INSTRUCTIONAL DESIGN AND ASSESSMENT

An Online Elective Course for Undergraduate Students on Common Prescription Medications

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Objectives. To design, implement, and evaluate an online elective course on common prescription medications for undergraduate (pre- and non-health professional) students.

Design. An 8-module online course on common prescription medications was designed following the ADDIE (Analysis, Design, Development, Implementation, and Evaluation) instructional design model and offered to students for 8 consecutive semesters.

Assessment. Following each offering, performance data were analyzed and a course review conducted, including evaluation of entrance survey data and course evaluations. Direct analysis of data over 2 offerings and grade distribution comparisons over all 8 offerings, demonstrated consistent knowledge gains. Feedback from course evaluations and a continual increase in enrollment over the 8 semesters indicated student satisfaction with the course.

Conclusion. Systematic design and quality assurance/improvement strategies resulted in the successful establishment of an online pharmacotherapy course for undergraduate, nonpharmacy students.

Keywords: online learning, quality improvement, Internet, pharmacotherapy, undergraduate students

INTRODUCTION

In order to become informed consumers, undergraduate students need to acquire basic pharmacotherapy knowledge. Additionally, students interested in careers as health professionals may want an introductory experience to the health sciences. Colleges and schools of pharmacy are uniquely qualified to meet these educational needs by offering a basic pharmacotherapy course for undergraduate students. Such a course would need to be a quality offering that would result in acceptable student performance and satisfaction and be sustainable, with consistent or increasing enrollment over time. Also, creating content for students with no prior pharmacy knowledge and with diverse educational goals (ie, informed consumer versus future healthcare professional) is challenging. This manuscript describes the design, delivery, assessment, and evaluation of an online pharmacy-delivered undergraduate course on common prescription medications. Specifically, the objective of this work was to determine whether a sustainable, quality online prescription pharmacotherapy course that achieves its stated educational objectives could be developed for an undergraduate student population.

As this course was developed, careful attention was paid to reaching the audience, identifying an appropriate level of instruction and methods for maximizing faculty time. In addition, recognizing the newness of this content and technology, a review process was initiated to ensure learning, enrollment sustainability, and continuous improvement of the course. As a result, a second objective was to assess the feasibility and success of a systematic review for course quality assessment and improvement.

DESIGN

Development

The outcome-based instructional design model, termed ADDIE (Analysis, Design, Development, Implementation, and Evaluation) can be used to make instruction more effective and efficient through a systematic approach to designing online courses (or any type of educational experience).¹ ADDIE was designed around the idea that educational outcomes can be observed, measured, planned for, and evaluated in a valid and reproducible manner.¹ During the 1970s, this “systems approach” to teaching became popular and has been embraced by the distance education community for its ability to standardize educational experiences.

A systematic approach to online course development is essential since gaps in content delivery or implementation

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cannot be readily identified and corrected in the same way as for a course delivered in person. Instructional design strategies used for an online course are both similar, as well as different, when comparing the process for development of a face-to-face course. Using the ADDIE model as an instructional design guidance tool, the needs assessment for the 2 delivery formats is the same – there must be a need for a course whether it is delivered online or in person. While the needs assessment using the model is the same for both face-to-face and online delivery of courses, the design, development, and implementation will be different. For example, because of the asynchronous nature of online learning, pedagogical considerations must be made to adjust for the different pace and independent nature of learning. Often, content is available all at once, resulting in content being completely developed prior to the first day of class. With face-to-face delivery, the instructor has the option of making last-minute changes to course content on the day the class meets. Therefore, implementation of an online course will dramatically differ from a face-to-face course. Depending on the course learning objectives, assessment may also be different between online and in-person course delivery, but it is often the same. To address all these educational needs, the ADDIE model is an important asset in guiding the development of an online course. Following the ADDIE model, the instructional team conducted a needs assessment. Undergraduate students who had successfully completed other entry-level online courses delivered by the same office were surveyed via a section of the online course evaluation. The survey, in part, sought to identify perceived gaps in knowledge and further interest in healthcare education. Having already developed a course on self-care and nonprescription medications, the undergraduate audience desired a complementary entry-level course on prescription medications. The instructional team framed the educational needs in this manner: students considering a career in the healthcare field would like a “sampler” course covering disease states and some pharmacotherapy, and all students, regardless of future career plans, required basic information regarding drug development, advertising, and drug action in order to be effective healthcare consumers. Survey results from past students indicated that a course’s flexibility (eg, no set structure for deadlines other than the end of the semester) and ability to fit into a tight schedule were key determinants in enrollment. As a result, a self-paced, online, 2-credit course was designed.

The course Common Prescription Drugs and Diseases was designed to create informed consumers with respect to commonly prescribed medications. An instructional design team developed and maintained the online

course. Two pharmacist faculty members served as the content experts for the course, providing instruction via online lectures and writing examinations. During development, an instructional designer worked with the content experts to make decisions about the module structure, learning activities, assessment methods, and evaluation plan. A course coordinator developed the course Web site and provided student support services once the course was running.

Three primary course objectives were identified for students: (1) describe basic drug development and regulation; (2) objectively assess drug advertisements; and (3) describe specific parameters related to selected, commonly occurring health conditions. The ability to describe drug development and regulation was seen as essential to creating informed consumers. Secondly, with the increasing exposure to media, providing participants with the tools to objectively assess drug advertisements also was important.

Finally, for each condition covered, participants were expected to describe the incident/prevalence, recognize the common causes, identify the most common symptoms and diagnostic criteria, list goals of therapy, and summarize the medications available for treatment, including the drugs’ basic mechanism of action and major side effects. All variables considered, the authors set out to determine whether a sustainable, quality online prescription pharmacotherapy course, which achieves its stated educational objectives, could be developed for an undergraduate student population.

Using data from the 2005 IMS Health National Disease and Therapeutic Index² as our primary source, the team designed an 8-module course providing information on the most frequently prescribed medications (eg, atorvastatin) and the conditions the medications are intended to treat (eg, dyslipidemia). After compiling the data, the instructional team met to make final decisions on the content of the course. Anticipating that the majority of enrollees would be traditional 18- to 22-year-old college students; thus, topics such as menopause were not covered, while topics such as oral contraceptives, insomnia, and migraine, were addressed (Table 1).

In the summer of 2005, the instructional team worked intensely on the course for 12 weeks. Each instructor produced 4 modules containing objectives, presentations, handouts, and optional resources for students to explore. Once drafted, the other instructor and the instructional designer reviewed each module and sent comments to the primary instructor for revisions.

To establish the importance of the topic for the learner, each module began with a brief (less than 3 minutes) introduction created in Macromedia Captivate, Version 2

Table 1. Topics Covered in the Pharmacy Course Common Prescription Drugs and Diseases

Module 1	Drug Information, Development, Regulation, and Advertising
Module 2	Contraception, Sexual Transmitted Infections
Module 3	Asthma, Allergy, Smoking Cessation
Module 4	Osteoporosis, Arthritis (Rheumatoid and Osteoarthritis)
Module 5	Diabetes, Obesity
Module 6	High Cholesterol, Hypertension
Module 7	Insomnia, Anxiety, Depression
Module 8	Migraine Headaches, Peptic Ulcer Disease

(Macromedia; San Francisco, CA) by the pharmacy team, which focused on the relevance to the average consumer (eg, incidence of disease state, consequences of disease or condition). Students were then provided with a direct-to-consumer advertisement of the prototype drug of the module and asked to reflect on that advertisement. The module then continued with handouts, recorded audio lectures using Breeze Presenter (Macromedia; San Francisco, CA), and activities delivered on the WebVista (University Learning Technology; Boston, MA) course delivery platform. After studying the learning materials, students again reviewed another direct-to-consumer advertisement on the same prototype medication.

In addition, a review and reflection exercise asked students to answer 3 questions: what were the 3 most important points that they remembered from the module; what did they consider the most difficult content; and what questions remained after completing the learning activities. These assessments were included to encourage students to actively engage in evaluating their own learning and also for us to gain information about the learning experience.³ Students submitted these reviews to the instructor anonymously and the instructors used these reviews to improve the clarity and scope of the learning materials.

An accelerated schedule was used to assist students in managing their course loads. Students were required to advance through the first 8 modules at their own pace, with a suggested schedule of 1 module per week. All 4 examinations were due by week 10 of the 15-week semester and were administered in person, in a proctored environment. This accelerated pace required students to complete the course content before end-of-semester assignments and final examinations began for other courses.

Two optional extra credit activities also were offered to provide students with an opportunity to improve final course grades and expand their learning experiences. The extra credit activities were case scenarios that required students to assess a very basic clinical situation and state

appropriateness of therapy. If they earned all of the extra credit points, students were able to improve their final course grade by half of a letter grade.

While respecting the desire for flexibility, the course also contained strategies to reduce procrastination. Students were given a suggested schedule in the syllabus and required to complete the online orientation by the end of the third week of the course. The first extra credit assignment had a fixed deadline in week 4. Weekly e-mails were used to prompt studying (eg “If you’re following the suggested schedule, you should now be on. . .”).

The pharmacy team wrote examination questions concurrently with the development of the content. Each question was classified according to the module and specific instructional objective it assessed. In addition, the team included feedback on the correct and incorrect answers, as well as linked the question to the learning materials where the content was discussed.

This development process enabled all the course content to be completed before the first day of class. Modules could then be released by the course coordinator, as needed. Most importantly, pharmacist faculty members were able to work on the course during the summer when teaching schedules were less demanding.

An important component of the module design was the direct-to-consumer advertisements (ie, television and print advertisements). Students were required to view a direct-to-consumer advertisement before being granted access to the module learning materials. Students were asked simple reflective questions about the direct-to-consumer advertisements (ie, main message, risks mentioned, interest in asking for this medication if they experienced the conditions described). Students then were asked to view another commercial or print advertisement featuring the same medication after completing the learning materials. Similar to the beginning of the module, students were asked reflective questions to see whether their impression of the advertisement changed after learning about the disease condition and its treatment. These assignments were required, but not graded.

The quality assurance knowledge assessment work and course evaluation data analysis was given exempt status by the University of Minnesota Institutional Review Board.

Implementation

Students were not required to purchase a textbook and instead used the online course delivery tool, WebVista (University Learning Technology; Boston, MA) to view online presentations with audio narration, download handout materials and optional learning materials, and complete study guides in preparation for examinations.

The online presentations were audio, with a still photo of the presenter and the PowerPoint slide on the screen. Live lectures were not given at any time. Students could purchase an optional course packet at the University bookstore that included printed versions of the materials.

The self-study nature of the course and online delivery mode made it possible to make the course available on 2 campuses from the first offering. A faculty course director was designated for each campus to allow for face-to-face meetings if a student desired or required it. Student services were provided for all students from 1 campus via e-mail and a toll-free telephone number. A teaching assistant was hired on the alternate campus to conduct the testing sessions. A single Web site was used for both campuses for the presentation of learning materials as well. Examination sheets were express mailed to the Twin Cities campus at the end of a testing week for scoring. Grades were posted for all students on the course Web site.

Students were required to complete 4 examinations by coming to a testing center, which was open for five 2-hour blocks every other week, including an early morning session, an evening session, and a Saturday session. Students could come in to the testing center at their leisure, completing multiple examinations in one visit if desired.

EVALUATION AND ASSESSMENT

Learner Evaluation

The course was offered to undergraduate students for the first time in fall 2005, with subsequent offerings in the spring, summer, and fall of each academic year. From fall 2005 through spring 2008 (8 semesters), 737 students completed the course. Enrollment in the course steadily increased over this time period, from 66 students in fall 2005 to 160 in spring 2008, a 142% increase.

Learning was assessed via self-report on a pretest, performance on examinations, and final grades. During the first 2 offerings of the course (fall 2005 and spring

2006), particular attention was paid to knowledge acquisition. In addition, a 3-month online posttest to assess retention was planned. These comparisons were designed to provide evidence that the course began at the appropriate level and resulted in knowledge acquisition following completion of the learning materials.

Entrance Survey. During the course orientation, students completed an entrance survey that gathered specific information to assist in better tailoring the instruction to student backgrounds, interests, and experiences. Student were asked to rate their knowledge of common medical conditions and common prescription medications. Demographic questions, such as college major and year of university, were also asked.

The average response rate to the entrance survey over the 8 semesters was 78% (578 respondents). The college level of participants is shown in Figure 1. The highest percentages of enrollees declared their program as pre-pharmacy (20%), biology (20%), and other (20%), with pre-medicine (11%) and pre-nursing (10%) following.

When asked their primary reason for taking the course, students most often reported professional development (36%). However, other common responses were personal interest (19%), needed 2 credits (18%), and needed elective credits (12%). Less frequently, students reported their primary reason for taking the course was the self-study format (7%) or online format (5%).

An average of 5.7% of students in each semester reported that they were highly knowledgeable of medical conditions upon entry to the course. Figure 2 shows the reported knowledge of prescription medications of students at the beginning of the course.

On average, students preferred lectures/presentations (43%), followed by cases (26%), reading (22%), and small group discussion (8%). This information supports the initial design of the course which relied primarily on audio presentations for delivering the course content, supplemented by case scenarios, handouts, and other activities.

Figure 1. College level of Phar 1004: Common Prescription Drugs and Diseases participants by semester. Postsecondary enrollment option (PSEO); high school students taking college classes.

Figure 2. Self-reported knowledge of prescription drugs.

Students also reported their concerns about taking the course in the entrance survey. These include pacing oneself (57%), performing well on examinations (48%), studying effectively (47%), and long-term retention (35%).

Pretest. The instructional team designed and delivered a quality assurance pretest to better understand participants' knowledge of common prescription medications and assess participant's baseline knowledge of disease prevalence and symptoms, including basic mechanism of action, primary side effects, and approved indications of commonly used medication classes. In addition, pre-designed, parallel, and content-matched (to the pretest) questions were embedded into the 4 in-course examinations. Following the fall 2005 offering of the course, item analysis was performed using point biserial indicators for each pretest and embedded examination question. One question (embedded, in-course question) was dropped due to performance errors. The corresponding matched question in the pretest was also dropped, since comparison was no longer possible, reducing the number of matched test questions to 32.

Posttest. For fall 2005, fifteen (25%) students completed the 3-month posttest; the average score was 67%. Unfortunately, for spring 2006, the online posttest was set up improperly and student responses were not recorded. Due to the small number of students who completed the posttest for fall 2005 and the lack of spring 2006 data, conclusions regarding knowledge retention cannot be made.

Twenty-six (43%) of the 61 students enrolled in fall 2005 course elected to participate in the sequence of knowledge assessments. The average score on the pretest was 51%, with an average posttest score of 86% ($p < 0.001$, paired t test)

Course Grades. Examination performance and grades were assessed at each offering using point biserial analysis generated by Remark scanning software (version 2.6; Principia – Division of Gravic, Inc; Paoli, PA). Students' self-reflection of learning was assessed through the review and reflection exercises, as described above, and

student self-perception of learning was also assessed as part of the course evaluation. Additional course evaluation variables included the helpfulness of the various types of learning materials, the difficulty of examinations, the appropriateness of examination scores as a reflection of acquired knowledge, amount of learning achieved, and likelihood of recommending the course to other students.

The grade distributions for the 8 offerings are presented in Figure 4. The number of A's in the course has declined over time and the summer offerings have tended to have different overall distributions than the fall and spring offerings.

Curriculum Evaluation

Course Evaluation. Two hundred thirty-one students completed a course evaluation over the 8 offerings. Initial participation in the course evaluation was approximately 40%, dropping to approximately 20% for the eighth offering. Ninety-two percent of respondents indicated they would recommend the course to others. In addition, only 8% rated themselves as not satisfied with the course, with 62% indicating satisfaction with the course and 30% indicating that they were very satisfied.

Eighty-three percent of respondents rated the difficulty of examinations as appropriate and 16% as too difficult. In addition, when asked the amount learned, 54% indicated that they had learned the amount expected; 32%, more than expected; and 8%, an exceptional amount. The majority of respondents (42%) indicated that they were moderately confident in their mastery of the course objectives, with 30% indicating they were confident and 20% indicating they were very confident. Despite concerns on the entrance survey, small numbers of respondents rated themselves poorly at pacing themselves (17%), studying effectively (7%) and performing well on examinations (6%) on the course evaluation.

Course Report. Following each offering of the course, the instructional team developed a course report that collated data from the entrance survey, enrollment,

Figure 3. Boxplot of pretest and in-course examination scores, %.

examination performance, and course evaluation. The course report also documented enhancements made prior to offering the course and issues that arose during the offering of the course. The instructional team then set goals for improvements during the next offering.

Quality Assurance Study. Forty-seven (37%) of the 127 students volunteered to participate in the quality assurance study, in the spring 2006 offering. The average score on the pretest was 51%, with an average in-course examination score of 89%. Using a mixed-methods ANOVA analysis (SPSS, version 15.0, SPSS Inc., Chicago, IL), a significant main effect of time ($p < 0.001$) was found, but not a time*semester interaction ($p > 0.05$), or a main effect of semester ($p > 0.05$). Figure 3 shows a boxplot of the results. The numbers 82 and 136 indicate

for spring 2006 the student number of an outlier value for pretest and in-class examination score, respectively.

DISCUSSION

The primary objective of this course was successfully achieved. We have demonstrated the feasibility of developing and delivering an online, undergraduate course of basic pharmacotherapy content. We were able to achieve knowledge gains and a positive educational experience, evidenced by improvement in assessment scores from pretest to in-class examinations, student satisfaction ratings, and growing enrollment over 8 offerings.

Faculty time in the development of the content for the course was intensive. However, when the course began, structures were put in place to support faculty members,

Figure 4. Students' final score distributions for Pharm1004: Common Prescription Drugs and Diseases.

limiting their necessary involvement to areas requiring content expertise. Faculty time spent on course development during the summer of 2005 was approximately 20 hours a week for 10 weeks for each of the 2 faculty members (400 hours). The greater amount of development time required for our course compared to other online pharmacy courses may have been due to differences in the type of course material developed and the additional challenge of designing content for a more heterogeneous student population.⁴

Once the course began, the estimated faculty workload was 1 faculty member working approximately 10 hours per week for 10 weeks. Ongoing review and revision of the course has averaged 10 faculty hours per semester.

The online learning model made repeated offerings feasible because materials could be reused. Additional faculty time then could be used to update recorded presentations and review and revise examination questions. Similar to Lockman et al, total faculty work time was significantly reduced with subsequent offerings of the course.⁴

The entrance survey information on student perceived knowledge of common medical conditions and common prescription medications suggested that there was a need for this course. The majority of respondents reported they were somewhat knowledgeable about common conditions (60%) and common medications (46%). However, a student's perception of their personal knowledge level may not accurately reflect actual knowledge; pretest scores also demonstrated a need for the course.

The strong interest in the course may also signify a need. Enrollment has steadily increased since the start of the course. Through word of mouth, University wide marketing efforts, and e-mail invitations sent to students in other online courses offered by our office, enrollment has grown, despite an ever expanding pool of online course options available to students. The growing enrollment also may be a result of a societal need (not just an academic one) to become more knowledgeable about an area that impacts a growing number of people each year.

The success of the course may, in part, be attributable to the considerable attention paid to creating a course that was interesting and applicable for the average university student. Data driven content identification (ie, common conditions, common medications) followed by customization of the topic list for college students was critical. Since this course was an elective and not required, it had to be intriguing to students for them to enroll.

Although convenience is one of the main attractions of online learning,⁵⁻⁷ students may not have performed well in the course, recommended it to others, or taken additional pharmacy courses if purposeful pedagogical integration had not been a part of the design, develop-

ment, and implementation of this course. The ability to maintain and grow enrollment has made this course a successful financial endeavor, while the strong design has made it a successful educational endeavor.

Although this was an entry-level course available to any University student, the majority of participants were in their junior or senior year and tended to be science majors and/or pre-healthcare professional students. The level of participation in later undergraduate years may be a function of students using the course to round up their credit load to appropriate levels for loans or tuition discounts. However, it may also be a reflection of emerging interests in the health professions and students wanting to test those interests prior to enrolling in a professional program. This idea is supported by 46% of participants indicating their intended program of study was health professional or preprofessional.

According to University standards, students should be studying 6 to 9 hours a week for a 2-credit course.⁸ However, the course evaluation indicated that respondents studied 2 (30%), 3 (26%) or 4 (18%) hours a week. Only 8% of students reported studying more than 6 hours per week for the course.

The change in grade distribution noted across the 8 offerings is largely related to a decreased number of A's and an increased number of B's. A potential explanation could be that the first few offerings for the course included primarily students who had taken other online courses from the Office of CyberLearning and Outreach in the College of Pharmacy, since those students were recruited by e-mail. Entrance survey data for fall 2005 showed that greater than 50% of enrolled students had taken at least 1 online class previously with our office. After the first 2 offerings, enrollment dramatically increased and attracted students from a wider university pool. Entrance survey data for the spring 2008 offering shows a greater than 30% drop in students with past experiences with our other online courses. This change in student population, with its related change in experience, may have affected overall grade distribution.

Several changes have been made over the course's history as a direct result of the course review process used following each offering. For instance, the initial use of the conditional release of modules, reliant upon the completion of the previous module, was discontinued, allowing students to access the entire course in week 1. Educational literature supports this change, which suggests that students are more satisfied with a learning experience if they have some element of control.⁹

The intent of using examples of direct-to-consumer advertisements in course activities was to demonstrate the relevance of course content and to assist participants in

becoming informed consumers. The data, however, suggests that many respondents did not perceive sufficient benefit to completing the advertisement activities: "if I were to see the commercial at home on TV, I would not bother to spend the time to critically analyze the commercial, and it can be safely assumed that the majority of the people wouldn't either. So I did not see the benefits of doing the assignments."

Several changes have been made in an attempt to improve student response to the advertisement activities. Specifically, comments on workload and repetitiveness were addressed. Rather than requiring analysis of 1 advertisement per module, the number of required analyses was reduced from 8 to 2 advertisements; 1 assignment due in the first half of the course, the other due in the second. Although all advertisements remained available, students were only required to submit an analysis of 2 and were given the choice of which 2.

In the fall of 2007, with no significant improvement in student response, the deadlines were removed, which provided additional flexibility. However, student comments continued to be polarized and further work is required to determine the best approach to teaching this important skill of critically analyzing direct-to-consumer advertising.

While this particular course was for an undergraduate student audience, the system approach used can be applied to the development of any online course, including those for health professional programs. The design and quality assurance/improvement models used in this course have been used to develop subsequent online courses. In addition, the content for this course was enhanced for use in an upper division course in pharmacotherapy. As pharmacy programs expand to have larger enrollments and additional remote campuses, technology will continue to play an increasingly important role in the delivery of the curriculum. Implementing the ADDIE model, as well as systematic course review and improvement, can create a uniform and effective delivery model.

Based on the experience of developing this course, there are strategies colleges of pharmacy may want to employ when developing online or hybrid courses. Consistent with other reports in the literature, it is a more efficient and effective process to concentrate and complete development over a short time period and well in advance of the delivery of the material and to utilize

a team approach.⁵ Allowing students the freedom to set pace of learning seems to be a desirable and feasible educational format if an adequate system is in place.

SUMMARY

A systematic design plan (ADDIE) resulted in the successful delivery of an online pharmacotherapy course to an undergraduate, nonpharmacy student audience on 2 campuses. Significant and reproducible knowledge gains were achieved. Students have consistently reported satisfaction with the course and enrollment has grown for 8 sequential offerings. Through quality improvement measures, changes have been made to maximize the educational experience of this course.

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