

Developing an Online Course in General Pharmacology

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Abstract

To develop an online course in General Pharmacology the following questions were addressed: 1. How can the lecture material be made simple, effective and interesting so that students don't feel the absence of an instructor? Lecture notes for each class consisted of Learning Objectives, Graphical Presentations and a Summary in the form of PowerPoint presentations on the WebCT course site. Students were also prescribed a textbook and instructed to read three chapters per week. 2. How can the examinations be scheduled so that students can take them on any computer, at any time? Students were given a weekly quiz and three examinations consisting of multiple-choice questions through a course site on WebCT. 3. How can the instructor be available to answer queries from the students so that the students feel that they have an instructor who is interested in teaching them? The instructor was available to students via email, which was checked multiple times throughout each day. Under the current online course format, it was observed that students taking the online Pharmacology course scored higher grades than the students taking the classroom-based course. However, depending on the enrollment in the course and other factors, an instructor may have to spend considerable more time in managing an online course than a classroom-based course.

Introduction

Pharmacology is a branch of life sciences that deals with the effect of chemical agents, including therapeutic drugs, on biological systems. In the General Pharmacology course students get an overview of the subject and learn about the general aspects of pharmacology, including drug absorption, distribution and metabolism; endogenous neurotransmitters; effect of depressants and stimulants on the central nervous system; anesthetics; drugs used in cardiovascular diseases; drug effects on the respiratory tract; drugs that influence metabolic and endocrine functions; chemotherapy; and principles of toxicology.

For the past 25 years I have been teaching a General Pharmacology course entitled "Pharmacology 600" to undergraduate students majoring in Pre-Medicine, Circulation Technology, Exercise Physiology, Psychology, other branches of Life Sciences, and graduate students in Pharmacology, Pharmacy and Veterinary Pharmacology. The course has always been offered in a classroom-based setting during the Spring Quarter to approximately 60

students annually. There have typically been three lectures per week (for a three credit hour course) delivered via chalk and a blackboard, overhead transparencies, or more recently through PowerPoint presentations and a LCD projector. I chose to offer an online version of this course, Pharmacology 600D, for two reasons: 1. Because of high student demand to take the course in quarters other than Spring, and 2. Because of my belief that less time, effort and resources would be required of me with the online course in comparison to a second classroom-based course.

In developing an online course in General Pharmacology, “Seven Principles for Good Practice in Undergraduate Education” advocated by Chickering and Ehrmann [1] were taken into consideration: “Good Practice” encourages contacts between students and faculty, develops reciprocity and cooperation among students, uses active learning techniques, gives prompt feedback, emphasizes time on task, communicates high expectations, and respects diverse talents and ways of learning.

Structure of the Online Course

Students were expected to learn the material posted on the course web site WebCT by going to the WebCT Home Page at <http://classroom.med.ohio-state.edu>. A course site on WebCT was developed consisting of the following sub-sites:

Syllabus and Schedule
Course Materials
Resources
Discussion Board
About Me
Quizzes and Examinations
My Grades
WebCT Support

The *Syllabus and Schedule* pages gave the pertinent details of lecture material to be studied, as well as the weekly quizzes and major examinations that would be taken by a specific date. Students were expected to read two to three book chapters each week. At the end of each week, students were required to take a quiz measuring their level of understanding of the material. A minimum score of 80% was required on each quiz before access was granted to the following week’s study material.

In the *Course Materials* page, lecture notes were presented in PowerPoint format. They were then converted to PDF format and uploaded on WebCT. Lecture notes were divided into the following categories: Learning Objectives, Important Drugs, Figures, and Summary. Traditional lecture notes were supplemented with the most up-to-date information regarding the field of Pharmacology, presented in various formats including news clippings, cartoons, anecdotes and jokes.

The *Resources* page contained a list of 200 key drugs commonly used in medicine and which were thought to be test-worthy. The mechanism of action and therapeutic uses of the drugs were provided. Also listed were web-based links to sites useful to the students, such as www.Rx.com. Information about the instructor, including Curriculum Vitae with a list of research publications was provided in the *About Me* page.

The *Discussion Board* page provides a platform where students can ask questions to one another or post any concerns they want to share with other students. I used this page to post my answers to some questions asked by students through email. Only those questions and answers were posted where I had offered an elaborate explanation of course material not covered in the class notes or not easily found in the prescribed textbook.

Ten quizzes and three examinations were administered in the *Quizzes and Examinations* page. The weekly quizzes consisted of 30 to 40 multiple-choice questions. We built sets of 40-50 questions for quizzes. WebCT would randomly select any 30 of the 40 questions, or 40 of the 50, depending on the quiz. A minimum passing score of 80% was required for the quizzes. Even if students scored 80% on their first attempt at a quiz, they were encouraged to make further attempts to score higher. Students were allowed a maximum three attempts to pass the quiz. If a second or third attempt at passing a quiz was made, students received a mixture of old and new questions; the new questions were of equally relevant and difficult test material, and were selected randomly by WebCT. In addition, old test questions had the answers scrambled to further challenge the students. The highest score in each quiz was used in the calculation of the grade.

The First Midterm Examination contained 60 questions based on the material learned during first three weeks. The Second Midterm Examination also contained 60 questions based on the material learned during weeks four to six. The Final Examination contained 80 questions; 60 were based on material learned during the last four weeks and 20 were based on material learned during the first six weeks. For the examinations we also built sets of 70-90 questions, ten more questions than the number of questions to be answered, depending on the examination. This was done so that not every student answered the same questions thus avoiding help seeking behavior from peers who had already taken the examinations. Furthermore, only one minute was given to answer each question in examinations thus prohibiting students from looking up answers in reference materials. Students could take the quizzes and examinations at any time, on any computer. The purpose of the quizzes was to enable the students to master the course material, preferably by taking each quiz three times. Since the highest quiz score was used for calculating the grade, students had incentive to study the material and take the quiz three times to get the highest score.

Students were able to review their test scores in the *My Grades* page and seek technical help by going to the *WebCT Support* page.

Calculation of Grades

The grade was based on the following cumulative scores:

≥ 90%	A
85-89%	A-
80-84%	B+
75-79%	B
70-74%	B-
65-69%	C
60-64%	C-
55-59%	D
< 55%	E

The quizzes were worth 50% of the overall grade and the examinations were worth 50% of the overall grade. For example, if a student scored 324/360 (90%) in the ten quizzes, and 160/200 (80%) in the three examinations, the final grade was determined to be $(90\%+80\%)/2=85\%$ or equivalent to an A-.

Results and Discussion

A comparison of the performance of students taking the Pharmacology course in the classroom versus students taking the same course online is shown in Table 1. The same lecture material was presented using PowerPoint and the same textbook was used (*Pharmacology*, Lippincott's Illustrated Reviews by M.J. Mycek, R.A. Harvey and P.C. Champe) for each course.

Table 1

Classroom-based vs. Online Performance

Grade	Pharmacology 600 (Classroom)* (% Of students)	Pharmacology 600D (Online course)** (% Of students)
A	25.2	44
A-	17.2	16
B+	13	24
B	17.6	8
B-	10.5	8

C	9.7	0
C-	4.2	0
D	4.2	0
F	0.42	0

* n=238 students, Spring Quarters 1999-2003.

** n=25 students, Summer and Autumn Quarter 2003.

The data presented in Table 1 demonstrate that, in general, students taking the online course performed better than the students taking the course in the classroom. An explanation for this discrepancy lies in the differences in format between the two courses. While students taking both versions of the course took three examinations with similar formats and levels of difficulty, only students taking the online course took the weekly quizzes. The students were permitted to take each quiz a maximum of three times, and their best score was taken into account when calculating their grade. As indicated above, the quizzes accounted for 50% of the total grade. Invariably, each student scored more than 90%, and many of them more than 95%, on each quiz (data not shown), thereby increasing their overall grade. An additional reason for students doing better in the online course may also be due to retention of only motivated and qualified students in the online course. During the first 10 days of the class more students dropped the online course than the classroom course. Some students who dropped the course could not do well in the first quiz. Most of the students who did well in the first quiz continued their enrollment in the online course.

The question arises that even though data presented in Table 1 show that online students performed better than in-class students, are they actually learning the material better? This is difficult to assess. To determine whether or not students learned the material, we may need some other method of evaluation other than just relying on their answers to questions asked in the quizzes. Almost all students did well in the quizzes and not every one did well in the examinations (data not shown). My initial impression is that students who learned the material well also did well in the examinations. Many students sent me emails stating they learned a great deal in the course. The bottom line is that for a three credit hour course, students were required to master 660 multiple-choice questions that thoroughly covered the course material, and I think a majority achieved the instructor's objectives.

The question must then be asked: What is the value of giving these quizzes if they will unconditionally raise the students' grades? To answer this question we have to examine how students taking Pharmacology courses are examined. Medical students taking the Pharmacology course at The Ohio State University are normally asked 3 to 4 question in their examinations from each lecture. In contrast, students taking the quizzes on the online course had to answer more than 13 questions per lecture, on average. In this way, the quizzes played an important role in thoroughly testing the students' knowledge of the lecture material; using the highest quiz score in the calculation of the final grade served as incentive for the students to

learn more. Medical students and the students taking course in class did not have the option of taking quizzes. Students taking both versions of the Pharmacology 600 course were tested on 7.4 questions per lecture, compared to 3 to 4 questions per lecture for the medical students. Requiring that students complete a quiz each week ensured compliance with the “Seven Principles for Good Practice in Undergraduate Education” [1], as follows:

1. There was additional time on task: students could take the quizzes 3 times.
2. There was instant feedback: electronic quiz scores.
3. The quizzes provided more frequent feedback in comparison to taking examinations only.
4. Weekly milestones increased students' ability to manage their own learning and provided a weekly work discipline.
5. Quizzes were administered from Monday to Friday so that WebCT technical support was available.
6. The first quiz was given early in the course so that students who were not self-starters had some external motivation.
7. The students' technical problems were handled quickly during the first two weeks of the quarter to allow trouble-free use of the WebCT system later.

In an online course the benefit of doubt is given to the students that their true intentions are to learn the course material to the best of their abilities, honestly and ethically. No restrictions were given to students regarding printing the quiz questions from the computers while they were being tested. Since a student was permitted to take a quiz up to three times in order to score above 80%, it was, of course, possible to print the questions and then prepare to answer specific questions with the intent of returning to take the quiz again and thus score higher. In order to discourage this behavior, as stated previously, for repeat quizzes the questions and answers were scrambled and several new questions were posed to provide a new testing experience instead of a repeat of the first quiz. In contrast, there was no luxury of such preparation for the examinations, as students could take the examination only once. Typically, one minute was allotted for students to answer each question on the quizzes and examinations. Students were also instructed not to print examination questions. Even then, it is conceivable that students may be able to use handouts/books while taking examinations. In teaching pharmacology, we have to note that there are over five thousands therapeutic drugs available in the market. In my course, I focus on approximately 200 of the most widely used drugs. Even for this limited number of drugs, it is virtually impossible for any single person to remember and recall of the drug names, mechanisms of action, therapeutic indications, contraindications and interactions with other drugs in the body. For a person practicing Pharmacology, the challenge is to know the pertinent drug information quickly, even if it involves referencing available resources. In light of this, the quizzes and examination questions used in our online course effectively test a students' ability to find the pertinent information about a drug in a limited time.

Another important factor in the learning process is the dialogue established between the instructor and the students throughout the course. Students were encouraged to interact with the instructor for thirty minutes each week for clarification of confusing issues or for other questions related to Pharmacology. As expected, students taking the classroom-based course visited the instructor in his office more frequently than the students taking online course, while

students taking the online course were more inclined to interact with the instructor via email. Upon review, it appeared that both groups of students had equal and ample access to the instructor throughout the course.

It appears that the day-to-day time I spent as an instructor was decreased when administering the on-line course, but the total time was not. Since there was not an overall timesaving, it must be asked whether it was worth offering the online course from a time perspective only (aside from the fact that the instructor could reach more students). Even though the overall time spent was equivalent, did the instructor find that it was time better spent (e.g., not walking to class; setting up lecture equipment; etc.)? We must remember that the time spent in giving a classroom course is predictable, and regular. My earlier impression was that the online course would take less time in dealing with students after I had spent considerable time in developing the course web site, and questions for quizzes and examinations. However, I realized that total time in giving an online course depended upon the nature of questions asked by students and it also depended how thorough I was in addressing each question. For example, one particular student asked me fifteen questions in one email, many of which could have been answered by carefully reading the prescribed textbook. In that case, my email reply took over an hour to complete. Later I sent instructions to students to ask me only those questions for which they could not find answers in the class notes posted on the WeCT or in the prescribed textbook. Some student queries were related to several ambiguous questions in quizzes that now have been replaced with better questions, proving that these interactions can be helpful. This quarter (Winter 2004), 47 students have registered in the on-line course, compared to 25 students during the last two quarters combined.

In total, I feel it was worth my time to teach the course online, despite the time spent addressing the web site-related technical problems. Most of the technical problems were related to not being able to log into the site. Some students complained about not being able to finish the examination in required time because the connection to the web site was mysteriously lost. Some students did not complete the quizzes in time and wanted more time (for example instead of finishing the quiz in the first week they finished the quiz in the third week). In all these cases, the benefit of the doubt was given to the students, and an agreeable solution was reached.

Conclusions

It has been a rewarding experience for the instructor to offer an online course in General Pharmacology. Particularly gratifying is that more students were able to take the course than ever before, including from as far away as Texas, and their grades were higher than those in the classroom-based course. For the instructor, there were fewer *day-to-day* demands in administering and managing the online course in comparison to the classroom-based course. It appears that the *total* time spent by the instructor in managing the online course was more than the time spent in managing the class room-based course, when taking into account the time required to comprehensively answer the many queries submitted via email by students taking the online course. Of note, less than 25% of the students enrolled in the online course submitted queries to the instructor via email. If enrollment in the online course increases, or if increasing numbers of students choose to correspond with the instructor through email, then the instructor may ultimately spend two to three times more time managing the online course in

comparison to the classroom-based course, due to the significant amount of time required to adequately respond to the email queries. There are 47 students registered currently in the online course in the Winter quarter and it does appear that an increase in the enrollment in the class has substantially increased the time commitment for the instructor.

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