

## RESEARCH ARTICLES

# A Web-Based Practice Examination to Improve Student Performance Concerning the 200 Most Prescribed Drugs

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**Background.** User-friendly technology has increased the ability of faculty to develop course web sites and has expanded ways to communicate with students. The benefits of technology must be weighed against the resources needed to use such tools. This article provides an overview of the features of WebCT, a web-based educational tool, along with a study that evaluated whether a voluntary, Internet-based practice examination developed using WebCT improved pharmacy student performance on a traditional "paper and pencil" format examination.

**Methods.** A retrospective comparison was made of the number of attempts needed to pass the actual examination, the pass rate at each attempt, and the percentage correct on each attempt between those who did and did not use the practice examination. The presence of a correlation between GPA and the number of times required to pass, and the percent correct were also evaluated.

**Results.** A majority of students (65%) took the practice examination. While there was a trend towards better performance by those who took the practice examination, the results were generally not statistically significant ( $P > 0.05$ ). No significant correlation was found between GPA and examination performance.

**Conclusion.** Further study is needed to assess whether such Internet-based tools can improve student performance.

**Keywords:** Internet, examination, assessment

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## INTRODUCTION

Computer-assisted instruction has become more popular in higher education. Web-based technology, such as WebCT (3.6 Standard Edition, WebCT, Inc, 2001) allows for some or all course instruction to occur on the Internet through a course web site. As of June 2002, 2654 educational institutions world wide had licenses for WebCT, making it one of the most popular educational software packages.<sup>1</sup> Like any new educational approach, before faculty members embrace technology they must be assured of a tangible benefit. Educational software can cost thousands of dollars to acquire, not to mention costs to update the programs and to train

faculty, staff, and students on their use.<sup>2</sup> Creating course materials with educational software can take many hours of preparation time on the part of the instructor, thereby consuming more resources. Studies comparing the performance of future or current health care providers after using computer-assisted instruction to more traditional methods of studying (ie, review of printed materials) have shown conflicting results.<sup>3-10</sup> This article will provide a brief overview of the features possessed by WebCT and the results of a study of how WebCT affected student performance on a traditional "paper and pencil" format examination.

### Description of WebCT

WebCT allows an instructor to develop a course web site with various features. One such feature is the administration of practice examinations over the Internet. Entering questions into WebCT can be cumbersome, but can be made easier with Respondus™ (Respondus, Inc., Redmond, WA), an accessory program. As of September 2003, a free trial of Respondus was

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still available at [www.respondus.com](http://www.respondus.com). WebCT will automatically grade the practice examinations and provide feedback from the instructor to the students. WebCT also provides the instructor with information on when the student accessed the practice examination, how long it took the student to complete the practice examination, the student's scores, and summary statistics of the class performance on the practice examination.

### **Application of WebCT**

#### **Description of "paper and pencil" examination.**

Pharmacy students in their second and third years at the University of Missouri-Kansas City (UMKC) School of Pharmacy must pass a 50-question multiple choice examination on the top 200 most frequently prescribed drugs. This examination attempts to ensure that students have built a knowledge base that will be needed in later courses. The examination coordinator develops these questions from information presented on Pharmacy Drug Cards published by Sigler & Flanders, Inc, Lawrence, KS. Students are considered to have passed if they answer 74% of the questions correctly. If they do not successfully pass the examination, they do not matriculate into the next academic year. Second year students are responsible for knowing brand/generic names, Food and Drug Administration approved indications, therapeutic classifications, and available dosage forms. In addition to this material, third year students are responsible for common or significant side effects and patient education information. This additional material composes 50% of the third year examination. A graduate student proctors the examination, takes the examinations to the grading service, and posts the results. Students are allowed a maximum of 4 chances within the semester to pass the examination; however, it is offered 6 times during the semester, allowing some flexibility as to when they take the test.

Since formal didactic teaching is not offered for the examination, students are responsible for studying on their own. The purpose of removing direct faculty involvement is to provide the student with the experience of being an independent learner. The knowledge base of medicine is constantly changing, and after graduation, pharmacists will need to learn new information without direct guidance. The importance of ensuring that students are "self-directed learners" is also reflected in the American Council on Pharmaceutical Education's Accreditation Standards and Guidelines.<sup>11</sup>

**Description of the Problem.** In the past, the coordinator offered the examination more than 6 times to

ensure that all students passed. In winter semester 2000, 12 of 135 students required more than 4 attempts to pass the examination and in winter semester 2001, 5 of 132 students required more than 4 attempts to pass. This situation created extra work for the faculty and graduate students, used extra resources (paper, room availability, grading service, etc) and did not hold students accountable for poor performance and/ or preparation. Identifying a method to improve student performance and therefore decrease the likelihood of needing multiple attempts to pass the examination would assist in decreasing the utilization of resources.

A student-based survey was administered during the winter semester 2001 to identify potential reasons for poor performance. Fourteen of 132 students (10%) returned the survey. One question asked whether students would use a study aid available over the Internet to help them prepare. Ten students indicated that they might use or definitely would use an Internet based study aid and 4 indicated that they would not. During a roundtable discussion held during the same semester, 3 student representatives voiced that it took them some time to get used to the type of questions that were asked on the examination. These same students voiced interest in having a computerized study aid as a method of becoming familiar with the assessment methods. Prior to winter semester 2002 a practice examination was not available to students.

**The Solution.** WebCT 3.6 Standard Edition was used to develop a computerized practice examination to improve student performance and lessen the number of attempts needed to pass the examination. Questions on this practice examination were different than the questions on the actual "paper and pencil" format exam, but were presented in the same format (eg, same number of answer choices available) and covered the same content. A different practice examination was available for the second- and third-year students, but students were allowed to take either practice examination. Each practice examination contained 50 questions. Students were also able to take the practice examination more than once, but the questions did not vary on each attempt. Students using the practice examination would hopefully not only become more familiar with the examination format, but also improve their knowledge base. WebCT was chosen over offering "pencil and paper" practice examinations for several reasons. With a WebCT examination, students would be required to answer the questions before seeing the answers, which hopefully would compel them to think through each question. WebCT increases the

Table 1: Use of the Practice Examination

Year in Pharmacy School	Students Completing the Practice Examination			
	Neither the Second or Third Year Practice Examination n (%)	Only the Second Year Practice Examination n (%)	Only the Third Year Practice Examination n (%)	Both the Second and Third Year Practice Examination, n (%)
Second	20 (26)	54 (71)	2 (3)	9 (12)
Third	29 (46)	0	18 (29)	16 (25)

ease of use of the examination for faculty members since faculty time is not required for examination administration or grading. Web CT also calculates the time the student needed to complete the examination and maintains a record of which students used the practice examination.

Students were given a hard copy syllabus containing instructions on how to access WebCT, 10 sample questions without answers, and their password to enter the web site. Students were not required to take the WebCT practice examination and they could take the examination at any time throughout the semester. Once the students completed and submitted the examination, WebCT automatically graded it and provided feedback that was based on information previously entered by the faculty coordinator. This feedback included the correct answer, why certain answers were correct or incorrect, and/or other helpful information that could aid the student in studying for the actual examination. The feedback provided was different for each question but did not vary depending on the student's response. Students were unable to obtain the feedback unless they had answered every question. The web site also allowed the students to see their practice examination grade. The investigator performed a retrospective study to evaluate whether this voluntary, Internet-based practice examination developed using WebCT improved subsequent pharmacy student performance on the traditional "paper and pencil" format examination.

## METHODS

To assess the impact of the practice test on student performance, a comparison of the number of attempts needed to pass the examination, passing rate at each attempt, and the percentage correct on each attempt was made between those who did and those who did not take the practice examination before that attempt. In order to evaluate the impact of GPA as a confounding variable, the correlation between the number of attempts needed to pass the examination and the student's grade point average (GPA), as well as the percentage of questions correct at each attempt and the student's GPA were analyzed. Chi-square was used to

evaluate nominal data (passing rate at each attempt). Student's *t* test was used where numerical data were normally distributed (percentage correct on the second and third attempt at the examination). Wilcoxon Rank Sum was used to analyze non-normally distributed numerical data (eg, number of attempts needed to pass the examination, percentage correct on the first attempt at the examination). A *P* value of less than 0.05 was considered significant. Data were analyzed using JMP® Statistical Discovery Software (version 4, SAS Institute, Inc, Cary, NC). The performances of all students taking the "Top 200" drug examination during winter semester 2002 were included in the analysis.

## RESULTS

One hundred thirty-nine students were enrolled to take the "Top 200" drug examination during winter semester 2002. Among these, 91 (65%) took the practice examination at least once during the semester. All students who took the practice examination did so less than 3 months before they took the actual examination. Table 1 describes the percentage of students who used the practice examination based on their year in pharmacy school. Thirty-nine students took the second-year practice examination more than once and 13 students took the third-year practice examination more than once. Not all students who took the practice examination submitted the examination for grading. The average percentage correct on the first attempt at the second year practice examination for the 67 students who submitted the examination for grading was 72%. The average percentage correct on the first attempt at the third-year practice examination for the 38 students who submitted the practice examination for grading was 64%.

Students required an average of 1.3+/- 0.66 attempts to pass the examination, and 81% of students passed on their first attempt. Only one student was unable to pass after 4 attempts. This student was not allowed to matriculate for the next semester, but was given the option to reenter the pharmacy curriculum for

Table 2. Impact of Taking the Practice Examination on the Pass Rate Regardless of Year in School

Attempt at the Examination	Used Practice Examination Before This Attempt n (Pass Rate)		P Value <sup>**†</sup>
	Yes	No	
First	72 (85%)	67 (76%)	0.20
Second	21 (76%)	6 (17%)	0.02
Third	5 (80%)	5 (60%)	1.0
Fourth	2 (100%)	1 (0%)	

\*Comparison between those who did and did not use practice examination

†Statistical analysis not performed on data for the fourth attempt due to lack of power.

Table 3. Impact of Taking the Practice Examination on the Pass Rate (Per Year in School)

Attempt at the Examination	Year in School	Used Practice Examination Before This Attempt n (Pass Rate)		P Value <sup>**†</sup>
		Yes	No	
First	2	45 (80%)	31 (71%)	0.36
	3	27 (93%)	36 (81%)	0.18
Second	2	13 (77%)	5 (20%)	0.05
	3	8 (75%)	1 (0%)	0.33
Third	2	3 (100%)	4 (50%)	0.43
	3	2 (50%)	1 (100%)	1.0
Fourth	2	1 (100%)	1 (0%)	
	3	1 (100%)	0	

\*Comparison between those who did and did not use practice examination

†Statistical analysis not performed on data for the fourth attempt due to lack of power.

fall semester 2003 if they passed the examination when it was offered during winter semester 2003. Tables 2 and 3 describe the impact of taking the practice examination on the pass rate. Completion of the practice examination significantly only affected the pass rate for the second attempt at the examination. Evaluation of the second- and third-year students independently revealed significant differences in the pass rate on the second examination for the second-year, but not the third-year students. The number of attempts taken to pass the examination did not significantly differ between students who took the practice examination be-

fore their first attempt at the examination (1.4 +/- 0.82 SD) and students who did not take the practice examination before their first attempt (1.2 +/- 0.45) ( $P = 0.15$ ). Only on the second attempt at passing the examination was the percent correct significantly different between students who took the practice examination before the attempt and those who did not (Table 4). There was no statistically significant correlation between GPA and either the number of attempts to pass or the percentage correct at each attempt. Post-hoc analysis demonstrated that there was insufficient power to detect a difference between those who did and did

Table 4. Impact of the Examination on the Percent Correct on Each Attempt at the Examination Regardless of Year in Pharmacy School

Attempt at the Examination	Used Practice Examination Before This Attempt		P Value <sup>*,†</sup>
	Mean % Correct (SD)		
	Yes	No	
First	82 (11)	79 (12)	0.08
Second	77 (8.0)	69 (9.1)	0.03
Third	79 (6.7)	76 (13)	0.07
Fourth	88 (11)	72 <sup>‡</sup>	

\*Comparison between those who did and did not use practice examination

†Statistical analysis not performed on data for the fourth attempt due to lack of power.

‡Standard deviation not calculated as this is the result of only one student.

not take the practice examination in either the number of attempts required to pass or the percentage correct on each attempt.

The time commitment of the faculty balanced with the impact of the new processes should be considered when evaluating the results of this new format. Developing the practice examination doubled the overall course preparation time for the coordinator from approximately 14 hours to 28 hours. Approximately 2.25 hours of consultation time was provided by the Technology for Learning and Teaching Center at UMKC during the design of the web site, raising an additional resource issue. Maintenance of the website during the semester was minimal. The course coordinator was able to assist 7 students who had difficulty logging onto the web site. The coordinator did not require assistance from the Technology for Learning and Teaching Center to help these 7 students.

## DISCUSSION

Even though there was a trend towards better performance for those who took the practice examination, the benefit was not robust. It is difficult to tell whether the difference in performance after the second attempt was due to the practice examination or just to the increased study time in general. Even if the improved performance seen on the second attempt at the examination was due to the practice examination, it was only beneficial for a minority of students, since the majority passed on the first attempt. GPA did not appear to be a confounding variable in the results.

The conclusion that administration of the practice examination resulted in fewer numbers of students

needing more than 4 attempts to pass during winter semester 2002 when compared to previous semesters can not be made from the data. Other variables could have been responsible for the difference in numbers of students requiring more than 4 attempts. One variable is that a different population of students was being studied. With changes in course content from year to year, students taking the examination during winter semester 2002 would likely have different academic experiences than those students taking the examination in previous semesters. Another is that 10 sample questions were provided in the syllabus given to all students during winter semester 2002, but not in the syllabus given to students during winter semester 2001 or 2000.

Other limitations to this work include the inability to identify difficulties that the students had with WebCT that were not brought to the attention of the coordinator, and insufficient statistical power to detect differences between the groups. Data on students' prior experience with computer-assisted instruction were not obtained. How the students used the practice examination could not be determined. Some students, for example, may have attempted to answer only a few questions on the practice examination or may have not reviewed the written feedback provided by the instructor. Students may have printed out the questions and feedback and given this to other students who had not accessed the practice examination on line, but who may have benefited from taking the practice examination online. If students were required to fully complete the practice examination or respond to the feedback, this may have resulted in greater differences in perform-

ance between those who did and did not use the practice examination.

Several reasons could be possible for the discrepancy seen in previous trials investigating whether computer-assisted instruction can improve performance more so than review of printed materials. The trials differed on how soon assessment was done after the subjects reviewed the content, the quantity of the printed materials to be reviewed, whether questions were provided in the printed materials or not, the type of assessment method used, and/or the population sampled from (i.e., students, residents, practitioners). Unfortunately the trials that demonstrated a benefit did not tend to have one characteristic over another. While some characteristics of these investigations were similar to the current study, none were a closer match to the current study than another. Although computer assisted instruction did not provide significant benefit in this study, it may be helpful in other scenarios.

The coordinator has chosen to continue use of the practice examination as minimal time is needed to maintain the practice examination and some students may have garnered benefit. Since there was a lack of clear evidence of a benefit, it will remain voluntary. Changes in the practice examination (for e.g., including more questions) may result in improved student performance. In retrospect, however, the author would not develop an Internet-based practice examination for another course at this time. The small, possible benefit seen would not outweigh the amount of time required to initially develop it. The experiences with this class highlight that technology alone cannot resolve student performance issues.

## CONCLUSIONS

WebCT has several features that may contribute in a positive manner to course instruction. There is insufficient evidence to suggest that an Internet-based practice examination developed using WebCT improved student performance on a "paper and pencil" format examination to a such an extent to warrant its use again in a similar situation. Future trials should not only include a larger number of students but also address whether differing the content (for eg, altering the feedback given, including more questions) but using the same feature of the same web-based tool changes

student performance. This may assist in determining whether the tool itself is beneficial.

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