Preparing Online Students for Comprehensive Examinations

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OBJECTIVE: Identify and remedy difficulties in the preparation of online students for certification examination success.

DESIGN: The final examination scores for the CLS Seminar course for the 2008 class of 27 on-campus and 10 online students were compared for statistical differences in seven examination areas. Problem areas were identified and changes in the CLS Seminar course were made in 2009 to improve the scores of the online students. The examination scores for the 2009 class of 33 on-campus and 10 online students were studied to determine improvement. Student's two-tailed t-test was used to determine statistical significance of differences between scores of on-campus and online students.

INTERVENTIONS: Interactive video over the web; used to answer online student questions, review games, more class time, and more recorded review sessions; were added to the Seminar. The study guides provided during preceptorships were tied to the objectives of the seminar course and the questions on examinations. Specific objectives for each question missed on the final examinations were provided to the student.

RESULTS: In 2008, examination scores for online students were lower in two of seven areas by a statistically significant amount than on-campus students. The difference approached significance in a third area. After interventions in 2009, the examinations scores had equalized with the exception of one area, Immunology.

CONCLUSION: Increasing the amount and method of review in areas deemed important to online education was successful in improving examination scores.

ABBREVIATIONS: Chem= chemistry, hemat = hematology, immuno= immunology, micro= microbiology, urine= urinalysis, CLS=clinical laboratory science

INDEX TERMS: Certification, Clinical Laboratory Techniques, Education, Online/methods, Laboratory Personnel/education, Technology, Medical/education

LEARNING OBJECTIVES:
Upon completion of this article, the learner will be able to:

1. Identify two interventions that decreased the gap in examination scores for online students.
2. Correlate interventions with the problem area they were designed to improve.
3. Discuss the limitations of online reviewing.
4. Provide two reasons that immunology material may be more difficult to reinforce than other areas.
5. List the areas in which statistically significant differences were seen in the 2009 scores between on-campus and online students.

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Online education is the current trend in Clinical Laboratory Sciences (CLS) education for many reasons. Among these are the shortage of laboratory personnel, especially in rural areas with place-bound students, the need for larger class sizes to ensure program survival, and limited clinical affiliates near large CLS programs. Both Freeman, et al. and Russell, et al. studied outcomes in online education students and found that GPA and certification examination scores were not significantly different between online students and those in the traditional classroom setting.[3,4] The same findings have been seen in online education of other health science professionals.[5,6] Online interactivity, whether delivered by email, case studies, discussion board, interactive videoconferencing, or recorded audio and video, is thought by many authors to be the key to success in content assimilation.[1-4] One of the challenges, when students are not on-site, is preparing them for certification and licensure examinations. When preparing to take these exams, online students are expected to set their own study schedule and take initiative to do their own preparation.

Faculty noticed that many of the online education students enrolled in the CLS Seminar class seemed to have difficulty preparing for the final examination and passing the course. This course is designed to assess the culmination of the knowledge they have acquired during the CLS program and to prepare the student to take the certification exam. The final examination in the seminar course is an approximation of the certification examination offered by the Board of Certification of the American Society for Clinical Pathology (ASCP) and includes sections covering blood banking, chemistry, hematology, immunology, laboratory operations, microbiology, and urinalysis. In the past, on-campus reviews and question and answer (Q&A) sessions were provided. The course instructors were also available during their office hours to explain to the students those concepts either forgotten or never learned. The course materials were available to both on-campus and online students on the course BlackBoard® site, with video/audio recordings of the on-campus sessions, online quizzes, and extra exam questions available to all students, as well as advice on purchasing review books. Comprehensive objectives for each of the seven areas were also on BlackBoard®. A question pool for the final examination, tied to the objectives, was maintained. Students were given a "dry-run" examination (for which they were specifically encouraged not to study) immediately prior to enrollment in the CLS Seminar course in order to show them the deficits present in their body of knowledge.

All the materials were available to the online students, including the videotaped sessions; however, blackboard interactions were difficult to capture clearly and in some cases PowerPoints with voiceover were added. Even with the availability of these materials the online students participated more passively in the class. They received feedback on the exam questions they missed either by email or over the telephone, where drawing diagrams and sketches were difficult. Areas identified as particularly problematic for online learners included convincing students to begin studying prior to enrolling in the CLS Seminar and engaging learners in autopsying their knowledge to determine what they actually have internalized versus what information they recognize when reading through their materials. Equally challenging was convincing them that knowledge is not retained when it is not being used or actively studied and reviewed. Additionally, limited face-to-face interaction with online learners inhibited their ability to ask questions as they thought of them and for instructors to fully explain the answer. When an instructor visually determines whether or not the learner is engaged and understanding, he or she can alter the explanation to fit the particular learner. This was impossible when the instructor could not see the learner as they could not tell if they were lost, bored, struggling, or had given up mid-explanation.

The aim of this study was to determine what changes could be made to the course that would enhance the learning of both the online and on-campus students and to improve their scores on the CLS Seminar final examination.

METHODS

Comprehensive examination scores from all students attempting these examinations during 2008 and 2009 were noted. Scores for each of seven areas (blood banking, chemistry, hematology, immunology, laboratory operations, microbiology, and urinalysis) were

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averaged for the on-campus group and for the online group. Student's two-tailed t-test was performed to determine the significance of the results. Significance was defined as $p<0.05$. The 2008 students were the control group and the 2009 students were the intervention group.

INTERVENTION

The following changes were made to the course and took effect in the Summer Semester 2009 course offering. In order to aid both online and on-campus students, previously recorded review sessions and a new review session for each area of the examination were made available, starting with the summer semester 2009 course offering. The previously recorded sessions were either on videotape for streaming video or narrated PowerPoint, whereas the new review sessions were done on Tegrity®. The Tegrity® recordings are much clearer to view than videotape that is streamed online and the instructor can be visible at the same time as the PowerPoint or other visual aid being used. The interaction with online students was enhanced by the availability of interactive videoconferencing over the web for answering questions. The instructors could draw and sketch on the screen while the students viewed the results on their computer screen. The amount of time provided every week for review and Q&A was doubled from one hour to two hours. Another aid that was added to the BlackBoard® site was a link to a free online review game that students have reportedly enjoyed playing.

Other interventions that took place to help the students were in the preceptorship courses preceding the seminar course. The University of Texas Medical Branch (UTMB) CLS students take four preceptorship courses that comprise the clinical experience portion of the curriculum. The instructors added a self-study preceptorship guide for each clinical area containing open-ended questions that were prepared from the seminar objectives and were also consistent with the preceptorship objectives. These were provided to the students at the time they took each preceptorship course and students were told that the examination at the end of the each course would be drawn from the material covered by the questions in the guide. The preceptorship guide was turned in to the preceptorship coordinator and graded by the faculty member with expertise in that area. Because getting students to start studying early has been challenging, it was hoped that this measure would encourage studying earlier and provide them with early feedback on areas they needed extra help understanding.

Because the students were allowed two attempts at the final examination, taking different versions, they were provided with the objective for each question that they missed on the first examination attempt. While the actual questions were not released, as they are in a permanent question pool, this was an effort to help the students determine exactly what information they were lacking and needed to study before the second examination attempt.

RESULTS

To see whether or not this intervention equalized the preparation of online and on-campus students for the comprehensive exam, the scores for the 2008 and 2009 graduates from the CLS program at UTMB were examined. The 2008 students were the control group and the 2009 students were the intervention group. Average comprehensive examination scores for the seven areas tested can be found for 2008 students in Table 1 and 2009 students in Table 2. Twenty-seven (27) on-campus and 10 online students attempted the examination in 2008. Significant differences were seen between the two groups in two areas: microbiology and urinalysis. A third area, immunology, was lower in the on-campus group than in the online group and was of concern in both groups. There were 33 on-campus students and 10 online students attempting the examination in 2009. In 2009, only one area, immunology, showed a significant difference when online student scores were compared to on-campus student scores. In immunology, the average of the online students was significantly lower at 66.2 than that of the on-campus students at 73.6. All of the other six areas showed no significant differences between groups. Table 3 provides the comprehensive examination scores for online students in 2008 and online students in 2009. Scores in microbiology and urinalysis, the areas of major concern in the 2008 online group, improved significantly for the online students in 2009. However,

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chemistry scores for both online and on-campus groups were down significantly in 2009 from 2008.

Table 1. Mean seminar final examination scores for 2008 students.

Group	Blood Bank	Chem	Hemat	Immuno	Lab Ops	Micro*	Urine*
On-campus N=27	76.6	82.1	74.8	69.9	82.9	81.2	75.6
Online N=10	75.1	81.7	73.2	73.7	79.5	68.8	65.3

*P<0.05

Table 2. Mean seminar final examination scores for 2009 students.

Group	Blood Bank	Chem	Hemat	Immuno	Lab Ops	Micro*	Urine*
On-campus N=33	76.4	75.4	77.7	73.6	72.7	78.6	77.5
Online N=10	80.5	73.6	76.4	65.6	75.5	80.0	77.6

*P<0.05

Table 3. Mean seminar final examination scores for online students 2008 vs. 2009 Group

Group	Blood Bank	Chem*	Hemat	Immuno	Lab Ops	Micro*	Urine*
Online - 2008 N=10	75.2	81.7	73.2	73.7	79.5	68.8	56.3
Online 2009 N=10	80.5	73.6	76.4	65.6	75.5	80.0	77.6

*P<0.05

CONCLUSIONS

The increase in class time, face-to-face interaction, recorded materials, and extra study materials appears to have equalized the results for online students on the comprehensive examinations in most areas. The decrease in the chemistry examination scores for all students between 2008 and 2009 may reflect the fact that a new chemistry instructor started in January of 2009 and that differences in emphasis were a factor. If chemistry scores do not improve again in 2010, further interventions will be required. The immunology scores remain of concern and further interventions will be tried to resolve this disparity. In general, additional emphasis on the immunology section is required for all students. Part of this may be due to the fact that immunology is not a discrete section of the clinical laboratory in any of the clinical affiliates, but rather spread through various areas of the laboratory. These laboratory areas may focus more on the analytes and instrumentation rather than the immunology concepts that drive the assays. Also, there is not a specific preceptorship rotation that reinforces many of the immunologic concepts. Additionally, some of immunology is strictly theoretical or conceptual. While it enhances the ability of the students to understand how tests work, they do not uniformly appear to be internalizing these theoretical concepts when working with a given test procedure. Further emphasis will be placed on playing the online review game in the immunology area, as well as more intense immunology review through questions and answer, written materials, and other means as they become available. Overall, the course improvements have provided the increased impetus for examination preparation that was sought.

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