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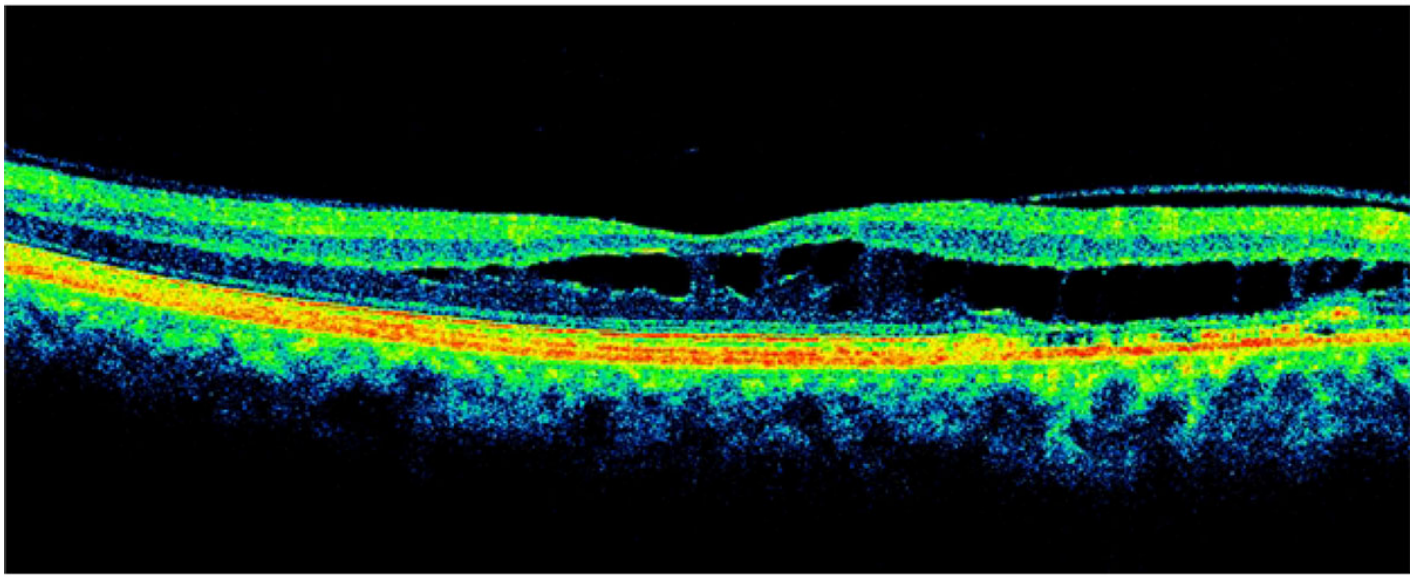

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# Research Teams Receive 2016 ASCO Educational Starter Grants

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The Association of Schools and Colleges of Optometry is pleased to announce the recipients of its 2016 Educational Starter Grants, which are dedicated to supporting educational research. *A generous donation from Johnson & Johnson Vision Care Inc. has provided funding for this year's grants.* We applaud all faculty who submitted grant applications this year.

The recipients are:

- Patricia Cisarik, OD, PhD, and Kristina Haworth, OD, PhD, FAAO (Southern College of Optometry) for "Development of a Digital Training Module for the Systematic Optic Disc Evaluation"
- Crystal Lewandowski, BS, OD, and Thomas Andrea, BS, OD (New England College of Optometry) for "The New England College of Optometry Student Perception of Cultural Competence"
- Valerie Wren, OD (Western University of Health Sciences College of Optometry) for "Development of Educator Consensus on Entry-Level Competencies in Brain Injury Visual Rehabilitation"

# Assessing Student Performance in Geometrical Optics Using Two Different Assessment Tools: Tablet and Paper

Gregory M. Fecho, OD, Jamie Althoff, OD, and Patrick Hardigan, PhD | Optometric Education: Volume 42 Number 1 (Fall 2016)

**Background**

Since the release of the first iPad in 2010, tablets have become increasingly prominent in educational settings. According to a 2015 survey by the Pearson Foundation, 51% of college students in the United States own a tablet and use it for academic purposes, while in 2011 only 7% owned a tablet.[1,2] Another survey, by McGraw-Hill, found that 81% of college students used mobile devices for studying in 2014, a 40% increase from 2013.[3] The portability and ease of use of tablets can make many aspects of teaching and learning more interactive and more convenient. It has become common to use tablets in the classroom for conducting formative assessments such as mid-lecture questions to check for student comprehension.[4,5] However, no publications have reported on the utilization of tablets for administering summative assessments such as midterm and final examinations. There are many reports regarding the use of personal computers for this purpose, some showing no significant difference in student performance,[6,7,8] and others indicating that computer-based testing methods should not be considered equivalent to pencil and paper testing.[9,10] Clariana and Wallace[9] describe the "test mode effect," whereby otherwise equivalent tests yield different results when completed with different methods. Their study found that undergraduate students performed better on computer-based assessments than on paper-based assessments. Their results conflict with a previous study in which Lee and Weerakoon[10] discuss the significance of computer anxiety when completing computer-based tests. They found that one-third of health professions students in a microbiology course experienced computer anxiety, and the students performed significantly better on paper-based tests than on computer-based. Leeson[11] describes important factors, such as the student's familiarity with computers, text readability due to screen resolution and font characteristics, and the intuitiveness of the user interface, which may affect student performance on computer-based assessments. Tablet use differs significantly from computer use in these aspects, and there are additional differences such as screen size and the use of a touch screen instead of a mouse. Therefore, the available literature describing computer-based testing should not be generalized to testing on iPads.

Since August 2012, Nova Southeastern University College of Optometry (NSU) has mandated that every incoming student acquire an iPad for use in classrooms and labs. During the first week of classes, a general orientation is given to familiarize the students with the basic functions of the iPad, including suggested apps, e-mail setup, and data backup strategies. Students have embraced the technology for taking notes and viewing interactive class materials. In Fall 2013, the College of Optometry acquired the ExamSoft program and began utilizing the SofTest-M app. Like other colleges of optometry, the NSU program traditionally administers in-class examinations using printed copies and Scantrons. Questions are typically multiple-choice, with the occasional short answer format, depending on the course. The SofTest-M app allows for a secure assessment to be taken on an iPad by downloading an encrypted exam file that can only be opened with a password. Before the exam starts, the iPad must be "locked" with the Guided Access setting, making it impossible for the user to view other apps or capture screenshots while the exam is in progress. Questions and answers can be randomized to improve security, and several types of test questions can be created. The ability to include pictures or videos within questions increases the potential to test the student's clinical observational skills and allows the instructor to test in ways not possible with pencil and paper examinations. The ExamSoft program utilizes a user-friendly and secure cloud-based test bank creation system, and a powerful reporting system allows instructors to provide more effective and constructive feedback to the student. Tagging test items with categories allows for long-term tracking of student performance in areas of concern, providing valuable information for individual student growth or overall course or program development. Data collected from these reports can allow instructors to gather more meaningful outcome measures from their courses than simple test averages. Depending on how each question in the test data bank is categorized, the instructor can gather outcome measures on specific topics, test question types, and even college-level accreditation outcome measures.[12]

All incoming optometry students in the Fall of 2013 were given an introduction to SofTest-M as part of the general iPad orientation. This orientation included the requirement to take a mock examination to become familiar with the mechanics of the program. After this general orientation, some instructors began using the program to administer small assessments such as lecture and lab quizzes. These initial experiences with the SofTest-M app and ExamSoft program showed great potential for efficient and secure creation, distribution, and analysis of assessments. Despite some reluctance to using ExamSoft expressed by a few vocal students, grades on these quizzes did not seem to be affected. There were no significant technical difficulties relating to test administration, grading or student test reviews when using ExamSoft.

The numerous benefits of the system for both instructors and students were clear during initial trials. Nevertheless, instructors may feel that adopting a new way of administering an examination could negatively influence student performance. Technical issues may arise, or psychological barriers when using technology in the exam process could negatively affect student performance on critical examinations. Therefore, we felt further research was warranted to determine whether testing on iPads is an acceptable and valid alternative to traditional pencil and paper testing. The goal of this study was to determine if any statistically significant difference exists in test scores in Geometrical Optics when tests are completed using the SofTest-M app on an iPad instead of pencil and paper. Student opinions on using this software were also obtained to determine whether student attitude correlates with exam score averages. Results of this study may influence educators' decisions to adopt this technology in their courses.

Based on our initial experiences with the software, we hypothesized that Geometrical Optics test score averages would not be significantly affected when tests were completed using the SofTest-M app on an iPad instead of the traditional pencil and paper method.

**Methods**

The Institutional Review Board of NSU determined this study to be exempt from review for the following reasons: Test scores were naturally available to one of us as the instructor of record for the Geometrical Optics course, the OAT scores and GPAs that were required in the comparison of the groups involved in this study were provided to us de-identified and as separate data sets, and participation in the survey was voluntary and anonymous with minimal risk to participants.

This study compared two groups: students who took exams using traditional pencil and paper methods (Fall 2013 group), and students who took exams via the SofTest-M app on their iPads (Fall 2014 group).

During the Fall 2013 semester of Geometrical Optics, three exams were given using pencil and paper and Scantrons. The two midterm exams were each weighted as 20% of the course grade, and the cumulative final exam was weighted as 40% of the course grade. An additional 20% of the course grade was based on homework and quiz scores. Each exam consisted of 26-28 multiple-choice questions with a two-hour time limit. Students used their own calculators for the exams. There were 111 new, first-year students enrolled in the course. One hundred and ten students took the first and second exams, and all 111 students took the final exam. These students had completed the iPad orientation, along with a mock quiz on SofTest-M, at the beginning of the semester, and the instructor administered small-stakes lecture and lab quizzes with the SofTest-M app during this semester to become familiar with test creation, administration and grading. Our Technology Advisory Committee felt it necessary to pilot SofTest-M on these smaller low-stakes quizzes for the 2013 academic year before adopting the new technology for higher-stakes, in-class examinations for Geometrical Optics starting in the Fall of 2014.

During the Fall 2014 semester of Geometrical Optics, three in-class exams were given using SofTest-M on iPads. The exams were identical in weighting, content and order of presentation to the exams given in 2013, with the exception of the last question on the final exam. Upon review in 2013, this item was ambiguous. It was removed from the 2014 final exam, and it was not included in the data for either year. The exams had the same two-hour time limit as the previous year. Students used their own iPads and calculators for the exams. There were 106 new, first-year students enrolled in the course. Two additional students were repeating the course, and their data was not included. One hundred and five students took the first and third exams, and 106 students took the second exam. All of the students had completed the iPad orientation with a mock SofTest-M quiz during the first week of classes, and they had used their own iPads to take at least seven small-stakes SofTest-M quizzes during the early weeks of the Geometrical Optics lecture and lab courses. This allowed all students to become familiar with the iPad testing format before the first exam on the iPad was given. In addition, while the students' first experience with a high-stakes examination using SofTest-M was in this Geometrical Optics course, it is worth noting that they were also using SofTest-M in another optometry course during the Fall 2014 semester for take-home quizzes and in-class examinations.

Protocol for test administration using pencil and paper exams was standard and straightforward during the Fall 2013 semester. However, the use of SofTest-M during the Fall 2014 semester required some changes to the testing protocol. Students were required to download the encrypted exam file onto their iPad. These exam files were available to download several hours before each test began, but the exams were password-protected and therefore inaccessible until the actual start time of the test. There were two instructors present during each test administration who were familiar with SofTest-M and available to address any technical issues during the exam. There were two extra iPads available for student use as needed, as well as several backup paper copies of the exam. Upon entering the exam room, students were given the exam password and several sheets of scratch paper and were expected to prepare their iPads to start the exam. This entails setting the iPad to "Airplane Mode" in order to block internet access and turning on "Guided Access" so that the students are not able to leave the SofTest-M app or take screenshots during the exam. The software requires these settings in order for a secure exam to be opened in the app. Once all students were prepared, they were told to begin the exam. Upon starting the exam, the SofTest-M

app began the two-hour timer set by the instructor. At the end of the time limit, the exam automatically saved and closed. As students completed the exam, they would return their scratch paper to an exam proctor and show the preceptor that their exam was permanently closed and therefore unable to be viewed or modified. Upon leaving the room, students would exit Guided Access mode and reconnect to the internet in order to upload their completed exam file. Any students who forgot to upload their exam file were sent an e-mail reminder, and all exam files were always uploaded and ready to grade within several hours of the end of the exam time.

A quasi-experimental design was employed to look for differences between the two groups: the pencil and paper test group (Fall 2013 group) and the iPad test group (Fall 2014 group). The dependent variable was the raw score on the three Geometrical Optics exams, with a maximum possible score of 26 on the first and second exams, and 28 on the final exam. To control for variation in academic ability between classes, comparisons were made between the pencil and paper test group and iPad test group by undergraduate GPA and academic average OAT score. De-identified GPA and OAT averages for both groups were provided by the Dean of Student Affairs. Descriptive statistics were calculated for all study variables. The Welch t-test was employed to look for differences between the two groups by each exam. Welch's t-test is more robust than a Student's t-test and maintains type I error rates close to nominal for unequal variances and for unequal sample sizes. Furthermore, the power of Welch's t-test comes close to that of Student's t-test, even when the population variances are equal and sample sizes are balanced.[13] Statistical significance was found at $p < 0.05$ and R 3.1.2 was used for all analyses.[14]

An online survey was e-mailed to students at the conclusion of the Fall 2014 Geometrical Optics course to ask them about their experience with the software. Two weeks later, an e-mail reminder was sent. The Fall 2013 students were not surveyed because they were only exposed to small-stakes quizzes and did not take course examinations in class using SofTest-M. The students chose one of five answers for each of the survey questions: "Strongly Agree," "Agree," "Neither Agree nor Disagree," "Disagree," or "Strongly Disagree." We assigned a value of 5 for "Strongly Agree," 4 for "Agree," 3 for "Neither Agree nor Disagree," 2 for "Disagree," and 1 for "Strongly Disagree." The mean response and standard deviation were then calculated for each question. The midpoint value for the 5-point scale was 3.0. For statistical purposes we treated the scale as an approximation to an underlying continuous variable whose value characterizes the respondents' opinions or attitudes toward SofTest-M.[15] In describing the trends of student feelings, we used any mean of 3.5 or above as representing "Agree" and a mean of 2.5 or less as representing "Disagree." For simplicity in presenting the survey responses in **Table 2**, we combined the "Strongly Agree" and "Agree" responses and calculated the percentage of students that generally agreed with a given statement. We also combined the "Strongly Disagree" and "Disagree" responses and calculated the percentage of students that generally disagreed with a given statement.

The survey also included free text boxes so students could share strengths, weaknesses and any other general feedback regarding SofTest-M. We used a grounded theory approach in analyzing these responses, relying on our empirical observations and data to qualitatively evaluate the free text responses and inductively obtain the general themes.[16] The steps we followed in applying grounded theory to our data analysis included open axial, and selective coding.[17] The open coding phase involved listing all of the individual statements collected from the survey, analyzing the comments and summarizing the main point of each comment to create an initial label for each statement. For the purposes of this study, a topic was considered significant when three or more comments were given the same label, while comments that were raised only once or twice were not further considered during axial or selective coding. In the axial phase we analyzed the labels made in the open coding phase for relationships and grouped comments into categories and subcategories according to their commonalities. Finally, in the selective coding phase, we were able to determine the broader overriding themes that emerged from these data.

**Results**

One-hundred and eleven students constituted the pencil and paper test group, while 106 were in the iPad test group. To examine if the groups had similar academic abilities, we compared their average undergraduate GPA and OAT scores. Using a Welch t-test we found no statistically significant difference by GPA or OAT score **(Table 1)**. Using a Welch t-test we also found no statistically significant difference between the groups for any Geometrical Optics exam **(Figure 1)**.

FIGURE 1

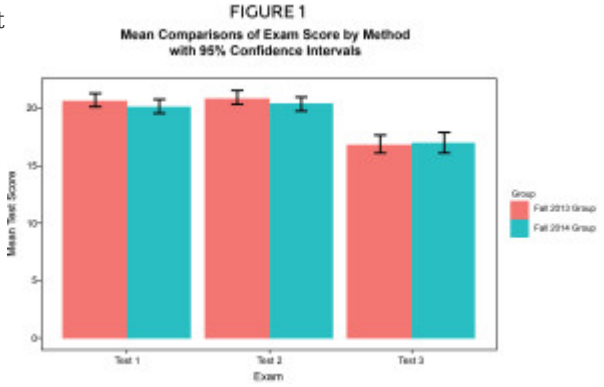


*Figure 1: click to enlarge*

*Survey results*

TABLE 1
Descriptive Statistics for Study Variables

| roup | N | M | SD |
|---|---|---|---|
| ll 2013 Group | 110 | 20.70 | 3.32 |
| ll 2014 Group | 105 | 20.18 | 3.42 |
| ll 2013 Group | 110 | 20.93 | 3.35 |
| ll 2014 Group | 106 | 20.42 | 3.09 |
| ll 2013 Group | 111 | 16.88 | 4.31 |
| ll 2014 Group | 105 | 17.03 | 4.83 |

| riable | N | M | SD |
|---|---|---|---|
| ll 2013 Group GPA | 111 | 3.33 | 0.32 |
| ll 2014 Group GPA | 106 | 3.33 | 0.32 |
| ll 2013 Group OAT Score | 111 | 314.23 | 20.12 |
| ll 2014 Group OAT Score | 106 | 317.92 | 21.96 |

*Table 1: click to enlarge*

A total of 60 out of 106 students from the iPad group completed the survey, yielding a response rate of 57%. Survey results are presented in **Table 2** and are divided into two categories: student opinions of the SofTest-M application, and student opinions on comparing in-class examinations on paper vs. in-class examinations on the iPad using SofTest-M. Most students agreed that the basic technical aspects of SofTest-M were simple to use. The students found SofTest-M easy to use (4.22 ±0.80, 90% agreed), found downloading the exams simple (4.52 ±0.60, 98% agreed), and found the software easy to adapt to (3.97 ±0.97, 75% agreed). The average response to the question that there were too many technical issues during test-taking fell slightly above our cutoff for "disagree" (2.55 ±1.17, 58% disagreed, 22% agreed).

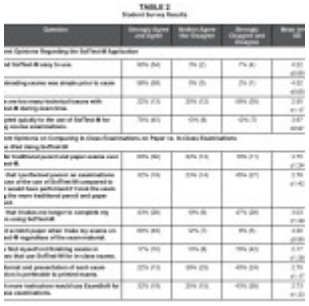

TABLE 2

*Table 2: click to enlarge*

On average, students prefer to take traditional pencil and paper exams (3.75 ±1.24, 60% agreed). Student feelings were divided regarding whether SofTest-M negatively affected their exam performance (2.78 ±1.42, 32% agreed, 45% disagreed), and whether it took longer to take exams (3.03 ±1.39, 43% agreed, 47% disagreed), and they were divided in their feelings that more instructors should use SofTest-M (2.73 ±1.33, 32% agreed, 43% disagreed). On average, students disagreed with the statement that they did not have time to finish the exams given on the iPad (2.17 ±1.26, 70% disagreed). Student opinions were generally indifferent regarding whether SofTest-M represented an improvement in formatting and presentation of questions (2.75 ±1.17, 38% neither agreed nor disagreed, 40% disagreed). Finally, most students agreed that they needed scratch paper for the exams given on the iPad regardless of course content (4.20 ±0.95, 80% agreed).

TABLE 3

*Table 3: click to enlarge*

Thirty-four students provided strengths and weaknesses of SofTest-M, and 12 students provided general feedback regarding their use of the software. In total, these students provided us with 159 individual statements. Each of the statements was assigned a label representing the main idea being conveyed. Because the students were asked to provide strengths and weaknesses of using SofTest-M, the comments naturally fell into these two main categories. Sixty-three cited strength comments, and 68 weakness comments were determined to be significant during open coding. Comments were then divided into six subcategories relating to software design, grading, time management, ergonomics and user comfort, stress and exam security. **Table 3** organizes the comments based on this grounded theory analysis and lists the number of occurrences for each statement.

## Discussion

We have found that there are no statistically significant differences in average Geometrical Optics exam scores when comparing the traditional pencil and paper method to the SoftTest-M app on iPads. Early studies of computer-based assessments describe a "test mode effect,"[9,10] but more recently published literature implies that performance on computer-based assessments is equal to performance on traditional pencil and paper tests.[6,7,8] Our study further shows that the mode of testing does not affect performance when using this more recently developed tablet-based assessment method.

Perhaps the most striking result from our survey is that most students preferred pencil and paper exams in spite of largely agreeing that SofTest-M is easy to use. We feel this preference is partially due to the students' comfort with pencil and paper assessments and relative unfamiliarity with SofTest-M. Ward et al.[18] found an increased anxiety level in students taking examinations on a computer compared to those who took exams using pencil and paper. They suggested that the increased anxiety level originates from the unfamiliarity with the technology, and we could expect this anxiety to lessen as exposure increases. While computerized test-taking is not an entirely new concept — the OAT and Part 2 of the National Board exam are given on desktop computers — the overall exposure to computerized testing over the entire career of the student is minimal, while paper examinations remain commonplace. The significance of this point might be apparent when comparing our study results to those of Higgins et al.[19] The much younger fourth-grade students in their study preferred computer-based exams over pencil and paper exams, perhaps due to the fact that they had spent fewer years developing a strong preference for pencil and paper exams. We agree with suggestions by Ward et al. that students' feelings toward a new technology may improve over time. If instructors in subsequent didactic courses utilize SofTest-M, it is possible that students will become accustomed to

taking exams on their iPads, and this increased exposure may reduce the stress of using a new method of testing. Hanson et al.[20] did in fact find that students at the Indiana University School of Medicine reported fewer concerns with computerized testing after taking two tests via ExamSoft on desktop computers than before taking those tests. Stress from using a new test-taking modality was not frequently mentioned in our survey, but more students might have expressed this concern if we had included this topic in the survey questions.

It is also possible that student anxiety manifested as, or resulted from, the perception of inadequate exam time while using SofTest-M. Although most students indicated that SofTest-M did not prevent them from finishing their exam in time, there was a notable minority that felt this was an issue. Our study did not attempt to analyze any differences in speed between groups, and it is unclear whether these students' perceptions were accurate. However, research currently indicates that computerized testing offers an advantage for timed tests because answers do not have to be recorded on a separate answer sheet.[21,22]

Responses to the survey questions also emphasized the students' strong desire for scratch paper during exams. This was also one of the most commonly cited weaknesses of SofTest-M in the free-response section of our survey. This was likely due to the inability of SofTest-M to allow annotation and highlighting of questions and answer choices, a practice that students are accustomed to on pencil and paper exams. Blazer[23] discussed the importance of this feature in a 2010 report for Miami-Dade Public Schools and referred to the use of an electronic marker to highlight passages on computer-based exams. The ability to highlight words and phrases in the question stem was added to the software after our study was completed. Perhaps as the software matures more annotation features such as drawing and writing may be added, and scratch paper will become less of a demand.

*Image 1. For long questions or questions with many answer choices, students may have to scroll or adjust the window size to view all necessary information. On the right side of this screen, the Questions List is opened and showing all Flagged Questions from this exam.*
*Image 1: click to enlarge*

The free-response section of our survey implicated the visually crowded screen as another significant weakness of SofTest-M. Students complained that information can get crowded on the screen, and that it is inconvenient to scroll through question text and answer choices for some of the longer questions **(Image 1)**. When using SofTest-M, images or attachments within individual questions may also compete for screen space, although these attachments can be closed and reopened as needed **(Image 2)**. The impact of scrolling on performance in computer-based assessments has been studied in various settings, and some studies suggest that the ability to view all question content without scrolling results in higher test scores.[19,21,24] However, we hesitate to assume these findings apply to SofTest-M exams because the process of scrolling on a computer is different than on a tablet. Scrolling through information on a computer screen involves a scroll bar, mouse wheel or page up/down keyboard keys. On a tablet, the students place their finger directly on the screen to move the content up or down to the desired location.

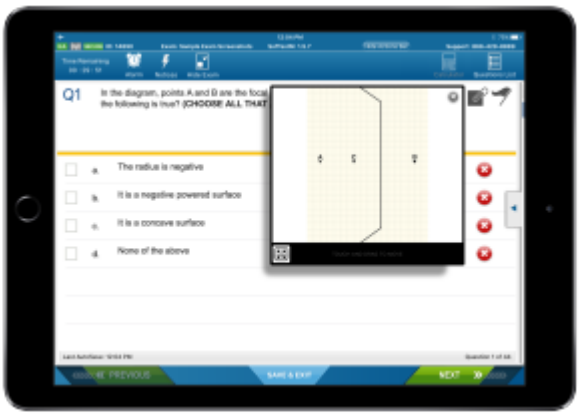

*Image 2. A question attachment such as an image or diagram opens automatically when the question is opened. The image may obscure parts of the question text or answer choices, but it can be moved or closed and reopened as needed.*
*Image 2: click to enlarge*

The greatest strength of SofTest-M that was mentioned in the free-response section of the survey was quickly receiving exam scores with detailed category reports **(Image 3)**. Faster scoring and more specific feedback are

commonly mentioned benefits of computer-based assessments,[25,26] and Bennet[27] has cited these as important reasons that state education agencies are employing more online tests. At the NSU College of Optometry, Scantrons are scored using an external grading center, and any errors such as a mis-key can cause significant grading delays. ExamSoft, on the other hand, allows for direct control of the grading process with the ability to easily adjust and re-score items and assessments as needed. This has decreased the time it takes for faculty to distribute grades to the students. The ability to tag and categorize questions also enables the instructor to provide customized, detailed

feedback regarding a student's performance **(Image 3)** and can help guide the student in determining particular topics that need to be reviewed.

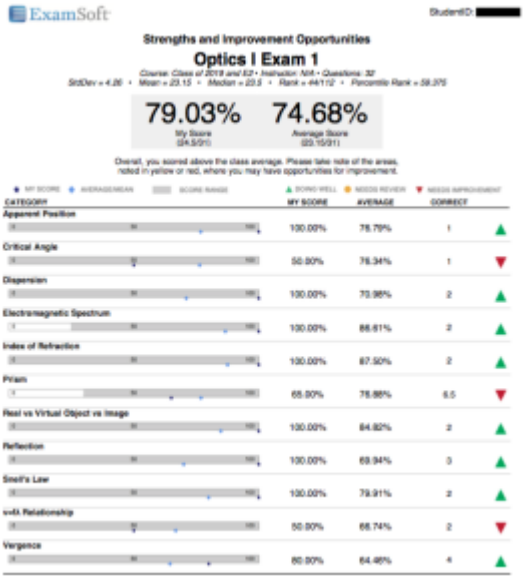


*Image 3. Student score reports can be customized to include more or less information according to instructor preferences.*
*Image 3: click to enlarge*

The ability to flag questions was another commonly mentioned strength of the SofTest-M design. The software has the ability to flag questions so that the student can return directly to the questions by accessing a question list menu **(Image 1)**. This menu can show a quick overview of the unanswered and flagged questions, and a simple tap returns the student directly to these questions. Russell et al.[28] and Johnson and Green[29] confirmed the importance of features such as reviewing questions, skipping questions and changing items that have already been answered. These features allow students to utilize test-taking strategies similar to those they have developed on pencil and paper exams.

The use of any technology introduces the potential of technical problems and software bugs, which could cause serious problems for the administration of an examination. Rabinowitz and Brandt[30] articulated this point, stating that computer crashes are more difficult to resolve than broken pencils. However, during our study, technical issues were rare and never prevented a student from completing and submitting an exam. Our policy is to bring two backup iPads and five paper copies of the exam for student use if needed. The backup iPads were used on occasion for students whose iPads were either stolen or broken, but the paper backup copies were never needed. During examinations for another course, we encountered software bugs in the form of app crashes that exit a student out of the exam. Because the exam is frequently and automatically saved locally to the iPad while the student is taking the exam, no exam progress is lost in the event of an app crash. Resuming an examination is trivial and simply requires a "resume code" entered by the proctor. We did not experience any of these crashes during the examinations in this study. In order to minimize technical issues with the software, we instructed students to keep both the SofTest-M app and the iPad operating system (iOS) updated to their most current versions. However, because the major annual iOS updates (e.g., from iOS 9 to iOS 10) are more likely to create compatibility issues, students are told to wait for approval from our Technology Advisory Committee before completing these particular updates.

Because SofTest-M can only be used on the iPad, and no other available apps allow for secure tablet-based exams, we did not attempt to separate student feelings regarding taking exams using SofTest-M and taking exams using iPads. While the survey focused on gathering student opinions on SofTest-M, distinguishing between feelings toward iPad testing and feelings toward SofTest-M as well as asking questions regarding the general use of the iPad during testing would have been informative. For example, feedback regarding glare from the screen, asthenopia from prolonged viewing of the display, and legibility of the print would have been valuable. It is also worth noting that the survey was only available online, and although it was simple to complete, this may have discouraged participation by students who are uncomfortable with technology and created bias in survey results. A final limitation of the study was the unavoidable use of a quasi-experimental design and the relatively small sample size. Therefore, we suggest others replicate the study.

Further research to compare the anxiety level of students taking examinations using SofTest-M and students using pencil and

paper would be useful to increase our understanding of students' mindsets during exams. Studies evaluating student performance with different question types, especially those available only with computerized testing, such as video questions, can help better define the usefulness of such unique questions in the examination. Students were divided on whether it took longer to complete their examinations with SofTest-M, and this is another possible topic for future study. Lastly, faculty experiences including test creation, category management and exam implementation experience could be explored in future research. Since implementing this study, many more faculty at the NSU College of Optometry have begun using ExamSoft, and initial anecdotal experiences have been largely favorable.

In light of our findings, instructors can confidently implement ExamSoft into their curricula in lieu of paper and pencil exams for multiple choice-type examinations without fear of a negative impact on student performance. Findings from this study can be used to assure students that their performance will not suffer if an instructor decides to use this modality of testing. The instructor can also inform students that SofTest-M is an easy and approachable system to use. We strongly urge the use of scratch paper for calculation-based examinations because of the limited annotation capabilities of the software. The importance of scrolling completely through both the question stem and answer choices should be emphasized to students. Instructors might also consider making adjustments to test items, such as limiting answer choices or reducing font size, to fit more information on the screen at one time. Students' experiences will be optimal if they are made aware of all software features, such as question flagging, and if instructors take the time to categorize all questions and provide individual student feedback.

**Conclusion**

We have concluded that there were no differences in test averages between students who took Geometrical Optics examinations using pencil and paper compared with those who took exams via the SoftTest-M app on their iPads. Students were divided on how they viewed their exam performance when using SofTest-M and overall preferred to take traditional pencil and paper examinations. Adoption of new technology in education should be implemented not because it may be trendy, but because it has the potential to produce effective outcome measures that can help strengthen students' understanding of the material in addition to strengthening the curriculum. ExamSoft has the potential of accomplishing these goals, and so far we have had a positive experience using the system. Students may not readily appreciate some of the most significant benefits of ExamSoft, such as the ability to categorize each question, generate individual reports highlighting a student's strengths and weaknesses, and eventually track a student's performance in each of these course topics over the entire curriculum. The advantages of such tailored feedback may become more apparent to students as more instructors take advantage of these features of ExamSoft. We hope the findings from our research help educators make informed decisions regarding the implementation and adoption of tablet-based assessments into their courses and curricula.

**Acknowledgement**

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# Targeting Intraocular Pressure in Glaucoma: a Teaching Case Report

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**Background**

Glaucoma is a range of conditions that causes a loss of retinal ganglion cell axons within the nerve fiber layer resulting in vision loss.[1,2] Although many novel treatments for glaucoma are being investigated, the mainstay therapy is control and reduction of intraocular pressure (IOP).[1,2] Upon diagnosis, the setting of an IOP target is the first step in the management of any glaucoma patient. This case report presents an example of one method for determining target IOP along with a brief review of the literature. This report is aimed for third- and fourth-year optometric students and practicing optometrists managing glaucoma.

**Case Description**

Referred by an outside physician, a 75-year-old African American male presented to the clinic for a glaucoma evaluation. The patient reported having no visual complaints, but he did report that his mother and maternal grandmother were diagnosed with severe glaucoma and that he had a history of high IOP. Best-corrected visual acuities were 20/20 in both eyes and all preliminary and anterior segment findings were normal except for mild nuclear sclerotic cataracts. Intraocular pressure measurements were 24 mmHg in the right eye and 27 mmHg in the left measured with Goldmann tonometry. Pachymetry revealed a corneal thickness of 525 µm in the right eye and 530 µm in the left eye. Anterior chamber angles were open to the ciliary body in all quadrants with minimal pigment and a flat iris insertion on gonioscopy in both eyes. Optic nerve head evaluation in the right eye revealed a round, distinct, well-perfused nerve with a vertical cup-to-disc ratio of 0.6 that followed the ISNT rule. According to the ISNT rule, the inferior rim of the optic nerve typically is the thickest, followed by the superior then nasal then temporal rim. The left optic nerve was also round, distinct and well-perfused, but the vertical cup-to-disc ratio was 0.8 and it did not follow the ISNT rule. The vertical disc diameter was 1.7 mm when viewed through a 78D lens in both eyes. The horizontal cup-to-disc ratio was equivalent to the vertical disc diameter. An inferior wedge defect was noted within the retinal nerve fiber layer on direct observation in the left eye and it was confirmed with optical coherence tomography (OCT). Primary open-angle glaucoma was diagnosed, and the patient was instructed to return for multiple follow-up visits for baseline visual field testing and repeat IOP measurements prior to treatment.

Upon multiple follow-ups, IOP remained in the 24-28 mmHg range in both eyes and a mild, superior/nasal step visual field defect was confirmed in the left eye. Prostaglandin therapy was initiated in both eyes and a target IOP of 18-20 mmHg was set to achieve a 30% reduction from the highest recorded measurement. Further glaucoma monitoring was initiated.

**Education Guidelines**

*Learning objectives*

At the conclusion of this case report a student should be able to:

- Accurately/consistently set a target IOP for glaucoma patients with scientific basis
- Understand the staging of glaucoma and how it relates to target IOP
- Describe variables in patient care that can affect the target IOP

*Key concepts*

- Properly staging glaucoma aides in the determination of the level of IOP reduction needed
- Setting a target IOP that ensures the highest probability for arresting the progression of glaucoma based on scientific evidence

*Discussion points*

- Basic knowledge of the role of controlling IOP in glaucoma

- Understand different technologies and how to incorporate them into glaucoma management
- Understand when to treat and when not to treat glaucoma
- Understand why a patient may not respond to treatment in the predicted way
- Clinical management of IOP
- Combine objective and subjective testing to create a consistent staging system
- Utilize the staging system to establish the initial target IOP range
- Understanding different strategies for setting target IOP
- Understand when an IOP target is inadequate
- Patient education
- How to use the target IOP to improve patient education, improve compliance, and provide the patient with a tangible goal
- Understand the importance of patient education on patient compliance

**Discussion**

Before students will be able to set the target IOP in glaucoma management, they must first understand the purpose and definition of target IOP. Target IOP is defined by the World Glaucoma Association (WGA) as "an estimate of mean IOP at which the risk of decreased vision-related quality of life due to glaucoma exceeds the risk of treatment."[2,3] Although this is an excellent description of the purpose of lowering pressure in this very diverse condition, it leaves room for interpretation of how to determine the extent to which the IOP should be lowered. This discussion will briefly review a few major studies that investigated the effect of IOP lowering on glaucomatous changes with ideas and concepts to be used in determining each patient's unique target IOP as in the example above. The faculty will be able to use the following studies to provide a foundation for which students can develop their own glaucoma management principles. These studies may be best presented through case examples but can be introduced initially through lecture presentation. Students should become increasingly independent in their decision-making in clinic while managing glaucoma patients. They should also be able to have higher-order discussions with attending doctors when discussing comprehensive glaucoma management. Course objectives will be met when students can stage glaucoma correctly and consistently while setting a target pressure for therapy that ensures the lowest risk of progression.

The first concept for students to grasp when diagnosing glaucoma and determining treatment is highlighted within the WGA definition of the target IOP stated above. The "risk of decreased vision-related quality of life due to glaucoma" must outweigh any risks of treatment. This statement implies a situation in which a patient may have glaucoma, but the risk of vision loss that would affect one's quality of life is not high enough to warrant treatment. This relates to the patient's age in the above example. The patient is 75 years old with mild glaucomatous visual field loss. Due to the patient's age, it is likely that there would be noticeable vision loss within his lifetime, and thus treatment was initiated. However, if the patient were 90 years old with mild vision loss and a concurrent terminal cancer diagnosis, initiating glaucoma treatment may decrease the quality of life of the patient even though vision loss would not be expected within the patient's' lifetime. There is often no absolute correct answer for these situations and the risk-benefit profile must be explained in detail to the patient and his or her family in order for a decision to be made on the proper course of action. A discussion must occur between faculty and students so that they understand that proper glaucoma management includes when to initiate glaucoma treatment and when to withhold treatment.

There are multiple theories for calculating target IOP. These theories are best presented to students in a lecture setting prior to clinical management. A commonly used theory, and the one used in this case report, is determining a percentage reduction based on a diurnal collection of untreated IOP measurements.[2] The percentage reduction needed for each patient can vary from 20-50% or greater depending on factors including the type of glaucoma, severity, family history and age.[1,2] In the Ocular Hypertensive Treatment Study (OHTS), the patients in the treatment group achieved a reduction of 20% and the study resulted in a 50% reduction in the number of patients who converted to glaucoma in five years.[4] This reduction, however, is limited to those patients with pressures defined as ocular hypertensive (greater than 21 mmHg). Although the patient in the case report above had ocular hypertension, it was decided that a 20% reduction was not adequate due to his family history of severe glaucoma and thin corneas (less than 555 µm). Therefore, a 30% reduction was designated. Corneal thickness is a risk factor for patients with ocular hypertension.[4] Patients with thin corneas are at a higher risk of developing glaucoma. Beyond this risk, corneal thickness has limited application. Corneal thickness can alter IOP readings in thicker corneas potentially providing falsely high readings and thin corneas providing falsely low readings on applanation tonometry. While corneal thickness nomograms proposed an addition or reduction of the IOP based on these generalizations, the extent of the actual alteration in the IOP reading for individual patients is unknown. This is a good example to use with students to show that they must combine multiple variables and risk factors for each individual case and there is not one correct way to manage every single glaucoma patient.

The Collaborative Initial Glaucoma Treatment Study (CIGTS) determined that a target percentage reduction of 35% in newly diagnosed glaucoma showed the same reduction in risk of progression as more aggressive therapy (40% reduction or greater).[5]

However, in patients who already had advanced disease, larger reductions achieved with surgery significantly reduced the risk of progression compared to medicinal therapies.[2,5] Surgery holds multiple benefits over medicinal methods that will not be discussed here, but it can be interpreted that a more aggressive approach to IOP management is most valuable in advanced disease. The severity of the glaucoma when initially presented can have significant importance when determining the target IOP.[2,5] In this case report, the patient had a mild stage of glaucoma, thus a more aggressive target was not indicated. Student knowledge can be assessed when evaluating glaucoma severity. This will provide the faculty member with the knowledge of how well the student understands glaucoma fundamentals. Medical coding can also be included with this discussion, as the importance for proper staging has increased with the introduction of new coding principles.

Percentage reduction can also be used in conditions that do not have higher than statistically normal IOP. The Collaborative Normal Tension Glaucoma Study (CNTGS) showed benefits of a 30% reduction in IOP.[6] However, with lower untreated IOP, it is sometimes difficult to reach high percentage reductions without surgical intervention. Expectations for treatment outcomes in different types of glaucoma can be addressed in the context of normal tension glaucoma. This provides a way to connect the mechanism of the disease and how that may change the expected outcome of treatment.

Through evaluation of multiple studies, it can be recommended that a staged percentage reduction can be considered. For mild, newly diagnosed glaucoma, a 30% reduction will significantly reduce the risk for progression. For more moderate and severe levels, a 40% and 50% reduction is likely needed.[2,4-7] This provides the faculty with a scientifically based thought process for targeting IOP instead of explaining it as an educated guess. When setting the target, aiming for a range around the target IOP will take into account the variance between measurements. For example, if the untreated IOP ranges between 28 and 30 mmHg, a 30% reduction for mild glaucoma would set the target to 21, or 9 mmHg less than 30 mmHg. The target IOP range for this patient would be 19-21 mmHg. A standard procedure for setting target IOP can be very useful for clinical efficiency and ensuring continuity of care, but it has limitations. Each clinician must be aware that each glaucoma case may differ slightly and will need to tailor therapy on a case-by-case basis.[1,2] In a clinical setting, students must understand common limitations to assessing intraocular pressure. IOP results can vary due to a number of variables including patient compliance, time of day and inter-clinician variability. This will help students understand that the target IOP is only an estimation and they should not be too quick to change treatment.

The percent reduction theory relies on the clinician having a scientifically based staging system for accurately assessing the severity of glaucoma. The standard for severity staging in glaucoma is mild, moderate and severe levels.[8-11] A standard staging system will allow a clinician to be consistent from patient to patient for determining desired IOP reduction while reducing the amount of subjective bias. Staging each patient is a combination of optic nerve head assessment, retinal nerve fiber layer (RNFL) assessment and visual field defect assessment. Beginning with the optic nerve head, mild staging includes the narrowing of the optic nerve head rim tissue, asymmetry between the rim tissue of the two optic nerves and the presence of a disc hemorrhage. Transitioning into more moderate levels of atrophy, the moderate stage includes increased narrowing of the optic nerve rim tissue, central pseudopallor and localized notching of the rim tissue. Severe staging may include complete rim tissue loss in at least three quadrants, blood vessel bayoneting and bean-potting of the optic nerve head tissue.[9,10] Only one of these characteristics is required to qualify the patient at that stage of glaucoma. Assessing a student's knowledge of staging glaucoma incorporates a large number of concepts. The student must be able to understand the disease, assess the risk factors, interpret exam findings and come to a conclusion. This is an excellent exercise to assess a student's ability for higher-order thinking that is crucial for becoming a successful clinician.

Evaluating the RNFL is the next step in evaluating the stage of glaucoma. Mild glaucoma is consistent with light striations in the RNFL and a decrease in brightness of reflectance of the RNFL tissue.[9] Moderate glaucoma shows an overall or sectional dimming of the reflectance with a loss of texture to the RNFL. Severe RNFL atrophy shows a dark reflex against the retina due to the minimal remaining RNFL.[9,10]

Lastly, evaluation of the visual field test results is necessary. Mild visual field defects begin with a nasal step or an isolated paracentral defect. On 24-2 SITA (Swedish Interactive Threshold Algorithm) testing, less than 14 points will be less than the 5% significance level and less than 8 will be below the 1%. The mean deviation will be less than 5 decibels (dB) and there will be no central points with a sensitivity less than 20 dB. The requirements are very similar on 30-2 SITA testing; however, more points are allowed below the 5% and 1% levels due to the increased total number of points tested. Moderate visual field defects are greater than the description in mild to one complete arcuate defect in one quadrant. There may be 14-28 points in the less than 5% significance level and 8-16 in the 1%. The mean

**TABLE 1**
**Staging Glaucoma Based on Visual Field Severity**

| Severity | 30-2 SITA | 24-2 SITA |
|---|---|---|
| Mild | Mean Dev < 5 dB<br>AND < 18 pts below 5% level and < 10 pts below 1% level AND no central pts < 20 dB | Mean Dev < 5 dB<br>AND < 14 pts below 5% level and < 8 pts below 1% level AND no central pts < 20 dB |
| Moderate | Mean Dev 5-10 dB<br>OR 18-36 pts below 5% level or 10-20 pts below 1% level OR one central pt 10-20 dB | Mean Dev 5-10 dB<br>OR 14-28 pts below 5% level or 8-16 pts below 1% level OR one central pt 10-20 dB |
| Severe | Mean Dev > 10 dB<br>OR > 36 pts below 5% level or > 20 pts below 1% level or < 20 dB pt in both central hemifields | Mean Dev > 10 dB<br>OR ≥ 28 pts in 5% level or > 16 pts in 1% level or < 20 dB pt in both central hemifields |

*Dev = deviation; dB = decibel; percentage refers to statistical relevance of the defect based on the SITA algorithm on the pattern deviation plot*

*Table 1: click to enlarge*

deviation may be between 5 and 10 dB and a central point in one hemifield may be between 10-20 dB. Severe visual field defects include complete arcuate scotomas in both hemifields and 28 or greater points in the 5% significance level or greater than 16 in the 1%. The mean deviation may be >10 dB and there may be central points less than 20 dB in both hemifields. In the moderate and severe categories, the patient must meet only one of any of the characteristics listed above to be considered in that category of glaucoma. **(Table 1)**[10] Table 1 is an excellent note for students to keep with them in clinic when they are first starting to manage glaucoma. Combining all of the above recommendations to categorize glaucoma patients into severity stages will aid in utilization of the percent reduction theory and ultimately better care for the patient.[8,9,10]

Another theory includes a fixed IOP threshold that is applied to all patients.[2] The Advanced Glaucoma Intervention Study (AGIS) found that with an aggressive approach to IOP lowering (achieving a mean IOP of 12.3 mmHg or lower), no glaucomatous progression was noted.[7] Supporters of the threshold theory often choose a fixed IOP of 12 or 13 mmHg to ensure that the risk for progression is the lowest possible for all patients.[2,7] However, like with any study, AGIS has its limitations. The study focused on patients with advanced glaucoma only. Applying the same strategy to patients with mild or moderate stages could result in overtreatment, introducing increased risks for side effects and an unnecessary further decrease in quality of life. The threshold IOP theory has clinical uses, especially in patients who present with severe glaucomatous vision loss, but it does not apply to all glaucoma patients. Understanding how to set a target IOP can be a great teaching experience for students, showing them that they must gather data from research, clinical experience and from their education to establish how they will manage different conditions. They cannot do something simply because a previous attending or lecturer did it that way.

Once treatment is started and the initial target IOP is determined, it is also important to know when the target IOP is inadequate and needs to be adjusted. If glaucomatous progression is noted on objective and/or subjective testing, it is very important to determine the cause of the progression. One possible cause is an inadequate target IOP. In this situation, the target IOP will need to be lowered and an additional medication or surgery is indicated. Setting a new target depends on multiple factors including type of glaucoma, untreated IOP, the current treated IOP, the stage of glaucoma, and the expected rate of progression. The more severe and faster progressing glaucoma needs a more aggressive adjustment in target IOP. Following the percentage theory for target IOP, if a patient has shown mild progression while obtaining a 30% reduction in IOP, then it is possible only an additional 10% reduction may be necessary. However, if the patient has shown a severe change in objective or subjective testing, it may be necessary to add 20% more reduction to the previous IOP or to aim below a 12 mmHg threshold as determined by the AGIS study.[7] It is very important to keep in mind limitations of topical therapy for controlling IOP including the difficulty of lowering IOP into single digits with medicinal therapy alone. This discussion allows for the faculty to introduce concepts to think about when adding additional therapy. It is still important to have goals set prior to changing or adding treatment and not to add treatment and gauge the goal in response to the results.

Another cause for progression of glaucoma is that the target IOP is adequate, but it is not consistently being met. This could result from the patient only using the prescribed medication consistently around the scheduled follow-ups, or sporadic use of the prescribed treatment regimen.[1,12,13] In this situation, the IOP is within the target range at each visit, but progression is found due to the IOP not meeting the target during the time between visits. The patient may also be compliant but only reaching target IOP at appointment times and the treatment regimen is not properly controlling diurnal IOP. If the patient consistently has clinic appointments only in the morning, it is also possible that he or she is achieving the target IOP only in the morning and throughout the day the IOP is much higher.

Although it is possible that the need for additional medication is required in some cases, the literature often shows that the first cause a clinician should rule out is medication adherence.[12,13] In a recent study, 48.1% of patients self-reported that their medication compliance was poor and/or declining by year four of treatment.[12] Medication adherence is a huge concern with many chronic diseases and is particularly troublesome in glaucoma due to the lack of symptoms. In regard to target IOP, it is possible that a patient has not been meeting the target due to medication adherence. Medication adherence in glaucoma can be influenced by a number a factors. These include cost of medication, lack of understanding of the condition, ocular irritation/side effects of treatment, or the inability to apply the medication.[12,13] When adherence is poor, glaucomatous progression would be confirmed, but, unless the stage significantly changed, no change in the treatment plan would be required. Reinforcement of the established treatment plan is required and more frequent monitoring of the patient may be required to improve compliance. It is important for students to understand that there are multiple reasons for disease progression and each must be carefully addressed to avoid over-prescribing of medications or polypharmacy. Patient education

can be a focused talking point when addressing patient adherence.

**Conclusion**

Although target IOP is in widespread use throughout the glaucoma management community, there is a lack of evidence that validates what target IOP is appropriate for each situation and how to calculate it. Many large associations such as the WGA or the American Academy of Ophthalmology recommend its use while understanding the limitations.[1,2] In the end, target IOP is a prediction, and reviewing literature allows the clinician to make the most educated prediction possible. Achieving or not achieving target IOP does not define control of the disease. It is only structural or more commonly functional change that dictates the target IOP. Based on the review of literature, a staggered percentage reduction system (30%, 40%, 50%) can be recommended for mild, moderate and severe glaucoma respectively. At the current time, modifying IOP is the only way to preserve quality of life for glaucoma patients. As the understanding of glaucoma changes and the ability to monitor IOP over a 24-hour period becomes a viable option, the strategy of target IOP could change drastically.

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# Upcoming Theme Edition Will Focus on Diversity, Cultural and Linguistic Competence

| Optometric Education: Volume 42 Number 1 (Fall 2016)

A future edition of *Optometric Education* will focus on the theme of diversity and cultural and linguistic competence. The edition will focus on diversity of our students, faculty and profession and all aspects of cultural and linguistic competence, including professional, organizational and individual responsibility.

**The deadline to submit manuscripts is Dec. 31, 2016.** Submit a cover letter and intact and blind copies of the manuscript with original figures electronically to submissions@opted.org. Please identify in the cover letter that the manuscript is intended for the diversity theme edition of the journal.

For additional information on the theme edition, please contact Gary Chu, OD, MPH, FAAO, or Aurora Denial, OD, FAAO.

# Upcoming Theme Edition Will Focus on International Optometric Education: Global Expansion and Transformation

| Optometric Education: Volume 42 Number 1 (Fall 2016)

Over the past 20 years, the profession of optometry has undergone dramatic global changes: expanding scope of practice, increasing quality assurance expectations, significant diversification of students, and the accelerating impact of information technology. Underpinning these changes has been the critical role of international optometric education in supporting and catalyzing this transformation. The same global forces that are driving the transformation of the profession are also creating challenges and opportunities for optometric educational institutions. Student, faculty, patient and institutional expectations are converging and greater accountability is expected. This includes such areas as clinical competency, professional ethics, interprofessional collaboration and curricular innovation.

This theme issue builds on the work of the ASCO International Optometric Education Committee and International Optometric Educators Special Interest Group (SIG).

Authors are invited to submit scholarly articles that address this theme and underscore innovation and the impact educational institutions are having on their students, the profession and the communities they serve. We encourage scholarly articles that are translational and promote global dissemination. **Please submit manuscripts by March 1, 2017.** Submit a cover letter and intact and blind copies of the manuscript with original figures electronically to submissions@opted.org. Please identify in the cover letter that the manuscript is intended for the international theme edition of the journal.

We are pleased to have Anthony F. Di Stefano, OD, MEd, MPH, Salus University, serve as the Guest Editor of this issue. For more information, please e-mail journal Editor Aurora Denial, OD, FAAO.

# Peripapillary Retinoschisis and Glaucoma Connection: a Teaching Case Report

Diana Mah, OD, FAAO, and Kristin Richwine, OD, FAAO | Optometric Education: Volume 42 Number 1 (Fall 2016)

### Background

Retinoschisis involving the peripapillary and macular regions is well-documented in the literature. The condition is commonly associated with optic nerve head pits, optic nerve colobomas, X-linked macular schisis and high myopia. Less often cited in literature are cases of retinoschisis associated with glaucoma or enlarged optic nerve cupping in the absence of other pathology, as described in this case.[1-4,7] Although the underlying pathophysiology may not be completely understood, it is important to be aware of this atypical finding when managing glaucoma patients with retinoschisis because treatment options may differ from other causes of secondary retinoschisis. In addition, resolution of the retinoschisis can affect the presentation of glaucoma stability or progression. As discussed in this teaching case report, being cognizant of these co-existing conditions enables the optometrist to better manage patients.

This teaching case report highlights diagnostic tools and appropriate management of the patient with retinoschisis and glaucoma. It is intended for fourth-year optometry students actively involved in patient care. As this condition is not common to glaucoma-related findings, knowledge about the condition and the appropriate steps for management and treatment is essential for the practicing optometrist in any clinical setting.

### Case Description

*Figure 1A. Enlarged C/D and neurosensory retinal detachment temporal to the optic nerve head OD.*
*Figure 1A: click to enlarge*

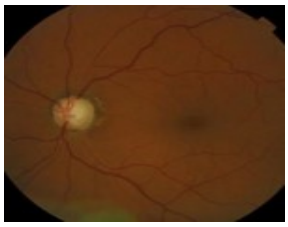

*Figure 1B. Enlarged C/D secondary to glaucoma OS.*
*Figure 1B: click to enlarge*

A 70-year-old Caucasian male presented to our clinic for an initial exam with the chief complaint of more difficulty with near vision over the past year. The patient had not had an eye exam in more than 25 years and was using over-the-counter reading glasses. His systemic history was positive for borderline hypertension and obesity. He was not taking any medications. His best-corrected visual acuity was 20/40 +2 OD (-0.50 -0.50 x 094) and 20/25 -2 OS (-0.75 -0.25 x 008). Slit lamp exam was remarkable

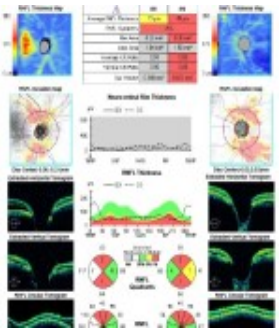

*Figure 2. OCT of the retinal nerve fiber layer showing significant thinning OU. Note that the temporal quadrant OD appears thickened due to the macular schisis and neurosensory macular detachment.*
*Figure 2: click to enlarge*

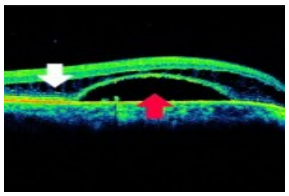

*Figure 3. OCT showing retinoschisis (white arrow) and neurosensory retinal detachment (red arrow) OD.*
*Figure 3: click to enlarge*

for mild nuclear sclerotic and cortical cataracts OU. Intraocular pressure (IOP) was 20 mmHg OD and 20 mmHg OS at 2:40 p.m. Dilated fundus exam revealed a serous retinal detachment extending from the optic nerve towards the macula in the right eye **(Figure 1A)** and significant cupping with cup to disc ratio (C/D) of 0.8 OD and 0.9 OS **(Figure 1B)**. Optical coherence tomography (OCT) of the optic nerve and macular region was performed OU **(Figures 2 and 3)**.

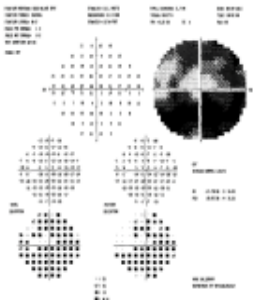

*Figure 4A. Humphrey 30-2 visual field test showing significant glaucomatous field loss OS.*
*Figure 4A: click to enlarge*

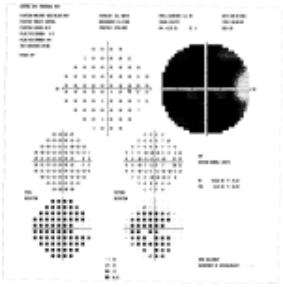

*Figure 4B. Humphrey 30-2 visual field test showing significant glaucomatous field loss OD.*
*Figure 4B: click to enlarge*

Based on the findings, the patient was diagnosed with advanced glaucomatous cupping OU and retinoschisis with neurosensory retinal detachment OD. The plan was to have the patient back in a week for an IOP check and visual field testing, and he was referred to the Retina Service for evaluation of the retinal findings. The patient was seen in the Retina Service two weeks later, and the

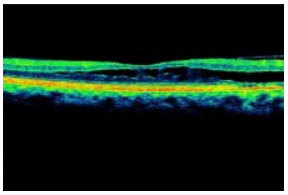

*Figure 5A. Decreased size and amplitude of retinoschisis and neurosensory retinal detachment OD after eight months of treatment for glaucoma.*
*Figure 5A: click to enlarge*

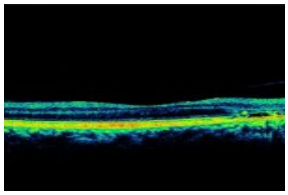

*Figure 5B. Decreased size and amplitude of retinoschisis and neurosensory retinal detachment OD after three years of treatment for glaucoma.*
*Figure 5B: click to enlarge*

retinoschisis and serous detachment were noted to be stable. IOP at that visit was 34 mmHg OD and 33 mmHg OS at 9:12 a.m. Due to the increased pressures and advanced cupping, treatment with travoprost ophthalmic solution 0.004% (Travatan Z) at night was initiated OU. The patient returned one month later for a follow-up and visual field testing **(Figures 4A and 4B)**. The Humphrey 30-2 visual field test showed significant superior and inferior arcuate defects OU consistent with advanced glaucoma. Gonioscopy revealed wide-open angles with flat iris insertion OU. IOP on Travatan Z was 24 mmHg OD and 21 mmHg OS at 12:09 p.m. Due to the advanced field loss, dorzolamide/timolol (Cosopt) twice a day was added for both eyes. The patient returned one week later and IOP was 11 mmHg OD and 11 mmHg OS at 7:42 a.m.

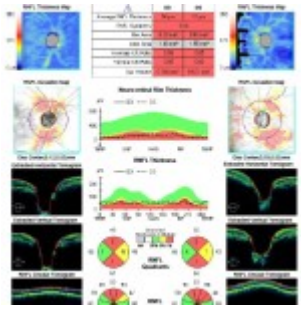

*Figure 6. OCT of the retinal nerve fiber layer performed two years after initial presentation showing advanced thinning from glaucoma OU. Thickness in the temporal quadrant OD is decreased compared to the initial OCT due to resolution of the macular schisis and neurosensory retinal detachment.*
*Figure 6: click to enlarge*

The patient continued to be followed over the next three years with pressure checks and dilated exams. Best-corrected visual acuity remained stable at 20/25- OD and 20/25+ OS. IOP remained consistently below 12 mmHg OU with Travatan Z at night and Cosopt twice a day OU. The schisis and sensory retinal detachment improved over time without any intervention except to control the intraocular pressure **(Figures 5A and 5B)**. Two years after initial presentation, OCT of the retinal nerve fiber layer (RNFL) showed advanced thinning from glaucoma OU, but the temporal quadrant OD showed decreased thickness compared to the initial OCT due to resolution of the macular schisis and neurosensory retinal detachment **(Figure 6**). Humphrey visual fields OU remained severely depressed but stable over the next three years **(Figures 7A and 7B)**.

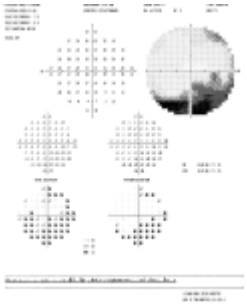

*Figure 7A. Humphrey 10-2 OS performed 2.5 years after initial presentation showing significant but stable field loss encroaching fixation, OD>OS.*
*Figure 7A: click to enlarge*

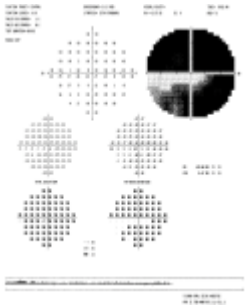

*Figure 7B. Humphrey 10-2 OD performed 2.5 years after initial presentation showing significant but stable field loss encroaching fixation, OD>OS.*
*Figure 7B: click to enlarge*

**Educator's Guide**

*Key concepts*

1. Use of technology in diagnosing and documenting retinoschisis and sensory retinal detachment
2. Conditions associated with retinoschisis
3. Clinical findings and use of technology with glaucoma
4. Treatment and management considerations with glaucoma and secondary retinoschisis

*Learning objectives*

At the conclusion of this case discussion, participants should be able to:

1. Describe the signs and symptoms of different types of retinoschisis (i.e., inherited vs. acquired, presentation and location of each subtype)
2. Understand the conditions commonly associated with the different types of retinoschisis
3. Recognize the rare association between retinoschisis and glaucoma
4. Describe typical visual field and OCT findings for glaucoma, primary retinoschisis and retinoschisis secondary to glaucoma
5. Understand the natural course of the disease and appropriate management of glaucoma-related retinoschisis
6. Provide proper patient education on management options and expectations following treatment

**Discussion Questions**

*Retinoschisis*

1. Describe the clinical findings of retinoschisis
2. Describe the different layers of the retina
3. What conditions are commonly associated with retinoschisis
4. Discuss the differential diagnosis for retinoschisis
5. What ancillary testing can be used to confirm retinoschisis
6. What is the natural course of retinoschisis
7. What is the role of the primary care optometrist in the management of retinoschisis

*Glaucoma*

1. What is the role of IOP in glaucoma
2. Discuss risk factors for the development and progression of glaucoma
3. Describe optic nerve head findings commonly seen in glaucoma
4. What are typical visual field defects associated with glaucoma
5. Discuss the differential diagnosis of glaucoma
6. Describe the role of imaging (OCT, GDx, HRT) in diagnosing and following glaucoma
7. Discuss the pharmaceutical treatment of glaucoma, including side effects and contraindications of medications
8. What are various ways to determine glaucoma progression
9. Discuss the staging of glaucoma and ICD-10 coding used for the various stages

**Discussion**

Only a handful of cases of a schisis and underlying serous detachment associated with glaucoma and optic nerve cupping in the absence of other pathology have been reported in the literature.[1-4,7] The purpose of this case report is to help enable students to recognize the clinical findings of retinoschisis and glaucoma, identify the correlation between these co-existing diseases, become familiar with special testing to document and manage these diseases, and consider the appropriate treatment options.

*Clinical findings and differential diagnosis of retinoschisis*

Retinoschisis is a splitting of the retina's neurosensory layers, usually in the outer plexiform layer. Depending on the cause, it may be present in the macula, posterior pole or peripheral retina, most often inferior temporal retina. Depending on the location of the schisis, the patient may be asymptomatic or notice blurred vision or a scotoma. The primary differential diagnosis is a retinal detachment **(Table 1)**. These conditions can be distinguished from each other clinically: a retinoschisis appears more transparent, is less mobile with less surface wrinkling, and has less underlying pigment epithelial atrophy than a full-thickness retinal detachment. In addition, the position of the cavity is constant and when the area is scleral depressed the inner retinal layer fails to collapse. If the student or clinician cannot determine whether the patient has a schisis or detachment, further diagnostic testing can be helpful. Visual field testing reveals an absolute defect with sharp borders in the case of a retinoschisis and a relative defect with a retinal detachment. OCT can also be used. In a retinal detachment, the separation of the layers will be between the neurosensory retina and the retinal pigment epithelium, whereas a schisis is a separation within the layers of the neurosensory retina.

**TABLE 1**
**Comparison of Retinoschisis and Retinal Detachment**

| | Signs | Symptoms | Associated Conditions | Testing | Treatment |
|---|---|---|---|---|---|
| Retinoschisis | Transparent<br>Less mobile<br>Minimal to no surface wrinkling | Reduced vision if foveal schisis; asymptomatic if peripheral | Optic nerve pit<br>Optic nerve coloboma<br>X-linked macular schisis<br>Myopia<br>Open angle glaucoma | Absolute defect on visual field<br>Split within the neurosensory layers on OCT | Observation<br>Laser<br>Scleral buckle<br>Vitrectomy<br>Lower IOP |
| Retinal Detachment | Surface wrinkling<br>Mobile<br>(+)Shafer's sign | New floaters<br>Flashes of light<br>Blurred vision<br>Curtain-like shadow | Aging<br>Sagging vitreous<br>High myopia<br>Injury<br>Eye surgery | Relative defect on visual field<br>Split between the RPE and neurosensory retina on OCT | Laser<br>Cryotherapy<br>Pneumatic retinopexy<br>Scleral buckle<br>Vitrectomy |

*Table 1: click to enlarge*

*Associated conditions*

Retinoschisis and peripapillary serous retinal detachments are often seen in patients with congenital and acquired optic nerve pits, optic nerve colobomas, X-linked macular schisis and myopia **(Table 2)**; therefore, these conditions need to be evaluated when a patient presents with retinoschisis and/or peripapillary serous retinal detachments. In optic disc pits, a small round hypopigmented or grey depression is seen funduscopically, typically on the temporal or central aspect of the nerve. These lesions are typically unilateral. Vision is often normal unless the pits are associated with a serous macular detachment. Optic nerve colobomas are congenital anomalies of the optic nerve resulting from incomplete closure of the embryonic fissure during development. These may be unilateral or bilateral and are typically accompanied by poor vision. The nerve is often large with an inferior defect and possible residual glial tissue. X-linked macular schisis is a retinal disorder associated with a variety of clinical findings. This condition usually occurs in males and results in impaired vision early in childhood. Foveal schisis is seen in almost all of these patients and appears as a stellate spoke-like maculopathy. OCT shows

**TABLE 2**
**Conditions Associated with Retinoschisis and Peripapillary Retinal Detachment**

| | Retinal Finding |
|---|---|
| Optic Nerve Pits | Unilateral small round grey depression usually on the temporal aspect of nerve |
| Optic Nerve Colobomas | Unilateral or bilateral large nerve with inferior defect and possible glial tissue |
| X-linked Macular Schisis | Stellate spoke-like foveal schisis with macular pigmentary changes |
| High Myopia | Staphyloma |

*Table 2: click to enlarge*

the split in the retina, and the split occurs across multiple layers.[11] Clinically, pigmentary changes may occur at the macula over time as the schisis resolves. In addition, macular retinoschisis is not uncommon in highly myopic eyes with staphyloma.[12] OCT shows the splitting of the retinal layers when this is present.[12] Because this patient did not have this condition in childhood, did not show evidence of a spoke-like maculopathy, disc pit, nerve coloboma, or high myopia, it is presumed that the retinoschisis and serous detachment were secondary to his open angle glaucoma with elevated IOP.

*Pathophysiology*

The source of fluid and definitive pathogenesis of papillary schisis and detachment associated with optic disc anomalies, or in glaucomatous papillary detachments, as in this case, are unclear. One possible source of the fluid is the vitreous, which is thought to enter the optic disc through small holes or breaks in overlying membranes or neuroectoderm tissue.[8] Vitreous traction may be associated with these breaks. Small changes in axial length accompanying IOP fluctuations may lead to vitreous traction in the inner retina that lead to schisis formation.[3] In addition, animal studies have demonstrated that prolonged increase in IOP may lead to breaks in the inner limiting membrane with penetration of the vitreous into the retrolaminar space.[4] It is also thought that fluctuations in IOP that lead to glaucoma-related structural defects in the nerve allow vitreous fluid to track through microholes in the thin tissue of the optic nerve leading to the schisis and serous retinal detachment.[4,5] Fluid from the subarachnoid space may also be responsible. It has been suggested that the vitreous, subarachnoid and subretinal spaces may be at times interconnected because of the permeable nature of the optic nerve.[2,10,14] A pressure differential must occur for fluid to move, and fluctuations in IOP can affect the pressure differential between the vitreous cavity and spaces outside the globe.[8] Further studies need to be done to assess the mechanism behind this process but this is difficult given how few patients are typically seen.

*Treatment/management*

Once the student clinician achieves a diagnosis, he or she must determine whether the disease exceeds the treatment threshold. The decision to treat is influenced by consideration of whether the disease is vision- or life-threatening and the treatment benefits outweigh the risks. In this patient, significant glaucomatous cupping, elevated intraocular pressures and field loss warranted the initiation of pressure-lowering medication. Medical management of glaucoma consists of pressure-lowering medications to reduce aqueous production and/or improve aqueous outflow. Commonly used medications include topical beta blockers (e.g., timolol, betimol), alpha agonists (e.g., brimonidine), prostaglandin analogs (e.g., latanoprost, travoprost), carbonic anhydrase inhibitors (e.g. dorzolamide, brinzolamide) or a combination of these drugs. Factors determining the selection of drugs include ease of use, cost, side effects, contraindications, target pressure and severity of glaucoma. Many clinicians use a prostaglandin analog or timolol for first-line therapy. These medications typically reduce IOP by 30% and 25%, respectively, and are inexpensive to use.[18]

In this patient, the retinoschisis was deemed stable and not immediately vision-threatening. Typically in an asymptomatic and non-vision threatening retinoschisis, observation only in 6- to 24-month intervals is appropriate management as the condition is usually stable to slowly progressive for many years. Laser, scleral buckle or pars plana vitrectomy may be performed for vision-threatening retinoschisis.[5,8,17] These procedures are not only invasive but also can lead to further complications and reduce patient quality of life. The peripapillary schisis reported here spontaneously resolved after glaucoma treatment was initiated. It is possible that lowering the IOP and minimizing fluctuations with topical glaucoma drops was responsible for this resolution as reported in similar cases in the literature.[2,3,5,13] Therefore, if vision is not threatened, it may be prudent to lower IOP first and monitor closely for resolution of the retinal findings before considering more invasive strategies. When considering target pressures, pressures should be set according to visual field and/or optic nerve changes. Typical glaucomatous field patterns include arcuate defects that respect the horizontal meridian **(e.g., Figure 4A)**, paracentral scotomas that are only part of the arcuate segment, and nasal step with a large sensitivity difference across the nasal horizontal meridian **(e.g., Figure 7B)**. In addition, thinning of the peripapillary nerve fiber layer and ganglion cell complex can be estimated using OCT to support the diagnosis of glaucoma. However, it is crucial to correlate optic nerve findings with OCT measurements and visual field loss as structure should match function.

When assessing visual field and RNFL changes in patients with glaucoma and concurrent peripapillary retinoschisis, students should be aware that these patients will likely have nerve fiber layer changes that occur after resolution of the retinoschisis. When the retinoschisis is present, the RNFL appears falsely thick and sometimes will show a considerable rapid decrease after resolution which might lead one to believe that glaucoma has progressed.[13] However, the visual field should not change in that area.[17] This patient did show a decrease in RNFL thickness **(Figures 2, 6)** along with resolution of the retinoschisis without

significant visual field progression. Therefore, when monitoring for progression of glaucoma, students should verify that a RNFL change on OCT corresponds with a change in visual field or in optic nerve appearance. In addition, retinoschisis associated with glaucoma may be overlooked because patients are often asymptomatic and retinoschisis can appear normal on fundoscopy alone. Therefore, if a sudden change in RNFL thickness is noted, consider ruling out an existing retinoschisis. If this cannot be confirmed, careful optic nerve examination as well as serial visual field testing should be used to confirm progression of glaucoma.

The assessment of the learning objectives for this case report can be accomplished in several ways. Students presented with fundus photos should be able to describe the photos, including normal and abnormal findings of the optic nerve, macula and retina. Once abnormal findings are identified, students should be queried on what additional testing should be performed to determine the underlying disease and any associated conditions. In this case, OCT scans were important in the diagnosis and management, so students can be evaluated for their knowledge of the different layers of the retina in a normal scan and be able to describe abnormal scans. Furthermore, students should also be assessed on their ability to describe abnormal visual fields and prescribe appropriate medical treatment for glaucoma. Proper patient education and management expectations can be accomplished by role-playing.

**Conclusion**

In rare instances, glaucoma may lead to peripapillary retinoschisis and underlying serous retinal detachment in the absence of other conditions mentioned in the differential diagnosis. Although the mechanism by which this occurs is not fully understood, awareness that this is a potential cause of secondary retinoschisis with serous detachment can lead to better patient outcomes. Students should be aware that these patients can be treated conservatively, by initiating glaucoma treatment and minimizing IOP fluctuations, rather than referred for potential invasive surgical intervention.

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# Learning Environment: Students' Perceptions Using DREEM Inventory at an Optometry Institute in Pakistan

Dr. Qamar Riaz, Dr. Shazia Sadaf, and Dr. Abdul Hameed Talpur | Optometric Education: Volume 42 Number 1 (Fall 2016)

**Introduction**

Educational environment refers to the whole range of components and activities within which learning happens. This includes faculty, teaching and learning methods, learning resources, monitoring and evaluation. Educational environment has been shown to directly affect students' performance both at undergraduate and graduate levels.[1] An educational environment that is not conducive to learning not only impedes learners' ability to acquire new knowledge, thus hindering their growth as professionals, but also adversely affects their social life and contribution in the community.[2] The availability of a learner-friendly environment becomes even more essential in disciplines that are directly related to health care and patient interaction.[3] Optometry is one such profession where optometrists are trained to prescribe and fit lenses to improve vision, and to diagnose and treat common eye diseases using topical diagnostic and therapeutic drugs and non-surgical procedures.[4]

Optometry is an emerging discipline in Pakistan with only three institutes offering graduate programs in vision sciences or optometry. Isra School of Optometry is the only such institute in the province of Sindh. It has been functioning since 2006 and caters to students from other provinces as well. Its facility is equipped with a library, many lecture halls and tutorial rooms, a laboratory and a computer room with internet access. It offers a four-year program during which students gain competence in the theory and contemporary practice of optometry with the aim of protecting, advancing and promoting the vision and eye health of people not only in Pakistan but also in other countries. Currently, 87 students are enrolled in Isra School of Optometry: 31 in the first year, 24 in the second, 20 in third, and 12 in the final year. The higher numbers of students in the earlier years is indicative of the development of the program over the years.

As with any other program, it is crucial to periodically evaluate the educational environment of the institute as perceived by its students. This helps to identify areas with deficiencies so that measures can be taken to improve them if required. It may also provide the evidence to support continuation of current practices/methods of teaching and learning so they can be shared with other institutes that wish to replicate them. A number of studies have been done to evaluate the educational environment of medical and nursing[5] colleges internationally and in Pakistan.[6,7] No study that explores the educational environment of an optometry institute has been found, but some studies have suggested means for improving learning and teaching strategies in an optometry institute.

A number of instruments have been used in the literature to measure educational environments in medical and allied healthcare education, both at undergraduate and postgraduate levels. However, the Dundee Ready Educational Environment Measure (DREEM) continues to be the most widely used instrument. The DREEM questionnaire was originally developed at Dundee and released as AMEE Medical Education Guide No. 23 by Genn in 2001 and has been accepted as an international instrument for assessing the educational environment.[8] It has been widely used as an instrument to collect information about the educational environment in many undergraduate health profesional institutions across countries, cultures and nationalities.[9] The instrument's validity has also been established in Pakistan.[10,11]

The aim of this study was to explore areas of strength and weakness in the educational environment at the Isra School of Optometry as perceived by its students using the DREEM questionnaire.

**Materials and Methods**

A prospective, cross-sectional, descriptive study was conducted at the Isra School of Optometry in Karachi in August 2013. The validated DREEM questionnaire[12] was used to identify perceptions of students at Isra School of Optometry regarding their educational environment, i.e., areas perceived as positive and strengths of the program and areas that might require improvement, so that appropriate timely interventions could be made.

**TABLE 1**
**Guide for Interpreting Overall and Subscale Scores**

| Domain | No. of Items | Scores | Interpretations |
|---|---|---|---|
| Students' Perception of Learning | 12 | 0 – 12 | Very poor |
| | | 13 – 24 | Teaching is viewed negatively |
| | | 25 – 36 | A more positive perception |
| | | 37 – 48 | Teaching highly thought of |
| Students' Perception of Faculty/Course organizers | 11 | 0 – 11 | Abysmal |
| | | 12 – 22 | In need of some retraining |
| | | 23 – 33 | Moving in the right direction |
| | | 34 – 44 | Model course organizers |
| Students' Academic Self Perception | 8 | 0 – 8 | Feelings of total failure |
| | | 9 – 16 | Many negative aspects |
| | | 17 – 24 | Feeling more on the positive side |
| | | 25 – 32 | Confident |
| Students' Perception of Atmosphere | 12 | 0 – 12 | A terrible environment |
| | | 13 – 24 | There are many issues that need changing |
| | | 25 – 36 | A more positive attitude |
| | | 37 – 48 | A good feeling overall |
| Students' Social Self Perception | 7 | 0 – 7 | Miserable |
| | | 8 – 14 | Not a nice place |
| | | 15 – 21 | Not too bad |
| | | 22 – 28 | Very good socially |
| Overall | 50 | 0 – 50 | Very poor environment |
| | | 51 – 100 | Plenty of problems in the environment |
| | | 101 – 150 | More positive than negative environment |
| | | 151 – 200 | Excellent environment |

*Table 1: click to enlarge*

DREEM is a 50-item, self-administered, closed-ended inventory based on students' perceptions of five areas directly related to their educational environment. These areas are: learning, teaching, academic self-perception, atmosphere, and social self-perception. Items are scored on a 5-point Likert scale as follows: 4 = strongly agree, 3 = agree, 2 = unsure, 1= disagree, and 0 = strongly disagree. However, 9 of the 50 items (number 4, 8, 9, 17, 25, 35, 39, 48 and 50) are negatively phrased statements and were scored reversely, i.e., 0 for strongly agree, 1 for agree, 2 for unsure, 3 for disagree, and 4 for strongly disagree. The instrument has a total possible score of 200, which is indicative of the ideal educational environment. The Practical Guide described by McAleer and Roff[13] for interpreting the overall and subscale scores, and the number of items in each subscale is given in **Table 1**.

Items with a mean score greater than 3 mainly represent strong areas, while items with a mean score of less than or equal to 2 are indicative of problem areas that require immediate review and remediation. Items with a mean score between 2 and 3 reflect areas that are neither strengths nor weaknesses but could possibly be enhanced.

*Data collection*

Data was collected using the self-guided DREEM questionnaire administered on the last day of end-of-year exams. This time was selected to ensure maximum participation. Also, by this time every student would have spent at least a year in the institute — time sufficient to understand the educational environment and develop perceptions regarding it. Students were briefed about the aims of the study and the importance of high levels of participation during a face-to-face session in a lecture hall. The DREEM questionnaire was distributed as a hard copy to all 87 students of the institute. The students were asked to return the completed questionnaire on the same day to help ensure a high response rate. Because participation was voluntary, return of the completed forms was taken as consent to participate. Confidentiality was maintained by keeping the forms anonymous and having them collected by a researcher who was not a faculty member at the institute. Approval from the institutional ethical review committee was obtained to conduct the study. The study adhered to the tenets of the Declaration of Helsinki.[14]

Statistical Package for Social Sciences (SPS) version 19 was used for analyzing the data. The completed surveys were manually entered into a Microsoft Excel data sheet and exported to SPS for descriptive and inferential statistical analysis. Medians and interquartile ranges were used to express a measure of central tendency, and non-parametric analytical methods were used. Kruskal-Wallis non-parametric one-way analysis of variance and pair-wise comparisons using a non-parametric multiple comparison procedure were conducted to measure significant differences between the DREEM score and domain scores across different years of education. Significance was taken at $p < 0.05$.

## Results

A total of 78 students returned the completed questionnaire, giving an overall response rate of 90%. This rate was 90.3% (n=28) for year 1, 83.3% (n=20) for year 2, 90% (n=18) for year 3, and 100% (n=12) for year 4 students.

*Table 2: click to enlarge*

Among the 78 respondents, 36 (46%) were male and 42 (54%) were female. The mean age of the students was 21.4 years (minimum 18 years and maximum 25 years).

The total (median) DREEM score for all the respondents was found to be 123/200 (61.5%). The domain scores for the whole group were compared on a percentage basis because of the different maximum score of each domain. The highest percent score was observed for the "students' perceptions of academic self" domain (72%) and the lowest for the "students' perceptions of teachers" (56.8%). By year, the median score was highest for year 2 (135, 67.5%) and lowest for year 4 (87.5, 43.8%). The overall scores of the program and that of years 1 (124.5), 2 (135) and 3 (114.5) indicated students' perceptions of the educational environment as "more positive than negative." However final-year students perceived the educational environment as having "plenty of problems."

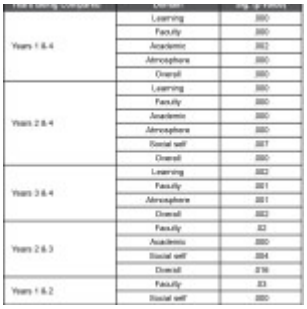

*Table 3: click to enlarge*

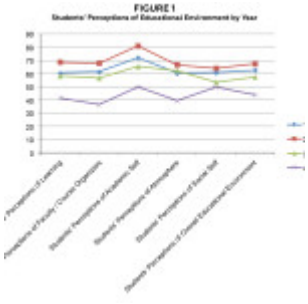

*Figure 1: click to enlarge*

In order to have a better understanding of the weaknesses and strengths of the educational environment at Isra School of Optometry, the median scores of the five domains and corresponding items of DREEM were also comparatively interpreted using the guide described by McAleer and Roff.[13] **Tables 2 and 3** show median scores for the five essential domains of the DREEM questionnaire according to the year of study.

*Table 4: click to enlarge*

The scores for all five domains of the first 2 years were better, indicating positive perceptions regarding all domains of the DREEM questionnaire, than the final-year scores, which gave negative perceptions of the educational environment. For year 3, the perceptions scores were positive for all the domains except "students' perceptions of social self," which was only borderline positive, indicating room for improvement. Final-year students viewed teaching negatively (13-24) and perceived faculty to be "in need of some training" (12-22). Final-year students' academic self-perception was "feeling more on the positive side" (17-24), and "atmosphere" according to their perceptions "needed change as there are many issues" (13-24). Final-year students' "perception of social self" was "not too bad" (15-21). The difference in the scores in the five domains among the students in different years of study is evident in **Figure 1**. Some of the common areas identified as strengths or requiring improvement on the basis of the higher and lower median overall DREEM scores are presented in **Table 4**.

## Discussion

This is the first study to report students' perceptions of the educational environment using a validated survey regarding an undergraduate optometry program. The students' perceptions about the educational environment at the institute were evaluated using the DREEM questionnaire. It is more focused to the environment, both classroom and clinical, experienced by students in medical and healthcare-related fields.

The overall response rate of 90% was very good for voluntary participation. This, on one hand, is a sign of students' confidence and trust of the survey methodology. On the other hand, it might be an indication of the students' desire to share their views about their educational environment in order to bring improvement.

The global score at Isra School of Optometry (123) using the DREEM, is similar to that reported from Nigerian medical schools.[6] Although there has been no established objective consensus on an acceptable DREEM score in the medical literature, our score is better than those reported from traditional medical schools in Saudi Arabia (102/200),[15] Srilanka (103/200)[16] and India (107.44)[17] and a nursing college in Malaysia,[5] suggesting a more positive educational environment. However, much effort is needed to achieve the standards of education as set by Roff et al. for Nepalese students (130/200),[6] and for students in a

medical school in the United Kingdom (143/200),[18] which is the highest DREEM score reported so far, indicating an environment highly conducive to learning.

When the scores of the students in different years of education were compared, it was observed that the year 1 and 2 students had more positive perceptions of the educational environment than year 4 students. This difference was also true for every domain of the DREEM inventory. Reduction in scores in the final year of training is a finding that has previously been observed in medical[19] and nursing schools.[20] A number of reasons have been suggested for this tendency, including higher expectations[17] at the time of admission, gradual loss of interest over time, and increased stress secondary to involvement in clinical activities, often leading to depression.[21] Unsatisfactory or unpleasant clinical placement experiences, attitudes of placement staff, workload, students' perceived unpreparedness secondary to inadequate knowledge and skills expected, and lack of support in the care of patients have been factors identified as reasons for stress after involvement in clinical activities.[22] All of this may cause loss of interest among students and affect their academic achievement and ultimately their patient care, often resulting in dropout from semesters or programs. Different methods have been employed by institutes to enable students to handle stress. This may include provision of psychological support, counseling and sessions/workshops on stress management.[23] A formal mentorship program has also been shown to improve the academic achievement of students and decrease dropouts.[24] Reviewing the academic and clinical schedule of the students to ensure balance between clinical workload, formal teaching and time for recreational/extracurricular activities can also contribute to reduction in students' stress levels.[25] Program directors need to look into the matter more closely to ensure retention of students in the program and the discipline of optometry.

Only three areas were identified as strengths of the educational environment indicated by an itemized score of 3.0 or more; one was related to the "students' perceptions of teachers" and two were related to the "students' perceptions of academic self" subscale. Most students perceived their teachers to be knowledgeable. They appreciated the relevance of the curriculum to the needs of the profession of optometry and the fact that they learned empathy during the course.

An item-wise analysis of different domains of perceptions identified key areas requiring evaluation and modification. Twelve out of 50 items scored less than 2.0. The majority of these items were in the "students' perceptions of teachers" (5 items out of 12) followed by "students' perceptions of learning" (3 items out of 12), indicating dissatisfaction with the faculty and teaching and learning at the institute. Educational environment is not limited to the physical infrastructure. Faculty play an important role in developing an environment that is conducive to learning. Some simple steps can improve the faculty-learner interactions and thus build a trustful and respectful relationship required for optimal teaching and learning at the institute. Steps may include involving the students in setting of ground rules, using interactive teaching strategies, encouraging students to ask questions without fear of being humiliated for lack of knowledge, and maintaining the content and session time balance. Sharing of information related to learning objectives and type and time of assessments well in advance and creating student-related institutional policies can also minimize the distance between the faculty and the students. Students should be provided with regular, timely and focused feedback on performance in a manner that is respectful and constructive for the learner and serves as a learning strategy rather than a cause for demotivation. Students who are having difficulties in learning need to be identified early and provided additional support. The teaching and learning strategies should follow the principles of adult learning. Using strategies that are interactive and promote critical thinking will not only reduce boredom and stress among students but is also likely to produce more competent and confident optometrists.

Students' initial experience with clinical practice can affect their approach to clinical situations as well as their desire to excel further in the discipline. The strikingly low score for the "students' perceptions of the faculty" by the final year highlights the need for the training of faculty as clinical preceptors in order to enable them to meet the expectations of students while maintaining their clinical workloads.[26] Also, the management should ensure that the faculty are getting adequate breaks, are not overworked, and have a physical environment where they can relax and concentrate on work. This can help even faculty tempers and create a congenial environment both for the faculty and the students. The faculty should also know their role as teachers and as positive role models.[27] Conducting regular course evaluations can also serve as a tool for assessment of the course and that of the faculty members.

The study also identified the group of learners (final-year students with lowest overall median and subscale scores) that require maximum support and guidance for acquiring the required knowledge and skills and gaining confidence to practice independently.

The DREEM questionnaire was helpful in providing valuable insight into how optometry students at Isra School of Optometry perceive their educational environment. It is important to have this information because students' perceptions of their educational environment significantly impacts their behavior, academic performance and sense of well-being. The study not only identified the strengths of the program but also helped greatly in identifying limitations or the areas of the educational climate at the institute that require improvement. Attempts should be made to identify causes of dissatisfaction among the

students and design appropriate remedial measures for weak areas in order to enhance the educational experience. The effect of such remedial measures would be evident in the form of improved students' perceptions regarding their educational environment. Introducing a system of periodic but regular evaluation of the educational environment (maybe by using the DREEM questionnaire) and devising remedial strategies incorporating students' feedback could help program managers and organizers to raise and/or maintain the quality of the educational environment. Further studies are recommended to evaluate the relationship between educational strategies and educational environment and identification of factors causing stress in clinical years and at work.

**Conclusion**

The median DREEM score of students at Isra School of Optometry was comparable to other medical and nursing institutes'. The study identified the strong and the weak areas of the educational environment and indicated critical need for faculty training, improving teacher-student interaction, ensuring constructive feedback to students, rescheduling of timetable by redistribution of teaching and working hours, restructuring clinical experience, and developing a support system for the students. Program managers need to take steps to improve the quality of the educational environment and thus the program by addressing the areas identified.

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## Appendix

### Dundee Ready Education Environment Measure (DREEM)

1. I am encouraged to participate during teaching sessions
2. The course organizers/teachers are knowledgeable
3. There is a good support system for students who get stressed
4. I am too tired to enjoy the course
5. Learning strategies that worked for me before continue to work for me now
6. The course organizers/teachers adopt a patient-centered approach to consulting
7. The teaching is often stimulating
8. The course organizers/teachers ridicule the students
9. The course organizers/teachers are authoritarian
10. I am confident about passing this year
11. The atmosphere is relaxed during teaching
12. The course is well-timetabled
13. The teaching is student-centered
14. I am rarely bored on this course
15. I have good friends on this course
16. The teaching helps to develop my competence
17. Cheating is a problem on this course
18. The course organizers/faculty have good communication skills with patients
19. My social life is good
20. The teaching is well-focused
21. I feel I am being well-prepared for my profession
22. The teaching helps to develop my confidence
23. The atmosphere is relaxed during lecture
24. The teaching time is put to good use
25. The teaching over-emphasizes factual learning
26. Last year's work has been a good preparation for this year's work
27. I am able to memorize all I need
28. I seldom feel lonely
29. The course organizers/faculty are good at providing feedback to students
30. There are opportunities for me to develop interpersonal skills
31. I have learned a lot about empathy in my profession
32. The course organizers/faculty provide constructive criticism
33. I feel socially comfortable in teaching sessions
34. The atmosphere is relaxed during seminars/tutorials
35. I find the experience disappointing
36. I am able to concentrate well
37. The course organizers/faculty give clear examples
38. I am clear about the learning objectives of the course
39. The faculty get angry in teaching sessions
40. The faculty are well-prepared for their teaching sessions
41. My problem-solving skills are being developed here
42. The enjoyment outweighs the stress of the course
43. The atmosphere motivates me as a learner
44. The teaching encourages me to be an active learner
45. Much of what I have to learn seems relevant to a career in health care
46. My learning environment/classroom is pleasant
47. Long-term learning is emphasized over short-term learning
48. The teaching is too teacher-centered
49. I feel able to ask questions
50. The students irritate the course organizers/faculty

# Concept Mapping as a Tool for Didactic Learning and Case Presentation in an Optometric Curriculum

Jean Pak, MSEd, Elaine Wells, MA, MLS, AHIP(D), David Libassi OD, Susan Schuettenberg, OD, and Kathryn Richdale, PhD, OD | Optometric Education: Volume 42 Number 1 (Fall 2016)

**Introduction**

Integrating theory and practice has long been a goal and necessity of medical training. Particularly in the past two decades, medicine has experienced exponential growth in the biomedical knowledge expected of students. Thus, it has become important to develop more systematic methods to integrate acquired knowledge with the aim of better applying it to practical scenarios. A "concept map" or "mind map" is a graphical tool for organizing and presenting knowledge. David Ausubel is widely credited as being the creator of the concept map.[1] His assimilation theory of learning, as presented in his 1968 work *Educational Psychology: A Cognitive View* forms the basis upon which the concept map is built.

The effectiveness of concept maps as a teaching tool in healthcare education is equivocal. Maneval et al.[2] showed that nursing students taught skills using their traditional care-planning method scored significantly better on examinations than students taught with a concept mapping method. A review by Pudelko et al.[3] suggested that there was not sufficient evidence to support the hypothesis that mapping improved the acquisition of knowledge, memorization or recall. On the other hand, it has been shown that employing concept maps in problem-based learning tutorials is feasible, acceptable to both students and teachers, and can enhance learning and exam performance.[4-6] Specifically, Torre et al.[7] showed that the use of concept maps strengthened the connection between theoretical information and clinical practice, promoting a higher capacity for problem-solving and holistic thinking and improved recognition of patterns or trends in clinical care. It was thought that this facilitated the ability to form and evaluate differential diagnoses by medical students. Participants in this project indicated a sense of connection between learning styles and the perceived value of concept maps.[7] Similarly, nursing students who self-identified as visual learners reported feeling that concept maps were easier to master.[8] These findings suggest that mapping exercises may not support learning equally for all students.

In 2010 the curriculum at the State University of New York (SUNY) College of Optometry was revised. One of the goals of the revised curriculum was to improve the ability of students to integrate basic and clinical sciences. The purpose of the pilot projects presented here was to gauge the utility and acceptance of concept maps among select groups of optometry students, and to determine whether the exercise improved their ability to integrate didactic knowledge and clinical care in a clear, cohesive way.

**Methods**

This pilot project was approved by the SUNY Optometry Institutional Review Board as exempt under educational settings (Code of Federal Regulations 45 CFR 46.101(b)(1)). The project was performed in three arms, with each arm utilizing the concept map software Mindomo (Mindomo, Expert Software Applications, Timisoara, Romania). Each arm of the project was performed successively, incorporating lessons learned from the prior projects. In each arm, the Academic Program Coordinator (JP) and Library Director (EW) provided demonstrations of the software to the course instructors and student participants.

Mindomo is a cloud-based software presentation program that allows real-time collaboration but can also support off-line use. The software integrates with Google Drive, Microsoft PowerPoint, Blackboard and Dropbox, and maps can be saved in multiple formats. To begin constructing a map in the program, the user chooses a template and assigns a title to the map. The user can then create a main topic and subtopics with further branches to expand areas of interest. Users can add photos and links to websites, journal articles or other points of reference.

The first arm of this project was a small (n = 5) focus group with third-year students in a Contact Lens II course. The goal was to allow students time to utilize the software with a given task and to provide feedback. Students volunteered to participate in a one-hour guided concept map instruction session. Topics for the concept maps were selected from the Contact Lens II curriculum by the Course Instructor (KR) to encourage incorporation of basic knowledge (e.g., ocular anatomy, optics) and clinical application (e.g., fitting of orthokeratology or multifocal contact lenses). Students selected from the list of potential topics and, after an in-person training session, were allowed to work with the software for the entire semester. They were asked to provide feedback to the Course Instructor, Academic Program Coordinator or Library Director.

In the second arm of the project, second-year students (n = 84) were invited to complete a concept map as part of the Contact Lens I course. The project was included in the syllabus as a graded assignment. The students were assigned to groups of six with individual grade-point averages taken into consideration to ensure a balance of academically strong students in each group. The Course Instructor (DL) provided general topics based on learning objectives in the curriculum, and each group selected one topic. Topics included how to identify appropriate contact lens candidates and how to decide which lenses and care systems are best for a patient. In addition to receiving instructions on how to use the software, the third-year Contact Lens II students were asked to present their concept maps to the rest of the class, both contact lens Course Instructors, the Academic Program Coordinator and the Library Director at the end of the term. Students were also asked to answer questions about their experience with the concept mapping exercise.

For the third and final arm of the project, the concept mapping tool was introduced to first-year students in the Integrative Seminar course (n = 93). The college's Integrative Seminar course incorporates observation in the college's clinical care facility to enable case-based learning using small-group discussions of real patient cases. For this arm of the project, each student was asked to create a map around a case he or she observed in clinic. The Instructor for Integrative Seminar (SS) was available throughout the term to assist students in selecting a case and creating their concept maps. Students were asked to submit their concept maps to their small-group discussion leader at the end of the term, and eight of the best concept maps were presented as part of a schoolwide grand rounds presentation. All students were also asked to complete a survey about their use of the concept mapping tool and to complete a Felder & Solomon Learning Style Inventory questionnaire.[9,10] This questionnaire is used to determine individual preference to "Active-Reflective, Sensing-Intuitive, Visual-Verbal and Sequential-Global Thinking" learning styles. In general terms, Felder describes active learners as those who learn best by active discussion and engagement, whereas reflective learners do better with passive or solitary methods. Sensing learners prefer facts and established methods, while intuitive learners prefer discovery and broader inquiry. Visual learners prefer diagrams or flow charts, while verbal learners tend towards written or spoken explanations. Finally, sequential learners appreciate step-wise learning, while global learners grasp things better as a large picture or model. Many people can express or feel comfortable with some characteristics of each type of learning style, depending on the setting, topic or other factor.

A few volunteers from the Integrative Seminar course were asked to participate in a one-hour post-activity focus group (n = 10). Open-ended questions about their experience with the concept mapping exercise, including the impact on their learning, participation in Integrative Seminars and the relationship between learning style and the use of concept maps, were used to facilitate the discussion.

**Results**

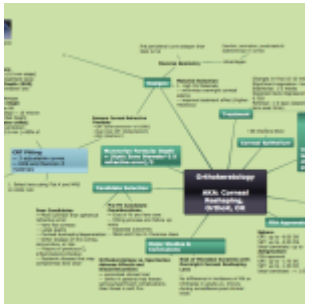


*Image 1. A concept map for orthokeratology contact lenses.*
*Image 1: click to enlarge*

An example of a concept map created in the Contact Lens II course by third-year students is shown in **Image 1**. The orthokeratology concept map demonstrates a student's integration and consideration of corneal anatomy, lens parameters, fitting considerations, and major research studies, among other things. The student also incorporated images she thought important to helping her understand the fitting of orthokeratology lenses.

General feedback from third-year students was that the tool required some explanation and practice to use. Some students found it helped to organize their thoughts, but others preferred their own study methods. The Course Instructor reported that it was a useful exercise to see which concepts the students thought to be key learning points and where there were gaps in understanding. She felt that it provided valuable insight into the breadth and depth of the students' grasp of the topic.

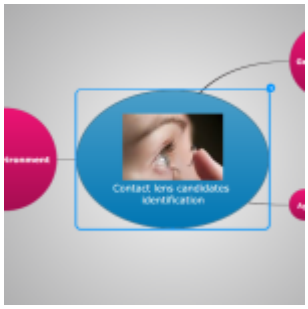
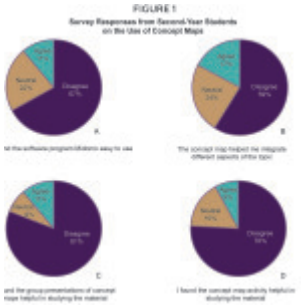



*Image 2. A section of a concept map for selection of a good contact lens candidate. View the full map here.*
*Image 2: click to enlarge*



An example concept map created in the Contact Lens I course is shown in **Image 2**. This concept map outlines potential contact lens candidates based on considerations such as systemic health, environment, age and ocular findings. The faculty members attending the concept map presentations were able to ask questions and give feedback directly to the student groups during their presentations. The faculty members felt that the concept map presentations were a good review of concepts and allowed them to clarify misinterpretations and questions prior to the final examination. They liked that it showed the students' ability to integrate and present course material in a way that is not typically done in a didactic course.

*Figure 1: click to enlarge*

There was an 85% response rate to the second-year Contact Lens I student post-mapping survey (n = 71 of 84). Categories were collapsed into three from five categories (Agree/Strongly Agree, Neutral, and Disagree/Strongly Disagree) **(Figure 1)**. The majority of students in the class felt that Mindomo was not easy to use **(Figure 1A)** and that the concept maps did not help them integrate the material **(Figure 1B)**. They also did not find the group presentations helpful in reviewing the material **(Figure 1C)**. Only 8% said that the concept maps were helpful for studying **(Figure 1D)**. Open feedback from the students suggested that they were not open to new learning tools at this point in their education, suggesting that it might be better to introduce the tool during the first year of the curriculum. Faculty and student discussion raised questions as to whether learning style had an influence on student acceptance. This advice led to the third arm of the project and incorporation into a first-year course.

*Image 3. A section of a concept map for ocular manifestation of Down Syndrome. View the full map here.*
*Image 3: click to enlarge*

The final arm of the project with first-year students incorporated both hands-on and written instruction in concept map building, as well as instruction on how to find and utilize didactic and clinical information to review and present a clinical case. **Image 3** shows a sample concept map that was created for the first-year Integrative Seminar course. This map is a review of ocular associations with Down Syndrome and it demonstrates a first-year student's incorporation and broad understanding of the many clinical manifestations he/she may come across during an examination. The signs and symptoms are elaborated upon with references, photo and video documentation and further explanation. The Course Instructor found the mapping exercise a good way to assess students' ability to cohesively integrate and present multiple aspects of clinical cases.

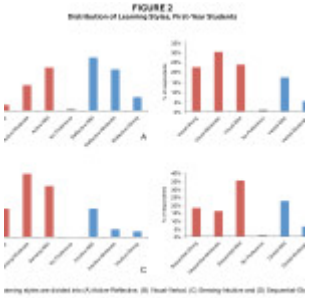


*Figure 2: click to enlarge*

The distribution of learning styles in the first-year class as determined by the Felder & Solomon questionnaire is shown in **Figure 2**. Overall, there was a tendency toward more reflective, visual, sensing and sequential learners; however, there was a wide range of learning styles in the class.

*Table 1: click to enlarge*

The post-activity survey from the third arm of the project demonstrated that the majority of students preferred to visualize or outline their map in the initial design **(Table 1)**. More than half wanted to get just a brief introduction before exploring the software on their own, and 51% would be likely to create new maps similar to what they had done previously. When asked about the utility of concept mapping, about half saw no utility, but the other half found it useful for bringing together concepts or understanding clinical cases better. Approximately 40% of students felt that the concept map enhanced their critical-thinking skills **(Figure 3A)**. In addition, 62% of the respondents indicated that the concept map helped them see the big picture in their clinical case presentations **(Figure 3B)**. About half of the students indicated that the concept map helped them make connections to other courses **(Figure 3C)**. But only one-third thought that the concept mapping exercise reflected their individual learning style **(Figure 3D)**.

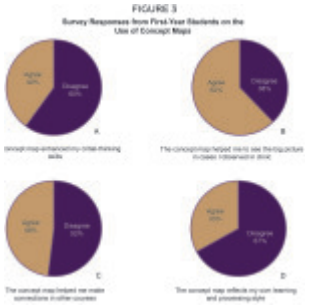


*Figure 3: click to enlarge*

The first-year focus group further demonstrated that the experience and impact on learning among participants varied. Some students indicated that the concept maps helped them to see the bigger picture and organize information and thought that it could be of benefit if the exercise were integrated as a continuous project throughout the program. Some continued to use the software in other courses in the curriculum. However, many students cited concerns over the time it took to complete the maps and questioned the utility compared to other methods of study. Many students also felt that, despite the additional training, they still needed more instruction on the technical aspects of the software. Some students reported that they felt other types of presentation software were easier to use.

**Discussion**

A review of the literature on concept mapping in medical education reveals that there are many factors that can influence its acceptance and viability as a learning tool. Harrison and Gibbons[8] noted that students expressed negative feelings about

concept mapping when they did not fully understand the reason for creating the maps and when they felt that this new learning strategy was imposed upon them. Students at the SUNY College of Optometry echoed this sentiment when concept mapping was introduced in the second and third years of their optometric studies. Student feedback demonstrated that by this point in the curriculum, they had developed their own methods of studying and many objected to having to learn and use a new study tool. This was even the case for some first-year optometry students who likely developed study methods during their undergraduate work. Many graduate level students simply may not be open to trying new study methods without solid proof of efficacy.

Contradicting many students' lack of enthusiasm for the learning tool, faculty reported that it was a useful tool to demonstrate student knowledge, ability to organize and present thoughts, and to integrate key concepts of a course or clinical case. That there is a discrepancy between student and faculty experiences with concept maps is not entirely surprising. From the first to the third arm of this pilot project, the authors learned that making the exercise part of the course was important, as was thorough and continued support for use of the software. It is likely that continued use across multiple courses would improve students' comfort and efficiency with the tool. This would likely also influence their thoughts on the utility of the learning tool. It is important that instructors utilizing non-traditional learning and assessment methods clearly share with students how the exercise can benefit their learning above and beyond typical written examinations or case presentations. These kinds of tools can serve as a future reference beyond any single course, for example, to review for board exams or as a quick reference in clinic. Another example is that a glaucoma map could be created as a single point of reference for diagnostic criteria, pharmaceutical dosing information, corneal thickness and intraocular pressure lookup tables, etc.

Previous literature suggested that learning style may have an effect on the utility and adoption of concept maps.[4] The SUNY first-year students tended to be more visual, sequential, sensing and reflective learners. The skew toward reflective and sensing learners may also partially explain why many of the students didn't embrace the active, broader, more global view of concept mapping.

There are many different platforms for creating concept maps including Inspiration, MindMap, Creately, Prezi, and others. Some are free and others, like Mindomo, require a license for expanded features. The costs generally vary with the number of users. Mindomo was selected for this pilot project population based on a personal recommendation and the software's sharing, storing and collaboration features. The cost for the SUNY student class size was reasonable ($90 for a six month license plus $250 for six months for 100 users). Some advantages of these concept mapping systems include features that allow a user to zoom in and "drill down" for more information and make presentations more dynamic and interactive with animation. These systems readily allow the addition of links to external photos, videos or other reference materials.

There are some limitations to this pilot project. The sample sizes of the focus groups were small and may not fully represent all students. This project was done in three iterations using learning from each arm to modify the next project. While this allowed us to improve the implementation each time, the same data points were not collected for all classes and thus the data cannot be compared across classes. Finally, these were all cross-sectional projects with only one map done per student/group, and there is no information about the acceptance and utility of continued implementation of concept maps throughout the curriculum or over time. In the future, a study could randomize half of a first-year optometry class to use a new learning tool throughout their four years of study and compare performance in the courses, in clinic or on National Board Exams. There is limited information on the ability of learning tools to improve short- or long-term knowledge in a clinical setting. In an undergraduate setting, Burdo and O'Dwyer[11] compared concept mapping to retrieval (self or small-group repeated recall testing) and showed that retrieval practice did improve performance on standardized exams. The idea behind retrieval practice is that the more learners actively practice using (retrieving) information, the better they retain the information. Clinical practice involves broader thinking and integration across multiple courses and longer retention of material than any single standardized course exam, thus larger, longitudinal studies would be required to fully assess the impact of any new learning method on clinical training.

Despite these limitations, the pilot projects presented here provide useful baseline information on how concept mapping might be utilized in an optometry curriculum. Based on the pilot projects and student feedback, we recommend the following to schools or instructors interested in incorporating concept maps into their curricula:

- introduce concept mapping early in the curriculum before students have formalized their study habits and methods
- weave the concept mapping exercise throughout the learning experience and across multiple courses in the didactic and clinical curriculum to increase student comfort with the tool
- ensure that students have sufficient training to utilize the software via tutorials, written reference materials and continued technical support
- provide direct feedback to students and emphasize the benefits of concept mapping exercises in their ability to allow students to demonstrate their depth and breadth of knowledge, ability to highlight key concepts, etc.

## Conclusions

The success of incorporating new learning tools into any curriculum depends on many factors, but especially instructor support and student engagement. While it is clear that faculty see learning benefits of concept mapping exercises, such benefits must be translated back to students for them to embrace the tool. Further research is needed to fully assess the utility of concept mapping in healthcare education.

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# Industry News

| Optometric Education: Volume 42 Number 1 (Fall 2016)

# Beware of Predatory Publishing

Aurora Denial, OD, FAAO | Optometric Education: Volume 42 Number 1 (Fall 2016)

*Aurora Denial, OD, FAAO*

I recently invited New England College of Optometry librarians to speak to my class about critically evaluating resources. During the presentation, they talked about "predatory publishing." Several students had never heard the term, and when I asked some faculty members whether they were familiar with it, many said they were not. However, after hearing a description of predatory practices, almost all of them realized they had a recent experience with a predatory journal or publisher.

The ease and speed of disseminating information via the Internet has been beneficial for researchers, librarians, faculty and anyone seeking information, and has led to the availability of open access journals. Most open access journals have the same quality attributes as print journals, including a rigorous peer-review process. However, unfortunately, many do not. Many exist for profit only and engage in unethical and unprofessional practices.[1] They are sham entities that do not provide a rigorous peer-review process or disseminate information appropriately.[2] These predatory journals and their publishers have become more prevalent. From 2010-2014, their publication volume increased from an estimated 53,000 to 420,000 articles, published by 8,000 active journals.[3] These entities are characterized by spam e-mails used to solicit submissions, no peer review or a poor quality peer-review process, a quick turnaround time from submission to publication, fake impact factors, listing of academics as members of the editorial board without the academics' consent, listing article processing fees (APF) only after copyright has been relinquished, and not belonging to a database for dissemination.[1-4] (Article processing fees can be assessed by legitimate journals but are always disclosed in publication guidelines with transparency.)

**Distinguishing the Good from the Bad**

Jeffrey Beall, a librarian at the University of Colorado, Denver, developed and oversees a list of "potential, possible or probable" predatory journals. His list and criteria can be found at his blog, Scholarly Open Access. While Beall's list has met with some criticism, it represents a starting point. He has included new, start-up journals and legitimate journals that were created in developing countries. Additionally, although the list is updated regularly, it may not be comprehensive. The skills and disposition to critically review resources should be used by all information-seekers as well as people interested in publishing a manuscript.

The Grand Valley State University Libraries' Scholarly Communications Advisory Committee (SCAC) has developed a set of indicators that can be used to evaluate publishers or journals.[1] The committee identified both positive and negative indicators:

*Positive indicators*

- scope of the journal is well-defined and clearly stated
- journal's primary audience is researcher/practitioners
- editor, editorial board are recognized experts in the field
- journal is affiliated with or sponsored by an established scholarly society or academic institution
- articles are within the scope of the journal and meet the standards of the discipline
- any fees or charges for publishing in the journal are easily found on the journal website and are clearly explained
- articles have DOIs (Digital Object Identifier, e.g., doi:10.1111/j1742-9544.2011.00054.x)
- journal clearly indicates rights for use and reuse of content at article level (e.g., Creative Commons CC by license)
- journal has an ISSN (International Standard Serial Number, e.g., 1234-5678)
- publisher is a member of Open Access Scholarly Publishers Association
- journal is registered in Ulrichsweb, Global Serials Directory
- journal is listed in the Directory of Open Access Journals
- journal is included in subject database and/or indexes

*Negative indicators*

- journal website is difficult to locate or identify

- publisher “About” information is absent on the journal’s website
- publisher direct marketing (i.e., spamming) or other advertising is obtuse
- instructions to authors are not available
- information on peer review and copyright is absent or unclear on the journal website
- journal scope statement is absent or extremely vague
- no information is provided about the publisher or the information provided does not clearly indicate relationship to a mission to disseminate research content
- repeat lead authors in the same issue
- publisher has a negative reputation (e.g., documented examples in Chronicle of Higher Education, list-servs, etc.)

SCAC also advocates that journals be evaluated on a case-by-case basis, with no single criterion indicating high or low quality.[1]

**Don’t Be Fooled**

Scholarly publications are an expectation for most faculty members. Research with dissemination is a key component of promotion and tenure evaluations. Promotion and tenure committees often review faculty who have publications in journals that are unfamiliar to the members of the review committee. Faculty, review committees and anyone seeking information must be proactive in evaluating journals to ensure high-quality publications. Predatory journals can look like legitimate journals and very often have titles that are similar to existing journals. Faculty should be on alert for journals with unethical or unprofessional characteristics.

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# Coming in December

| Optometric Education: Volume 42 Number 1 (Fall 2016)

Stay tuned to your Inbox for the announcement that the Winter 2016 issue of *Eye on Education* — the online newsletter from the Association of Schools and Colleges of Optometry (ASCO) — is available.

In the issue, you can read about the recent appearance of ASCO President Karla Zadnik, OD, PhD, on *All Sides with Ann Fisher*, a public affairs talk show broadcast by WOSU 89.7 NPR News in Ohio. The discussion with Dr. Zadnik coincided with the Centers for Disease Control and Prevention's Contacts Lens Health Week.

**Also:** Visit ASCO's website to take advantage of a variety of resources, including the recently posted "Career Opportunities for ODs in Academia: Teaching & Research Needs," a PowerPoint module that explores the need for increasing the faculty ranks at optometric institutions.