Blended Learning in Optometric Clinical Procedures Instruction

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Abstract

Blended learning combines online and face-to-face teaching. One-third of a refraction course in the second year of optometry school was offered in a blended format. We evaluated student understanding, preparation for laboratory sessions and satisfaction. The final exam scores comparing online and in-class topics were not significantly different from 2011 to 2012. No difference was noted in laboratory skills. Students were satisfied with the online activities. Blended learning did not affect learning or laboratory performance. However, students appreciated its flexibility and ability to keep them engaged. Blended learning may be an effective way of delivering material.

Key Words: *optometric education, blended learning, refraction*

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Introduction

Blended learning is a hybrid of online and face-to-face teaching. It uses technology to enhance teaching and can increase interaction between faculty and students. Technology can allow flexibility in both teaching and learning. Online learning allows for a greater variety of teaching and learning styles.[1] Different techniques can be used in order to meet the needs of different types of learners. The learner can also adjust the pace of the learning to meet his/her needs. There is improved access to the information and greater convenience because the students are able to view the information multiple times and at any time.[1] In addition, multiple assessment methods are available through the use of technology. This helps to assure that students understand the topic areas. Finally, technology allows ease of communication between students and between student and professor.[1]

Learning styles of students have changed over the years. Technology has become an integral part in the lives of the students we teach. Many larger educational institutions now use online instruction.[2] Evaluations of blended learning in the areas of orthopedics,[3] physiotherapy,[4] nursing,[5-7] dentistry,[8] geriatric medicine[9] and pediatric medicine[10,11] have shown that students have a high satisfaction with online learning, including better contact with tutors, more timely feedback and improved flexibility. There are conflicting results from studies that attempt to objectively compare test results from traditional vs. online learning.[4,8,12,13] While blended learning approaches have been demonstrated to be effective in many disciplines, these approaches have not been studied in optometry.

Clinical Procedures III occurs during the fall semester of the second year at Pacific University College of Optometry. In the course, students are taught how to perform distance and near phorometry. Students traditionally meet for one hour of lecture per week and participate in a two-hour hands-on lab each week. Two multiple-choice examinations are given through the semester to assess knowledge, and students are required to demonstrate proficiency of the skills they have learned with a

hands-on assessment. Due to the combination of lecture and laboratory time, it was felt that this class was an ideal place to implement blended learning in the optometry curriculum. Here, the traditional lecture time is replaced by computer modules, and the face-to-face teaching is done in the laboratory setting.

After integration of blended learning in the Clinical Procedures III course, we evaluated three general areas to determine the benefits and challenges of the blended learning program: the understanding of material presented, student preparation for laboratory sessions, and student satisfaction. The results of our study will aid optometric educators in integrating this technology in their curriculum.

Methods

Clinical Procedures III includes 12 topics presented through the semester. **(Table 1)** In fall 2012 we offered four of the 12 topics in a blended format. The other eight lectures were done using the traditional format. The traditional lectures were kept as similar to the previous year as possible so we could compare student performance.

An example of the blended learning on a Moodle page is seen in **Figure 1**. Each blended learning session included three to four, 3- 8-minute video segments. Each video segment was followed by a quiz to assure students understood the content. Students were required to watch the videos and receive a perfect score on all quizzes prior to the start of their lab time. Students received a quiz grade based on their first attempt. However, they were required to retake the quiz until they got 100%, otherwise no credit was given. The students were not required to attend class the weeks that they participated in the blended learning, but they were required to attend lab every week. Two in-class multiple-choice tests occurred through the semester, as well as the hands-on proficiency assessment. To assess understanding and compare performance with online vs. classroom-related topics, we compared the results of the cumulative final examination from 2012 with the same examination given in 2011.

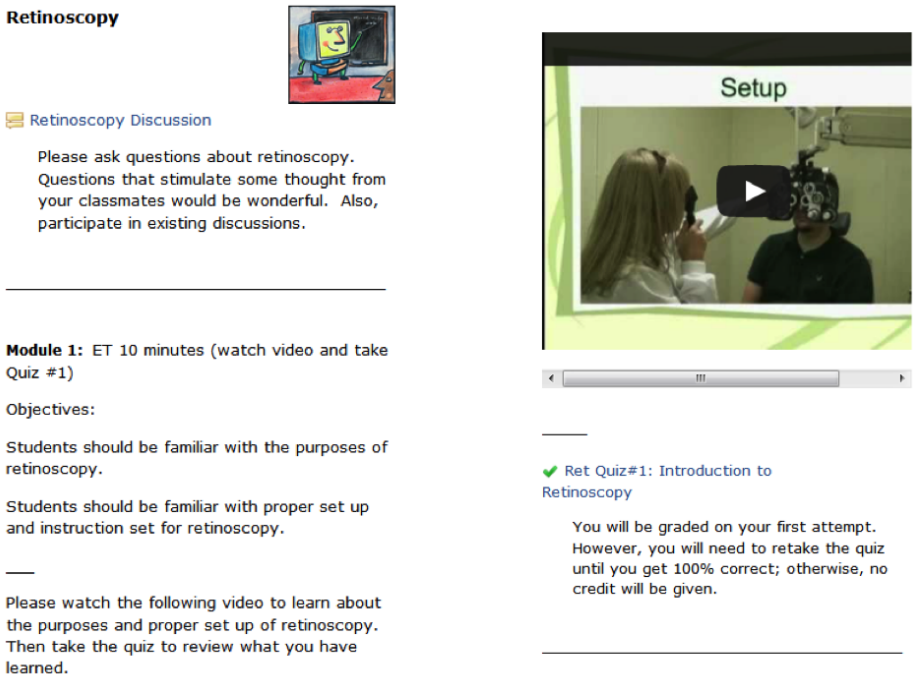
Table 1
Clinical Procedures III Topics and Rankings by TAs

Topics covered in Clinical Procedures III and ranking of the topics the teaching assistants (TAs) thought were presented online. (See text for further information.) Topics presented in a blended format are denoted with an asterisk. Topics that the majority of TAs thought were taught online are indicated with a "+".

Topic	TA ranking
Week 1: Orientation	0
Week 2: Static Retinoscopy*	0
Week 3: Keratometry+	4
Week 4: Radial Line	2
Week 5: Monocular Distance Sphere	0
Week 6: Jackson Cross Cylinder+	3
Week 7: Distance Equalization and Binocular Distance Sphere*	0
Week 8: Forced Accommodation+	5
Week 9: Accommodative Posture*	2
Week 10: Phorias*	2
Week 11: Vertical and Horizontal Vergences	1
Week 12: Sequencing and Clinical Thinking	0

Figure 1
Example from the Moodle Website

The first of three retinoscopy modules is shown. The computer icon indicates that this activity will be done online. Each online topic during the semester starts with an area where the students can discuss the topic (Retinoscopy Discussion). Each topic is then broken down into three or four modules. The estimated time (ET) that it is expected that the student will take to complete each module and what tasks the student needs to complete are listed. The total estimated time for each topic can be determined by adding the estimated times for each module. The objectives are then stated. Finally, the video is available by clicking the play button, followed by a link to the quiz.



In addition to completing the blended learning modules, the students were required to meaningfully participate in discussion boards. No quota or required topics were given. Students were encouraged to post questions that stimulated a meaningful conversation, participate in the conversations, and read the posts. The instructor posted questions and responded to discussion questions intermittently when it was necessary to clarify or correct information given by other students or to stimulate further discussion.

No pre-written notes were given to the students for the online lectures. Students were neither encouraged nor discouraged from taking their own notes. As was done in previous years, for all in-class topics a pre-written outline was given to students explaining details of how to perform the procedures.

We used three methods to evaluate the efficacy of the blended learning model. First, we compared performance on the final exam from previous years when no blended learning took place. Additionally, we gathered feedback from the instructors and teaching assistants (TAs) in an attempt to determine if the blended learning activities affected laboratory performance. Finally, students were given extra credit to participate in a survey to determine their thoughts regarding the blended learning experience.

Results

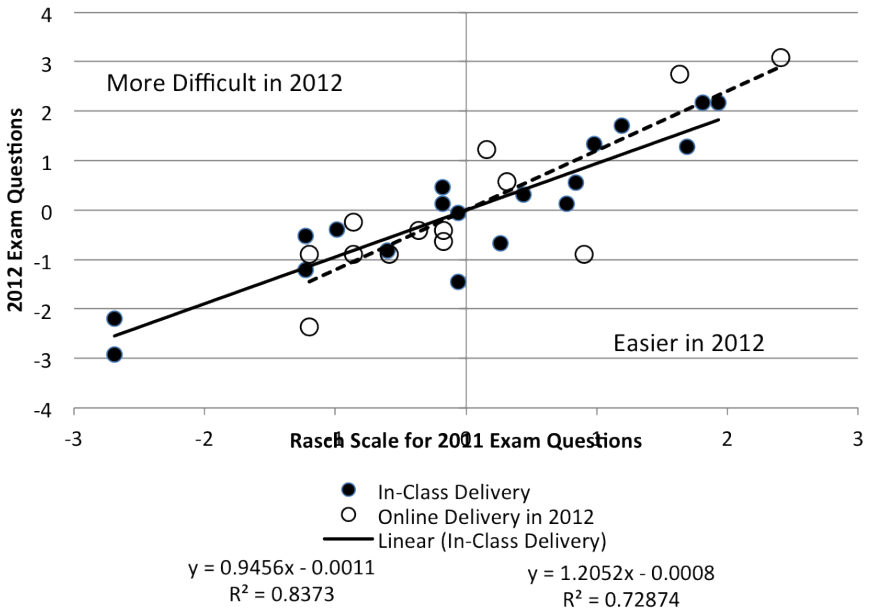
Final exam comparison

We compared the final exam results to the results of the same final exam given the previous year. Ninety-two students completed the Clinical Procedures III final examination in 2012 and 88 students completed the exam in 2011. The final exam was comprised of 40 multiple-choice questions. Of these, 30 questions covered topics from week eight to week 12, and the remaining 10 questions covered topics from week one to week seven. **(Table 1)** Thirteen exam questions pertained to information delivered online. Nineteen questions pertained to material covered in class. Eight questions were not included in the analysis either because the question covered material that was presented both in class and online or because the lecture was delivered by a different instructor than the person that delivered the information the previous year.

Table 2
Test Results of the 2011 and 2012 Final Exam for In-Class and Online Delivery

	Median	Mean	SD	n	t	p
2011 Class questions	0.824	0.828	0.124	88	0.79	0.43
2012 Class questions	0.824	0.813	0.128	92		
2011 Online questions	0.923	0.887	0.122	88	0.93	0.35
2012 Online questions	0.923	0.865	0.112	92		
2011 Diff between online - class	0.05	0.060	0.141	88	3.97	0.00
2012 Diff between online - class	0.04	0.053	0.133	92	3.79	0.00
Differences between online/class 2012-2011					0.34	0.73

Figure 2
Rasch Item Scale for Values for 2012 Plotted on 2011 Values for In-Class and Online Delivered Content



The mean score for questions that pertained to information given in class was 82.8% in 2011 and 81.3% in 2012. The mean score for questions that pertained to information presented online was 88.7% in 2011 and 86.5% in 2012. The median scores were identical for both online and in-class topics. **(Table 2)** These differences were not statistically different (p=0.43 for in-class questions and p=0.35 for online questions). A Rasch analysis was conducted to provide information on the level of difficulty for each exam question. Generally, this demonstrated that the questions that were easy in 2011 were easy in 2012, and the questions that were difficult in 2011 were difficult in 2012. **(Figure 2)**

Impressions from instructors and TAs

At the end of the semester, laboratory instructors and TAs were questioned to determine whether they thought the blended learning activities affected laboratory performance. First we determined whether the lab instructors and TAs had knowledge of which lectures had been given online. Four instructors were involved in the laboratory sessions. We received responses from two instructors. One of the two respondents was aware of which topics had been presented online. None of the

TAs who responded to the survey knew which topics had been taught online.

All lab instructors and TAs who were unaware of which lectures were given online were given a list of the topics delivered in Clinical Procedures III and were asked, "If you are unsure which lectures were put online, which four lectures do you think were online, and why?" If the instructors or TAs knew which lectures were online they were asked what differences they had noted when comparing labs where information was presented online vs. those where information was presented in class. Additionally, all instructors were asked to compare performance of the students from this year to students who took the course in previous years.

The instructor who was unaware of which topic had been presented online reported that he had not noted a difference in student performance compared to performance in previous years. The instructor who was aware of which topics were online noted that students did not rely as much on their notes when performing the online-taught procedures for the first time. However, no difference in skill level was noted when comparing the online-related labs and the in-class labs from previous years.

All TAs were third-year students who had taken and passed the course the previous year. Seven TAs were involved in the laboratory sessions. We received responses from six TAs. When TAs were asked what lectures they thought were online, and why, one TA chose the lectures he/she thought were online because he/she thought they would be easy to show in a video format. Five of the six TAs chose the topics they thought were presented online based on the feeling that the students would do poorer in labs associated with the online presentation. The following were the reasons why the five TAs chose the labs they thought were online:

"The students were less prepared for those labs."

"These labs were most challenging for the students."

"They had a few more questions about those tests than others."

"These labs seemed to be the most confusing labs for the students."

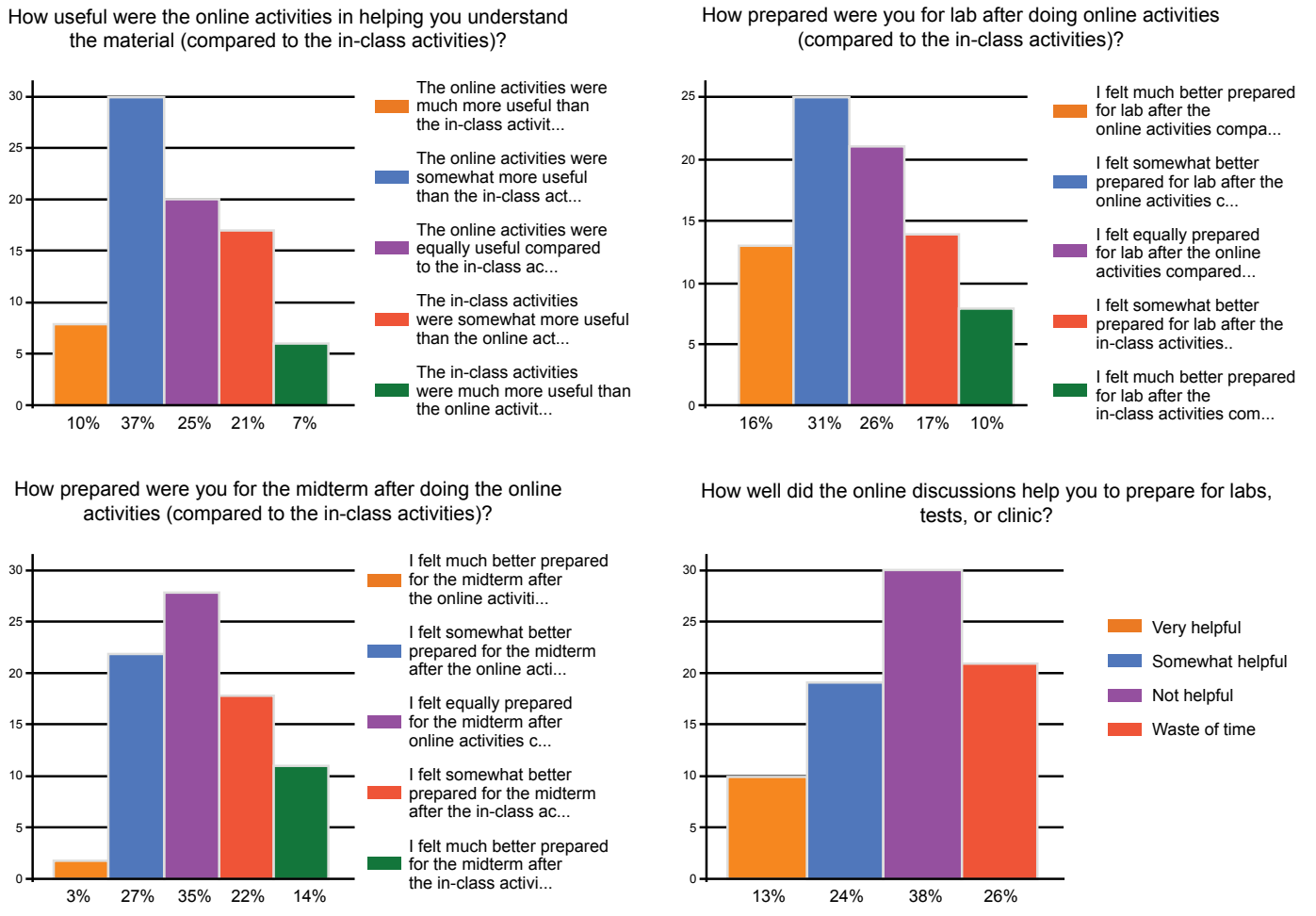
"The students were not very prepared for these topics and required a lot more in-lab instruction."

Four of these five TAs picked four courses they thought were taught online, and one picked only three courses he/she thought were taught online. **(Table 1)**

Student impressions

Despite that extra credit was given for completing a survey regarding their satisfaction with the blended learning, only 81 of the 92 students completed the survey. These questions and responses are seen in **Figure 3**. In general, students were satisfied with the online

Figure 3
Select Results from the Student Survey



activities (56% satisfied, 26% neither satisfied or dissatisfied, 19% dissatisfied) and felt the videos (95% very or somewhat helpful) and quizzes (95% very or somewhat helpful) helped them prepare for the labs, tests or clinic. They did not feel as if the discussion topics were helpful. Sixty-four percent felt the discussions were a waste of time or not helpful.

In the survey, students were given a chance to state what they liked and did not like about the blended learning. Because the responses were from individuals, some appreciated things that others did not. For example, many stated that they liked the immediate feedback from the quizzes, but some students felt that they did not receive immediate feedback. In this instance the students may have been referring to a different aspect of the online learning experience, such as not being able to ask questions immediately as you would during a lecture. However, the comments given were not specific.

Student responses to the question of what they liked are summarized below, in order of the most common sentiment:

- Videos helped with understanding
- Liked quizzes/quizzes helped to keep them focused and engaged/ liked immediate feedback from quizzes
- Ability to watch repeatedly
- Ability to do it on their own time or anywhere/ability to do it right before lab
- Ability to go at their own pace
- Liked the discussions

Student responses to the question of what they did not like are summarized below, in order of most common sentiment:

- Being graded on discussions
- Didn't have pre-written notes
- Discussions were not helpful/ would rather ask or interact in person
- Quiz grading too hard
- Make quiz questions harder/worth more
- Hard to study from videos
- No immediate feedback

Discussion

Advances in computer technology and software over the past decade have offered new ways for teaching and training. More and more students are taking courses fully online or in a blended/hybrid format.[14] Studies have shown that when online learning experiences are well organized and delivered (keeping the focus on outcomes and learning), they significantly enhance learning and retention of complex topics related to health sciences.[15,16] This project aimed to determine if applying blended learning methodology in an optometric clinical procedures course would enhance student learning, as well as increase student satisfaction.

The current focus of health education research aims to determine how instructional technology can be used effectively and efficiently to achieve learning objectives. A recent study in exercise physiology found that students who took a hybrid course performed significantly better and got higher letter grades than students in a traditional lecture-based course.[15] Likewise, blended learning resulted in improved grades in an undergraduate human anatomy course[12] and in a dentistry program.[8] A study with physiotherapy students showed improvement in some, but not all, areas.[4] When evaluating punctuation, those participating in traditional learning performed 24% better than those who participated in online activites.[13] Nevertheless, blended learning has been proposed to promote lifelong learning in larger educational institutions.[17] It may not be effective for all disciplines and has not been studied in optometry. The only report about online learning activity and optometry was a survey given to a group of second- and third-year students from the School of Optometry and Vision Science at the University of New South Wales to assess the usefulness and the frequency of use of a learning management system (WebCT).[18] The authors concluded that the web-based learning tool can serve as a platform to facilitate independent deeper learning and foster learning communities amongst optometry students.

Moving the Clinical Procedures III (phorometry) material online did not appear to affect learning as defined by multiple-choice exam performance. There was no statistically significant difference in scores on online-related questions or on in class-related questions when comparing identical final examinations given in 2011 and 2012. The medians were identical. The questions remained the same difficulty, and exam performance was the same both years. Generally, the difficult questions in 2011 were difficult in 2012 regardless of the method of delivery. This lack of difference in test scores correlates with the large number of students reporting on the end-of-the-course survey that they felt equally prepared for the midterm after the online activities compared to the in-class activities. **(Figure 3)** Likewise, Amin and Saqr[3] reported that only a little more than half (54.1%) of students in an orthopedic course said that e-learning helped them understand surgery better. From our study design we are unable to determine if blended learning has long-term learning implications.

Whether presented online (in 2012) or in the classroom (in 2011), topics that were chosen to be presented online were easier for students on the multiple-choice examination compared to the information presented in class. There was a median score of 92.3% in both 2011 and 2012 for the questions related to material presented online in 2012. This was a higher percentage than the score pertaining to information that was taught in the classroom in 2012 (median of 82.4% in 2011 and 2012). This may have been due to the instructor inadvertently choosing the online topics because they were easier for the students.

The lectures given online did not correspond with the top three lectures that the TAs thought had been presented online. It was very interesting that all but one of the TAs who responded to the survey chose the labs they thought were associated with online teaching because they felt they were the most challenging labs for the students. The TAs may have assumed that because the information was presented online the students would not take the initiative to complete the assignment. None of the details about the content or struc-

ture of the online lectures were given to the TAs. They did not know that there were quizzes or that there were consequences for the students not completing the quizzes prior to lab.

Lab instructors did not note a difference in skill level when comparing 2012 students to previous years. It makes sense that because no written notes were distributed, students were not relying on their notes as much to do the online labs. A number of students had organized details of the refraction into tables. It can be argued that the same thing would happen if the written notes were not distributed prior to an in-class lecture.

The majority of students were satisfied with the online activities. Generally, they liked the videos and the quizzes. No one felt the videos were a waste of time, and only one student felt the quizzes were a waste of time. Comments indicated that students liked to do the online activities on their own time (some liked to sleep in and do it in their beds). They also liked that they could watch the videos at their own pace. They were able to pause the videos to contemplate the information. However, they did find it difficult to study from videos. This was because it was challenging to find specific details when reviewing the video.

At least three quizzes were given throughout the online modules. The questions included multiple-choice, short-answer, true/false and matching questions. This assured that students were actively watching the videos. It also helped the instructor and student to discern whether participants understood pertinent principles. On the survey, many students commented that the quizzes helped them to stay focused and engaged. They also liked immediate feedback from quizzes.

A couple of students stated that it was difficult to remember to do the online activities. Only two students did not complete one quiz with 100% prior to the lab. Both instances occurred with the online activities associated with the first lab. All students completed all online activities prior to their lab session after the first week.

In general, the students did not like the discussions. They did not like that the discussions were mandatory and graded. In order to keep track of the quality of discussions in Moodle, the instructor needed to put some sort of rating system on the questions. This showed up automatically on the student grades. Despite the students being told multiple times that there was no requirement on the number of posts – they just needed to meaningfully participate – many felt that they needed to post the number of times that was implied by the rating system. Some students got together and planned to post a question so that another student could post a response. This made it more difficult to find the meaningful discussion topics on the website. Some students said that if they had a real question they would just ask it on their Facebook page. However, faculty do not have access to this Facebook page so the instructor would not be able to see what was being written. Students did not seem to want to participate in what the instructor viewed as more thoughtful questions. Many preferred to have an immediate answer from the "professor" rather than discussing topics with their classmates.

The discussions were very useful to the instructor in determining what the students were and were not understanding. The students answered each other's questions, but the discussions allowed the instructor to see and correct misconceptions when appropriate. Also, inconsistencies or misunderstandings that were presented in lab could be addressed immediately.

We will be rethinking how we organize the online discussions. Although students preferred the discussions to be non-mandatory, the author (DG) put a non-graded discussion section in the Clinical Procedures IV (spring 2013) course. This course involved the same students who participated in Clinical Procedures III in 2012. Students were told that they could post and should check the discussion board. However, by the last week of class, only six students had made a post (one student made three posts), and only 60 students even viewed the discussion more than once through the semester. Suggestions for a more meaningful discussion include having the students teach certain topics online, requiring citations for responses, or requiring them to respond only to prompts by the instructor. In addition, some classes may be able to have students work in small groups, have peers edit papers, perform case analysis, discuss assigned readings, or develop an area where students contribute links to certain research topics. It is recommended that the participation in the discussion is included in the course grade.[19] Alternatively, the traditional lecture time can be used for a discussion. The instructor chose not to do this, as she wanted the blended learning experience to be time-neutral for the students. She did not want to add activities to the students' already busy schedule without removing something.

In the future, the instructor will consider distributing the pre-written notes to the students. Additionally, more guidance will be given regarding what is expected in the discussions. There were a total of five discussion boards on which students could post (General Discussion, Retinoscopy, Distance Equalization and Binocular Distance Sphere, Accommodative Posture, and Phorias). This became unwieldy. Rather than having multiple areas for the discussion, the author would suggest only having one discussion board.

No major technology difficulties occurred. One facet that may have contributed to the lack of technology difficulties was that although the orientation on the first day of class was done in the classroom, the students were required to watch a 2- 3-minute video to ensure everyone had their technical difficulties worked out the first week. They were instructed to contact Technology Information Services immediately if they had difficulties and were told that this would not be accepted as an excuse for not completing the assignment prior to the due date.

Conclusion

Blended learning involves blending the classroom activities with online activities. Although there was no difference in examination or laboratory performance, putting the lectures online allowed the students to listen to or watch the lectures as many times as they desired. It allowed for more flexibility in that the students could do the assignments at any time of the day. It allowed more active student involve-

ment. Optometric faculty need to meet the expectations of the students while delivering difficult material in an effective way. Blended learning may be an effective way to achieve this goal.

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