

INSTRUCTIONAL DESIGN AND ASSESSMENT

A Web-based Interprofessional Diabetes Education Course

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Submitted January 31, 2007; accepted April 3, 2007; published October 15, 2007.

Objective. To develop a comprehensive diabetes management course for pharmacy students that is available to all colleges and schools of pharmacy via the Internet.

Design. *DM Educate*, a Web-based course consisting of 12 topic modules with video lectures, active-learning exercises, and test questions prepared by nationally recognized experts was developed. The modular design allows use as a standalone, 3-credit course or use of individual module content as a supplement to an existing course.

Assessment. Two pilot studies found the comprehensive, interprofessional nature of the material beneficial for learners. Students showed a significant increase in knowledge of the subject material by correctly answering 26 of 34 questions on the posttest compared to answering only 14 of 34 questions correctly on the pretest ($p < 0.001$). Student feedback was positive for the flexibility of the Web-based format.

Conclusion. Pilot studies demonstrated the effectiveness of the course, which became available in the 2006-2007 academic year.

Keywords: Internet, diabetes, distance instruction

INTRODUCTION

Emerging technologies and the accessibility of the Internet have opened up possibilities for providing pharmacy education through innovative strategies. Since the introduction of a commercial browser in 1993, various applications of Internet-based education in pharmacy have been implemented, including courses, course modules, learning resources, mentoring, recitation, combinations with lectures, technique tutorial, remote instruction, and continuing education.¹⁻¹³ In all of these examples of Internet education in pharmacy, the content was developed by faculty members at a particular institution and used only by students enrolled in that institution.

In order to fully prepare students for their future role as pharmacists, an in-depth understanding of the various aspects of disease states is needed beyond drug therapy. Diabetes is one such disease state. Information specific to diabetes treatment is often addressed within therapeutics courses with a narrow focus on drug therapy. This may be due to curricular time constraints or availability of faculty at an individual institution. In addition, coverage of diabetes-related material may vary between institutions for the same reasons. As a result, pharmacy students may not

have access to resources to learn about detailed aspects of diabetes beyond drug therapy or be receiving consistency in course material covered.

The nature of the Internet allows for an innovative approach for creating a course that can be accessible to all colleges and schools of pharmacy in a Web-based format. Through the production of one sharable course, experts in various fields of practice can collaborate in creating courses that provide resources for faculty members to use in part or in their entirety to teach pharmacy courses. This strategy has the potential to efficiently provide a large number of students with high quality education using the most current information available.

A unique Web-based, comprehensive diabetes management course with content provided by nationally recognized experts in management and education of patients with diabetes was developed. This course addresses the need for comprehensive diabetes management education by bringing recognized experts of various areas of diabetes management to each classroom via the Internet. The course was offered to all colleges and schools of pharmacy at no charge, beginning in fall 2006.

DESIGN

Faculty members at the University of Pittsburgh School of Pharmacy led the development of the *DM Educate Comprehensive Diabetes Course*. Curriculum

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and technology development spanned 12 months from the beginning of the project to the first pilot test of the course, with an additional 6 months for completion of the pilot testing. The members of the curriculum design team outlined the content and outcomes that represented a comprehensive overview of diabetes management, and then determined that a 3 credit-hour course (45 hours of content delivery) would be appropriate to address all of the outcomes.

Description of the Course

Design Principles. The structural design of the course was influenced by several principles which the design team deemed should be foundational to the course. The first principle was a commitment to using a platform that would allow the course to be available to any college or school of pharmacy. In addition to curriculum materials for students, the design would include course management tools accessible only by instructors. Second, the course design team wanted to provide course material in a format that was adaptable to different learning styles and selected the type of technology and multimedia format accordingly. Last, but likely the most important factor, was the need to allow maximum flexibility for use of course content by instructors. These structural design principles were achieved by developing an Internet-based course incorporating video lecture, printable handouts, examination questions, and active-learning exercises in a modular format that could be utilized by an instructor as a standalone course or incorporated into existing courses. To achieve the desired flexibility, the curriculum design team developed the course as a collection of 12 topic modules, as shown in Appendix 1.

The design of the curricular content of the course was influenced by 2 primary factors. First, the course was to be comprehensive in nature, covering all aspects of diabetes management; and second, the course faculty were to be drawn from multiple disciplines and needed to be recognized experts in their respective fields of practice. Potential contributors from the fields of pharmacy, nursing, medicine, behavioral psychology, dietetics, and exercise physiology were then identified. The *DM Educate* contributors are listed in Appendix 1.

Each contributor was charged with developing the lectures, slide presentations, and active-learning exercises for his or her topic, as well as 30 test questions for each hour of course material. The curriculum design team reviewed all of the course material as it was developed and made editorial suggestions to the contributors. Final drafts of materials were reviewed and edited by a professional editor for style and grammar. When the lecture materials were finalized, each contributor came to the

University to produce a video recording of his or her lecture. The final video tapes were edited, coordinated with slides, and converted to Flash files for incorporation on a web site.

The *DM Educate* web site (www.dmeducate.org) was developed while the contributors were developing their content and is the access point for the course. The web site is designed to include a public space with information about the course and private, password-protected space that may be accessed only by onsite instructors and students registered for the course. The secure space contains learning management tools, navigation tools to access the course, and the presentation “theatre” for the video lectures. The video lectures, active-learning exercises, and test questions were added to the web site as they were completed.

Content and Delivery. *DM Educate* presents a comprehensive approach to diabetes management and education, encompassing the entirety of diabetes patient care. The scope of the course goes beyond traditional pharmacy education by providing information on diabetes-specific topics, such as medical nutrition therapy, exercise physiology, psychosocial and behavioral aspects of the disease, patient education, and self-care. The first 2 modules focus on diabetes pathophysiology, metabolic syndrome, and ways to approach management of diabetes, including a historical review of past milestones in diabetes research. Modules 3-5 provide in-depth coverage of the treatment of diabetes utilizing pharmacotherapy (including oral and injectable agents, medication delivery devices, and complementary/alternative medicine), medical nutrition therapy, and exercise physiology. Modules 6-7 were dedicated to monitoring and desired outcomes for the treatment of diabetes and the management of diabetes-related complications. Modules 8-11 are directed to special treatment considerations including 2 modules for treatment in special populations, including children, adolescents, pregnant women, and the elderly, and 2 modules discussing the impact of different behaviors on diabetes management and educational approaches to overcoming potential barriers. A unique aspect of this course is Module 12, the Diabetes Reality module, which shows a day in the life of a diabetes patient who speaks about her own experience with diabetes, providing personal insights into the impact of diabetes on daily life.

Course material is available from an Internet web site and delivered via video lecture with synchronized PowerPoint slides. Once started, the presentation may be paused or restarted. Students are able to download and print the slides from the lecture to allow for note taking or review of material at a later date.

In addition to video lecture presentations, student learning is also facilitated through active-learning exercises, and post-module self-assessment questions. Some course modules have incorporated supplemental learning activities provided through links outside the delivered lecture. An example activity is a step-by-step instructional video on the use of insulin delivery systems. At the end of each module section, a self-assessment test provides 10 multiple-choice questions that are randomly selected from a pool of at least 30 questions such that individual students receive unique examinations based on the questions selected and/or question order. Once an answer is submitted, the next screen will show the correct answer, thus giving the student immediate feedback.

Implementation. Minimal effort is required for a college or school of pharmacy to implement this Web-based course, as the content is complete and the course is administered from the web site. Each module is accessed individually by each registered student. A faculty member serving as the course instructor may choose to incorporate onsite or online discussion sessions and patient case or other assignments to supplement course material. A data-bank of questions is also provided for course instructors to use for written examinations.

DM Educate was designed to serve either as a comprehensive standalone elective course or as a resource to supplement existing courses. The modular design facilitates its use as a "tool box," allowing individual instructors to select all or part of the material to meet their needs. Portions of this course can be used to supplement existing courses that include diabetes management and education. A particular module could be accessed and viewed in a classroom setting with instructor-led active learning or discussion at the end of the lecture. Students could be assigned to view a lecture via the web site prior to a class session, with the active learning or discussion sessions occurring afterwards in the classroom. Modules do not need to be viewed in a specific order, again allowing for flexibility in class planning. Another option is to download slides and speakers notes for use as resources for a lecture presented by onsite faculty members. Instructors who want to present the material themselves have access to the PowerPoint slides and lecture notes for each module that can be downloaded and saved to their own files, truly supporting the shareable nature of this course.

Several tools are built into *DM Educate* in order to aid instructors in management of the course. Students register with a password unique for their school, so each course instructor can access only his or her students' information. The course instructors have access to a student roster, which tracks the latest date and time each student logged into the site and a course grade book containing

the scores of each student's self-assessment tests. Instructors also have an opportunity to network with instructors from other colleges schools of pharmacy through a dedicated listserv group.

Course Pilots. The School of Pharmacy at the University of Pittsburgh and Washington State University College of Pharmacy chose to serve as pilot sites for *DM Educate* during spring 2006, offering a diabetes elective course utilizing *DM Educate*. The faculty instructors at each school of pharmacy worked independently in developing the syllabus for each elective course.

At the University of Pittsburgh School of Pharmacy, *DM Educate Comprehensive Diabetes Elective* (PHARM 5808) was approved by the school's curriculum committee. Participating students were in the second semester of their third-professional year and had completed the endocrinology therapeutics module (which included diabetes pharmacotherapy) during the previous semester. Student assessments were focused on diabetes knowledge, course satisfaction, and ease of use of the Web-based course.

DM Educate was utilized as a standalone course with added learning activities provided by the onsite instructors. Students were provided with a syllabus and class schedule that called for viewing an average of 3 hours of lecture per week. In addition to viewing the lecture material, students were asked to complete 2 patient case assignments, which were distributed and collected via e-mail. Contact with the students occurred in various ways: face-to-face, e-mail, and Internet chat room. Six discussion sessions were held throughout the semester to discuss modules viewed in the previous 2 weeks as well as patient case assignments. Three discussion sessions were held onsite and 3 via Web-based chat room. Student grades were based on 2 multiple choice examinations (40%), 2 patient case assignments (25%), and participation in discussion sessions (35%).

In addition, students at the University of Pittsburgh completed a pre-course knowledge test to assess their baseline knowledge of diabetes. This test was comprised of 34 questions, 2 to 3 randomly selected from each of the 12 *DM Educate* modules. The same test was readministered upon course completion. This test was used for comparative purposes only, and was not incorporated into the students' course grade.

Lastly, the students at the University of Pittsburgh were asked to provide 2 types of feedback on the Web-based course content, technical aspects of the course delivery, and integration of case and discussion sessions to the course. First was an indication of student satisfaction using a 3-point Likert-type scale. Second was an open response to questions assessing the positive and negative

aspects of the course, inclusive of the Web-based resources and the onsite additions to the course.

The Washington State University School of Pharmacy found the Web-based nature of *DM Educate* appealing as there are 2 campuses in different parts of the state. The technology allowed the instructor to bring 2 locations together for 1 elective course. The course was approved by the school's curriculum committee under PharP 499, *Special Problems Class*. A description of the course was sent to students in each year of the curriculum; therefore, students who participated in the class had varying levels of exposure to diabetes pharmacotherapy.

The course was designed to be self-directed: students could view the video lectures at his or her own pace throughout the semester. The instructor met with the students at random intervals to monitor their progress and had frequent e-mail contact with the students to answer questions on course material. Student's grades were provided via the *DM Educate* self-assessment tests at the end of each module. Students at Washington State University were required to correctly answer 75% of the questions in each module to attain a passing grade of "satisfactory" for the course.

ASSESSMENT

At the University of Pittsburgh, 15 students volunteered to participate in the elective course. Four of the students were permitted to register for the course "not for credit" due to their current credit load.

Figure 1 represents the results of the precourse and postcourse knowledge tests. At baseline the average number of correct answers was 14 (range 8-20). At the completion of the course, the average score was 26 (range 23-28) for the 11 "for credit" students, resulting in an average 36% (20%-47%) increase in correct responses. A paired *t* test revealed this was a significant increase

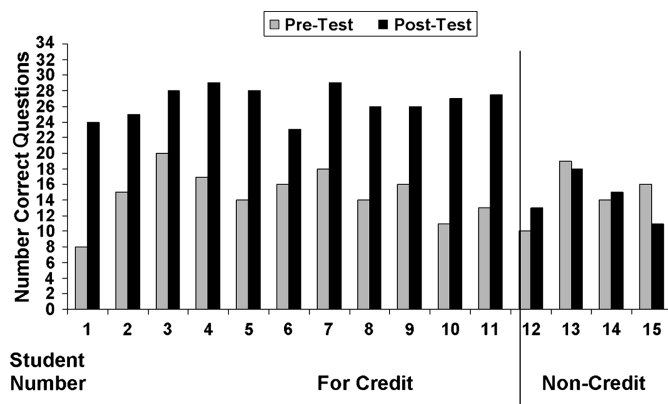


Figure 1. University of Pittsburgh Student Knowledge Pretest and Posttest.

from baseline ($p < 0.001$). The 4 students who chose to take the class "not for credit" showed no improvement in their diabetes knowledge, with an average score of 14 at baseline and upon course completion. These 4 students stated that they did not keep up with the material because other classes taken for credit were their priority. Final class grades for the 11 "for credit" students ranged from 89%-96% based on the above criteria.

Results of the survey of student satisfaction with the course utilizing the 3-point Likert-type scale are shown in Table 1. In open responses, students repeatedly stated that the greatest benefit gained from the course was the ability to learn from an interprofessional group of faculty members who were experts in their fields of practice. Another reported benefit was inclusion of all aspects of diabetes management, not just medications. The students liked the flexibility of being able to play video lectures at their convenience and at their own pace, and to replay course material if needed. The students found the patient cases and discussion sessions to be beneficial, but stated that patient case discussions would be better suited for face-to-face class sessions and suggested reserving the Web-based chat sessions for review of the module lecture material.

Forty-seven students at Washington State University enrolled in the course and all 47 received a passing grade. Although no formal assessments of student satisfaction were conducted, general comments provided by students were positive regarding the multidisciplinary design of the course content and Web-based format of the course. Several students who participated were in their fourth-professional year advanced pharmacy practice experiences and found that because of its flexible structure, the course did not interfere with their other responsibilities.

DISCUSSION

Advances in technology have made the creation of Web-based courses possible. Increases in bandwidth and download speeds, new technologies for compressing files, and steaming media servers make it possible to routinely use multimedia, including video, in the design of Web-based education. Health care is constantly changing, especially in diabetes management where clinical guidelines are adjusted yearly and new treatments are being approved every few months. Three new medications have reached the market since the roll out of the pilot course. The technology incorporated and modular design of the course allow for new course material to be added or updated without recreation of the course as a whole, thus allowing for adjustments in a short timeframe. Two lectures on newly approved medications have been added to

Table 1. Survey Responses of PharmD Students at the University of Pittsburgh Regarding a Diabetes Course Using *DM Educate* (N = 15)

	Disagree/Strongly Disagree	Neither Agree Nor Disagree	Agree/Strongly Agree
Content			
Time line provided in the syllabus is appropriate for this course	2		13
Discussion sessions added to learning separate from the on-line lectures	2	3*	10
Case assignment added to learning separate from the on-line lectures		2*	13
Structure			
“I feel the information provided in this course. is at an appropriate level of difficulty.”			15
..has increased my confidence in speaking with patients about any aspect of their diabetes.”		3*	12
..will help me be a better pharmacist.”		2*	13
User ability of web site			
The <i>DM Educate</i> web site is user friendly.	1	3	11
The level of technological difficulty experienced was more than expected.	0	9	6

*Represents “not for credit” students

DM Educate since its original implementation in early 2006. Being able to constantly evolve the course components to meet the changing needs of instructors and students is the key to the longevity of a sharable Web-based course.

Delivery of course material via the Internet is not a novel concept. Previous studies evaluating Web-based courses have shown that students learn at a similar level compared to face-to-face learning.^{14,15} The pilot at the University of Pittsburgh revealed that the students significantly increased their level of diabetes knowledge with this course. Evaluations of student satisfaction in other Web-based courses have shown that the flexibility of being able to work at their own pace and within their own schedules was an important factor.^{16,17} Comments from students at both the University of Pittsburgh and Washington State University revealed high satisfaction with the course structure, especially the flexibility of accessing materials. This becomes a growing concern as professional students are often balancing work and family life along with their educational demands. Both the University of Pittsburgh and Washington State University have maintained student enrollment beyond the pilot course, supporting the continuation of *DM Educate*. Nineteen students at the University of Pittsburgh enrolled for the next offering of this course. Due to the success of the class at Washington State University, 17 students enrolled for the summer 2006, 28 students for the fall 2006 term and

the elective was granted its own course name and number to replace the initial Special Problems Class designation.

DM Educate has incorporated new concepts to Web-based education. This course was designed on the principle of being a sharable course, thereby allowing instructors not only to access the course materials, but also the freedom to incorporate and deliver these materials to meet individual needs. In addition, the content development by recognized experts from multiple disciplines gives pharmacy students the ability to learn from thought leaders within diabetes who would not otherwise be available. This also includes the Living with Diabetes Module, which allows the student to experience diabetes management from the patient’s perspective, thus allowing the student to experience a powerful connection to a patient, enabling patient care issues to become a reality, not simply an abstraction.

Lastly, the comprehensive nature of the course allows for incorporation of the course into other health professions, such as nursing and medicine. *DM Educate* truly brings diabetes experts into every classroom.

Currently, over 70 colleges and schools of pharmacy are registered to use *DM Educate* either as a standalone course or with components integrated into existing courses. This overwhelming participation and use of the course is evidence of faculty member willingness to utilize technology to deliver course material and the need for comprehensive diabetes educational tools.

CONCLUSION

The *DM Educate Comprehensive Diabetes Elective* offers students the opportunity to learn various aspects of diabetes education and management from experts and provides individual instructors with the tools needed to deliver this material to their students. Future evaluations of course material will include an assessment of the different ways the course is utilized, onsite instructor satisfaction, and student satisfaction and knowledge. Discussions are underway to expand access to *DM Educate* to practicing pharmacists for continuing education credit, as well as to other health science schools and practitioners.

ACKNOWLEDGMENTS

Novo Nordisk provided an unrestricted educational gift to the University of Pittsburgh School of Pharmacy to support development of a comprehensive diabetes management elective course for pharmacy students.

The authors thank the following individuals: Teresa McKaveney, staff member at the University of Pittsburgh School of Pharmacy, for her assistance in the preparation of this manuscript; Cheri Hill, staff member at the University of Pittsburgh School of Pharmacy, for her administrative oversight of the *DM Educate* web site; the *DM Educate* Design Team for their work on the development of the curriculum and course structure; Scott Drab, PharmD, CDE, BC-ADM, Assistant Professor, Pharmacy and Therapeutics, University of Pittsburgh School of Pharmacy; R Keith Campbell, PharmD, CDE, MBA, Distinguished Professor of Pharmacy, Washington State University College of Pharmacy; Marion J. Franz, MS, RD, LD, CDE, Nutrition/Health Consultant, Nutrition Concepts by Franz, Inc.; William H. Polonsky, PhD, CDE, President and Founder, Behavioral Diabetes Institute, Assistant Clinical Professor in Psychiatry, University of California, San Diego; Linda Siminerio, RN, PhD, CDE, Executive Director, Diabetes Institute, University of Pittsburgh.

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American Journal of Pharmaceutical Education 2007; 71 (5) Article 93.

Appendix 1. Module sections and faculty members who developed and presented the material for *DM Educate*.

Section	Topic	Faculty
Module I	Definition and Pathophysiology	Evan Sisson, PharmD, MHA, CDE Clinical Pharmacy Manager, Southside Regional Medical Center; Clinical Assistant Professor, VCU/MCV School of Pharmacy Richmond, Virginia
Module II	A Comprehensive Approach to Management of Diabetes	R. Harsha Rao, MD Professor of Medicine, University of Pittsburgh School of Medicine, Pennsylvania
Module III	Treatment of Diabetes: Pharmacologic Agents (Oral Agents)	Scott Drab, PharmD, CDE, BC-ADM Assistant Professor, Pharmacy and Therapeutics, University of Pittsburgh School of Pharmacy, Pennsylvania
Module III	Treatment of Diabetes: Pharmacologic Agents (Injectable Agents)	Mary Lynn McPherson, PharmD, BCPS, CDE Professor, Department of Pharmacy Practice and Science, University of Maryland School of Pharmacy, College Park, Maryland
Module III	Treatment of Diabetes: Pharmacologic Agents (Insulin Devices)	James A. Bennett RPh, FACA, CDE Director of Clinical Services, J. Bennett Apothecary, Corinth, Mississippi
Module III	Treatment of Diabetes Mellitus - Complementary and Alternative Medicines	Laura Shane-McWhorter, PharmD, BCPS, FASCP, CDE, BC-ADM Associate Professor, University of Utah College of Pharmacy, Salt Lake City, Utah
Module IV	Treatment of Diabetes: Medical Nutrition Therapy	Marion J. Franz, MS, RD, LD, CDE Nutrition/Health Consultant, Nutrition Concepts by Franz, Inc., Minneapolis, Minnesota
Module V	Treatment of Diabetes: Exercise Therapy	Bret Goodpaster, PhD Assistant Professor, University of Pittsburgh, Division of Endocrinology and Metabolism; Director, Exercise Physiology Laboratory; Co-Director, Metabolism Core of the Pittsburgh Obesity and Nutrition Research Center, Pittsburgh, Pennsylvania
Module VI	Monitoring Diabetes	Peggy C. Yarborough, PharmD, BC-ADM, CDE Professor – Campbell University School of Pharmacy, Buies Creek, North Carolina
Module VII	Complications	R Keith Campbell, PharmD, MBA, CDE Distinguished Professor of Pharmacy, Washington State University College of Pharmacy, Pullman, Washington
Module VIII	Special Populations (Children & Adolescence)	Jean Betschart-Roemer, MN, MSN, CRNP, CDE Pediatric Nurse Practitioner, Endocrinology, Children’s Hospital of Pittsburgh, Pennsylvania
Module VIII	Special Populations (Preconception and Pregnancy)	Susan Cornell, BS, Pharm.D, CDE, CDM Director, Experiential Education, Assistant Professor, Department of Pharmacy Practice, Midwestern University Chicago College of Pharmacy; Clinical Pharmacist and Educator Dominick’s Pharmacy, Chicago, Illinois
Module IX	Psychological Issues	William H. Polonsky, PhD, CDE President and Founder, Behavioral Diabetes Institute, Assistant Clinical Professor in Psychiatry, University of California, San Diego, California

(continued on next page)

Appendix 1. Continued

Section	Topic	Faculty
Module X	Education	Linda Siminerio, RN, PhD, CDE Executive Director, Diabetes Institute, University of Pittsburgh, Pennsylvania Robin Nwankwo, RD, MPH, CDE Diabetes Self-Management Consultant, University of Michigan, Ann Arbor, Michigan
Module XI	The Pharmacists Role in Management of the Patient with Diabetes	Jerry Meece, RPh, FACA, CDE Owner, Director of Clinical Services, Plaza Pharmacy and Wellness Center, Gainesville, Texas
Module XII	Living With Diabetes Diabetes Reality	Nicole Johnson-Baker Diabetic Patient – Miss America 1999, Pittsburgh, Pennsylvania