Survey

According to the 10th annual Transitions Optical Employee Perceptions of Vision Benefits survey, eight in 10 people are plagued by vision-related symptoms at work, ranging from eye fatigue and headaches (half of employees) to dry eyes and blurred vision (more than one in three employees). The survey uncovered two factors specifically — digital eyestrain and light sensitivity — that have been linked with these symptoms and are affecting employees' ability to do their jobs.

While the vast majority of the surveyed employees reported they have taken steps to protect their eyes from light sensitivity and digital eyestrain at work, the survey revealed few are using the right eyewear, such as anti-reflective or no-glare coatings, photochromic lenses or blue-light-filtering lenses, to help. Eight in 10 surveyed employees reported they would be likely to purchase premium lens options if their eye doctor recommended them.

To help elevate the importance of comprehensive eye exams and quality eyewear available through vision benefits, Transitions Optical offers a variety of employee and employer focused tools and education. These can be accessed, free of charge, at HealthySightWorkingforYou.org.