

INSTRUCTIONAL DESIGN AND ASSESSMENT

The Impact of Elective Active-Learning Courses in Pregnancy/Lactation and Pediatric Pharmacotherapy

Jennifer Padden Elliott, PharmD, Pamela Hucko Koerner, PharmD, Jennifer Heasley, PharmD, and Khalid M. Kamal, PhD

Mylan School of Pharmacy, Duquesne University, Pittsburgh, PA

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Objective. To implement and evaluate the impact of 2 elective courses, Pregnancy & Lactation and Pediatrics on student acquisition of knowledge and development of lifelong learning skills related to these special populations.

Design. Two 3-credit elective courses were implemented using various student-driven learning techniques, such as case-based exercises, group presentations, pro-con debates, and pharmacist “grab bag” questions. Strong emphasis was placed on medication literature retrieval and analysis, and a wiki was used to create an electronic resource for longitudinal use.

Assessment. Pre- and post-course tests showed significant improvement in knowledge related to pregnancy, lactation, and pediatrics. Pre- and post-course confidence and ratings on satisfaction survey tools also revealed significant improvement in several domains relating to lifelong-learning skills, knowledge related to medication use within these special populations, use of technology to enhance learning, and overall course design.

Conclusion. The combination of student-directed learning techniques used in 2 pediatric-concentration courses is an effective teaching model.

Keywords: pediatrics, pregnancy, lactation, case-based learning, lifelong learning, wiki, active-learning strategies

INTRODUCTION

A white paper published in 2009 by the American College of Clinical Pharmacy (ACCP) along with the Accreditation Council for Pharmacy Education Accreditation (ACPE) identified the critical need for education regarding medication use in pregnant and pediatric populations.^{1,2} Students are often apprehensive about undertaking pediatric practice experiences as they are viewed as one of the more challenging practice experiences of the advanced pharmacy practice curriculum.³ Student hesitation may stem from a fear of the unfamiliar. The mean time devoted to pediatric topics in doctor of pharmacy programs is only 17 hours (range, 2.8 to 52.8 hours), despite that this patient population is one that most pharmacists will deal with in practice.

Although differences and changes in drug absorption, distribution, metabolism, excretion and dose response that occur throughout a child’s development make pedi-

rics its own specialty,³ the medical literature is relatively scant regarding the safety and efficacy of medication use within this population. This paucity of information is further complicated by complexities related to weight-based dosing, lack of available formulations appropriate for pediatric patients, and communication barriers. For these reasons, pediatric patients are at increased risk for medication errors. As pharmacotherapy experts, all pharmacists should have a basic understanding of pediatrics, regardless of their practice site.

The school of pharmacy’s self-assessment revealed that only 8 hours of required lecture-based courses were devoted to pediatric topics and less than 2 hours covered medication use during pregnancy and lactation, suggesting that the curriculum would benefit from an enhancement in pediatric and pregnancy/lactation therapeutics. Thus, a pediatric concentration was developed.

Twenty-five students from each class are accepted into the pediatric concentration program through an application process. The pediatric concentration requires students to take one 3-credit-hour course in the P2 year, General Pediatrics & Neonatology Pharmacotherapy, and two 3-credit-hour courses in the P3 year, Medication Use in Pregnancy & Lactation, and Pediatric Pharmacotherapy: A

Corresponding Author: Jennifer Padden Elliott, PharmD, Assistant Professor of Pharmacy Practice, Duquesne University Mylan School of Pharmacy, 309 Bayer Learning Center, 600 Forbes Avenue, Pittsburgh, PA 15282. Tel: 412-396- 4990. E-mail: elliott3@duq.edu

Focus on Ambulatory Care. Students are allowed to choose 1 additional 3-credit-hour elective course during the P3 fall semester to fulfill the school's requirement of 12 elective credit hours. They also must complete a 5-week advanced pharmacy practice experience. This paper focuses on the student-directed learning techniques used in the two P3 year courses.

DESIGN

The course development goal for Medication Use in Pregnancy & Lactation, and Pediatric Pharmacotherapy: A Focus on Ambulatory Care was to increase knowledge related to medication use in pregnant and pediatric patient populations. This was found to be difficult given the shortage/lack of pediatric pharmacy education resources.⁴ There are limited textbooks focusing on pharmacotherapy specific to the pregnant or lactating woman and the pediatric patient. Information regarding the treatment of these vulnerable populations is most often found in journal articles and drug information handbooks. Therefore, both courses were designed to enhance students' ability to find relevant information within the vast medical literature and apply it to clinical decision-making. A wiki was used to organize key references and summaries for the most common disease states. Students used this as a basis for developing their own electronic pregnancy/lactation and pediatric reference database throughout the semester, which they were able to continue accessing following course completion.

The design goal of Medication Use in Pregnancy & Lactation and Pediatric Pharmacotherapy: A Focus on Ambulatory Care was to develop the skills necessary for a career dependent on lifelong learning, while focusing on pediatric and pregnancy/lactation content. Given the rapid growth of the pharmacy and medical literature, the ACCP white paper on Clinical Pharmacist Competencies, authored by Jungnickel and colleagues, states that providing quality patient care requires a knowledge base that is continuously expanded and updated.⁵ Pharmacists must take an active role in acquiring this knowledge to continue performing as a quality member of the healthcare team. Development of these learner-centered skills is imperative to promote thinking, problem-solving, self-directed learning, and professional responsibility. The current design aspired to achieve this goal by implementing a combination of student-driven learning techniques throughout both courses. Students demonstrated learning through progressive case presentations, pharmacist grab-bag assignments, and a pro-con debate.

The progressive case presentations and pro-con debates were group assignments. A class design incorporating group work was used to help achieve the following

Center for the Advancement of Pharmaceutical Education pharmacy practice supplemental outcomes for students: the ability to formulate patient-centered pharmaceutical care plans in collaboration with other healthcare professionals, patients, and/or their caregivers; and the ability to communicate and collaborate with prescribers, patients, caregivers and other involved healthcare providers to engender a team approach to patient care.⁴ At the beginning of the semester, each student was assigned to a pharmaceutical care team consisting of 5 members, as the concentration was limited to 25 students.

Progressive Case Presentations

The Medication Use in Pregnancy & Lactation course was conducted during the first half of the P3 spring semester, beginning with conception, proceeding through all trimesters, and ending during week 7 with the birth of 5 mock-patients' babies. Pediatric Pharmacotherapy: A Focus on Ambulatory Care was conducted during the latter half of the semester, beginning week 8 with the neonatal period and ending the semester with adolescence. For each course, students met for 3 hours twice weekly for half of a semester.

Both courses used problem-based learning as a framework. Progressive cases involving a select group of mock patients were chosen so that students would have a better appreciation of the correlation between events occurring during pregnancy/infancy and future childhood disease predisposition and medication choice. This progressive patient follow up also allowed for application of immunization recommendations prior to and during pregnancy and throughout each stage of childhood development.

Faculty members developed 2 patient cases each week and distributed them during class 1 to initiate the learning process. Two groups were given 1 case to evaluate, while 3 groups received the other. Each case incorporated several disease states (Table 1). Class was held in the computer laboratory in close proximity to the Drug Information Center. The class period focused on drug literature retrieval and analysis. The students were given roughly 30 minutes to use electronic and print resources to evaluate and determine both a primary and a differential diagnosis. Faculty members then met with each group to discuss their initial findings. During this time, faculty members discussed appropriateness of resources and evidence supporting or negating the students' diagnosis. Instructors never provided students with the correct diagnosis but instead guided their efforts. Students were then given the remaining 2 hours of class time to research best treatment strategies. Faculty members met with each group periodically to discuss resources and treatment guidelines in an advisory capacity. Each student group

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Table 1. Outline for a Pregnancy/Lactation Course and a Pediatrics Course

Week	First Class Each Week (Presentation/Class Discussion)	Second Class Each Week (Drug Literature Retrieval and Analysis)
1		Evidence-based medicine assignment
2	Introduction (patient-care group assignments; pharmacist grab-bag assignments; overview of Wiki, presentations and grading; precourse confidence/satisfaction surveys and knowledge examination)	Preconception Case #1: contraception/prenatal counseling and ovulation Preconception Case #2: infertility testing/oral medication options Distribution of grab-bag questions
3	Preconception case presentations/class discussion	Preconception Case #1: pregnancy testing/ectopic pregnancies/information resources Preconception Care #2: infertility medications and procedures/risk of multiple births/progesterone use
4	Preconception case presentations/class discussion	Pregnancy Case #1: asthma/headache management Pregnancy Case #2: mild hypertension/nausea and vomiting
5	Pregnancy case presentations/class discussion/pharmacist grab bag	Pregnancy Case #1: gestational diabetes/hypothyroidism Pregnancy Case #2: preeclampsia/fetal lung development
6	Pregnancy case presentations/class discussion/pharmacist grab bag	Pregnancy Case #1: tocolytic agents and induction medications Pregnancy Case #2: depression/postpartum depression
7	Pregnancy case presentations/class discussion/ pharmacist grab bag	Pregnancy Case #1: epidurals/venous thrombo-embolism/postbirth contraception
8	Pregnancy case presentations/class discussion/pharmacist grab bag	Neonatal Case # 1: Baby A- bronchiolitis/Respiratory Syncytial Virus/immunizations Neonatal Case # 2: Baby B- feeding (breast feeding/formula overview)/gastroesophageal reflux disease/protein intolerance/immunizations
9	Neonatal case presentations/class discussion/ pharmacist grab bag	Infant Case # 1:Baby C- gastroenteritis/dehydration/diaper rash/immunizations Infant Case # 2: Baby D- fever/seizures/
10	Infant case presentations/class discussion/pharmacist grab bag	Early Childhood Case #1: Baby D-autism/sleep disorders/constipation/immunizations Early Childhood Case #2: Baby A-eczema/otitis media/immunizations
11	Early Childhood case presentations/ class discussion/ pharmacist grab bag	Early Childhood Case #1: Baby A- asthma/immunizations Early Childhood Case #2: Baby B-cystic fibrosis/immunizations
12	Early childhood case presentations/ class discussion/ pharmacist grab bag	Late Childhood Case #1: Baby A- obesity/diabetes mellitus type-2/candida albicans/immunizations Late Childhood Case #2: Baby C- attention-deficit/hyperactivity disorder/immunizations
13	Late childhood case presentations/ class discussion/ pharmacist grab bag	Adolescence Case #1: sexually transmitted infections/immunizations Adolescence Case #2: major depressive disorder/substance abuse/immunizations
14	Adolescence case presentations/ class discussion/ pharmacist grab bag	Pro-con debate
15	Pro-con debate Postcourse confidence/satisfaction surveys and knowledge examination	

was ultimately responsible for developing a Microsoft PowerPoint presentation, patient care plan, and resource guide that was to be posted to the course wiki by the following Sunday evening.

Prior to the second class, faculty members reviewed each group's presentation on the wiki. Presentations were typically divided into the following sections: presentation of the patient; epidemiology, pathophysiology, treatment guidelines; patient care plan; and summary of resources used. At this time, faculty members chose which groups would present which information during the class. Allocation of topics was not revealed until the second class, encouraging student accountability for all topics. If 2 groups had opposing information, faculty members had both groups present. This allowed the faculty member to guide the class through the decision-making process to ultimately determine the best treatment option. Faculty members also developed presentations/handouts to supplement the students' material as needed.

Patient case presentations, disease state discussions, and review of best treatment options took place each week. Each group presented an equal amount of information and all group members were required to present during each class period. By the end of the semester, each student had participated in the development, coordination, and delivery of 14 formal group presentations.

Two faculty members team-taught both courses and each acted as the course coordinator for 1 course. Both faculty members were present for 1 of 2 weekly classes, but only the course coordinator was present for both classes. This allowed both faculty members to contribute to the direction of class discussion and made it easier to interrelate the course material.

After the grading of each presentation faculty members met with each group during the following class to provide direct formative feedback. This gave students time to assess their work in comparison with that of their peers. In this student-centered model, instructors guided rather than led class discussions. Students and instructors alike had to be prepared for the unknown, as there was

flexibility in the direction of each class discussion. Given this potential, allowing adequate time for topic preparation was essential.

Pharmacist Grab Bag

The pharmacist grab-bag assignment was a novel exercise developed by the course coordinators to incorporate student interests and inquiries throughout the semester. Each student was required to submit 2 questions about medication use in both pregnancy/lactation and pediatrics during the first class. Each student then chose 1 of the questions from the grab bag for each course. Students were given 2 weeks to research and develop a 10-minute presentation to effectively answer their questions. The instructors then chose questions at random throughout the semester and the respective student was called on to present. Unlike the other 2 course assignments, students' development and presentation of their response to the pharmacist grab-bag questions were completed individually. The presentations were evaluated using a rubric of which 5 of the 50 points were allotted for creativity, encouraging students to use various presentation strategies.

Pro-Con Debate

In an effort to expose students to current controversies in healthcare and to foster an environment wherein they would learn to develop evidence-based opinions and defend them in a professional manner, the semester ended with pro-con debates. Five controversial topics involving medication use in pregnancy/lactation or pediatrics were assigned to student groups. Each group was assigned 1 topic and required to determine which members would debate the pro or con stance. A rubric was used to evaluate the pro-con debates.

EVALUATION AND ASSESSMENT

Student success in achieving the development and design goals of the 2 courses were assessed throughout the semester. Each goal was evaluated using both direct and indirect methods (Table 2). All statistical analyses

Table 2. Evidence of the Active-Learning Strategies' Contribution to Student Learning in a Pregnancy & Lactation Course and a Pediatric Pharmacotherapy Course

Learning Goal	Motivation	Evidence
Goal 1: Improve pregnancy, lactation, and pediatric pharmacotherapy knowledge	Current deficit of pediatric and pregnancy/lactation education in the pharmacy curriculum	Patient case presentations/grab-bag assignment/pro-con debate Pre- and post-test of knowledge
Goal 2: Develop the skills necessary for a lifetime of self-directed learning	Need for a learner-centered curriculum Need to expose students to team-based learning	Observation of drug literature retrieval and analysis skills Resource postings to Wiki Confidence/satisfaction surveys

were conducted using SPSS, version 18 (Chicago, IL). Results of the confidence survey tool, satisfaction survey tool, and knowledge examination are continuous data and reported as mean and standard deviation. A paired sample *t* test was used for comparison of continuous data and a significance level was set at $p < 0.05$.

The course development goal was to increase knowledge related to medication use in pregnant and pediatric patient populations. Patient case presentations were the primary assessment mechanism for both courses. Student groups delivered 7 case presentations for each course for a total of 14 presentations during the semester. Students were graded on accuracy and depth of information presented, accuracy and completeness of care plans, presentation skills, and ability in conducting a question/answer session. Grades gradually improved throughout the semester and the number of critical comments given by the evaluators decreased. There was an observed improvement in quality of presentations as well as presentation skills. Because multiple groups prepared the same case, each classmate contributed significantly to each group presentation, encouraging peer mentoring.

Unlike the patient case presentations, which were completed and assessed as a group, pharmacist grab-bag assignments were completed and assessed individually. Comparing these presentations to the group presentations gave faculty members valuable insight on the ability levels of each individual student as well as their ability to work effectively within a group environment.

Ungraded, diagnostic pre- and post-knowledge tests were administered for each course. Each course coordinator prepared a test consisting of 4 individual cases with 5 follow-up questions each, for a total of 20 questions. The cases and associated questions were based on the knowledge the instructors hoped the students would develop over the course of the semester. To ensure that the examination scores would not bias faculty members in what material was emphasized throughout the semester, a post-graduate pharmacy fellow administered the pretest. The fellow did not provide the pretest scores to the instructors until the posttest had been administered at the end of the course. The mean difference between the precourse pregnancy and lactation knowledge test (8.6 ± 1.6) and the postcourse pregnancy and lactation knowledge test (15.5 ± 2.1) was 6.9 ± 1.9 ($p < 0.001$). The mean difference between the precourse pediatrics knowledge test (19.0 ± 3.6) and the postcourse pediatrics knowledge test (23.7 ± 3.7) was 4.7 ± 3.5 ($p < 0.001$).

To evaluate student perceptions of the learner-centered teaching model, pre- and post-confidence and satisfaction survey tools were administered at the beginning and end of the semester. The precourse survey tools were to be

answered based on previous courses, in aggregate, taken throughout the pharmacy curriculum. The postcourse survey tools were to be answered based on the course content of Medication Use in Pregnancy & Lactation and Pediatric Pharmacotherapy: A Focus on Ambulatory Care, in addition to the previous curriculum. The confidence survey tool was developed by adapting questions from existing instruments to assess student self-reported confidence related to researching, identifying, and interpreting appropriate literature, as well as therapeutic decision-making.^{6,7} The satisfaction survey tool was developed by adapting questions from existing instruments to assess student-reported satisfaction with the combination of student-directed learning techniques and tools used in both courses.^{8,9} The confidence and satisfaction survey tools are 18 and 28 item, 5-point Likert scales ranging from 1 = strongly disagree to 5 = strongly agree.

When students were asked about confidence in designing a drug regimen, the mean difference between the results of the precourse confidence survey tool (3.0 ± 0.8) and those of the postcourse confidence survey (4.1 ± 0.5) was 1.2 ± 0.9 ($p < 0.001$). When students were asked about confidence in defining therapeutic goals for these patient populations, the mean difference between the results of the precourse confidence survey (3.6 ± 0.7) and those of the postcourse confidence survey (4.3 ± 0.6) was 0.7 ± 1.0 ($p = 0.001$). When students were asked whether the course enhanced their ability to learn the material presented during class sessions, the mean difference between the results of the precourse satisfaction survey tool (3.7 ± 0.6) and those of the postcourse satisfaction survey (4.2 ± 0.6) was 0.5 ± 1.0 ($p < 0.001$). Table 3 contains additional pre- and post-course survey tool results assessing students' confidence and satisfaction relating to medication knowledge within these special populations.

The goal of course design was to develop the skills necessary for a career dependent on lifelong learning. Because these learning skills are challenging to evaluate, the current study focused on longitudinal evaluation of drug information skills. Therefore, throughout the semester, the instructors observed the quality of students' drug literature retrieval and analysis skills. At course commencement, faculty members observed that students either did not know where to begin or used the first article that met their search criteria. Throughout the semester, a vast improvement was noted not only in the students' ability to find and assess appropriate literature references but also in their confidence to complete the task. As this occurred, the instructors were able to spend much less time guiding drug literature retrieval and more time on analysis. The instructors observed that the students became more independent, self-directed learners, requiring

Table 3. Pharmacy Students' Responses on Confidence and Satisfaction Surveys Regarding Courses in Pregnancy/Lactation and Pediatrics

Survey Tool Item	Precourse, Mean (SD)	Postcourse, Mean (SD)	P
Confidence Survey			
Precourse: Based on previous courses taken in the school of pharmacy, how confident are you in your ability to . . .			
Postcourse: Based on the courses just taken, how confident are you in your ability to . . .			
Find up-to-date information regarding drug therapies and recommendations	3.8 (0.8)	4.3 (0.8)	0.032
Recommend appropriate monitoring parameters	3.0 (0.9)	4.1 (0.6)	<0.001
Identify medication related adverse effects	3.6 (0.6)	4.0 (0.6)	0.032
Satisfaction Survey			
Precourse: The courses I have taken so far in the school of pharmacy. . .			
Postcourse: The courses I have just taken. . .			
Provided an environment that enabled me to learn from my peers as well as my instructor	2.4 (0.9)	4.5 (0.6)	<0.001
Used group collaboration in a way that increases knowledge to a greater extent than learning individually	2.5 (1.0)	4.2 (1.2)	<0.001
Prepared me to be a good pharmacist	3.1 (0.9)	4.6 (0.5)	<0.001
Gave me adequate feedback to guide my learning throughout the course	2.5 (0.9)	4.0 (0.8)	<0.001
Provided me with flexibility to gain additional information to enhance understanding of content	3.0 (0.9)	4.5 (0.7)	<0.001
Used technologies that enhance my learning	2.9 (0.9)	4.4 (0.7)	<0.001

Paired *t*-test, $p \leq 0.05$.

less assistance to perform higher quality work as the semester progressed.

Wiki postings were also a way to qualitatively evaluate each group's ability to identify appropriate literature resources. Each week, the students were responsible for posting 3 key references on each of their respective wiki topic pages. This served as the basis for the electronic textbook that was created at the end of the semester. Once a week, groups were responsible for presenting and defending the resources they chose. This allowed for impactful class discussion as the students and faculty members evaluated the postings. Students' ability to perform critical analysis and retrieve resources was enhanced from the beginning to the end of the semester.

When students were asked about confidence in using drug information resources to answer drug-related questions at an audience-appropriate level, the mean difference between the results of the precourse confidence survey tool (3.5 ± 0.8) and those of the postcourse confidence survey tool (4.3 ± 0.7) was 0.8 ± 1.0 ($p < 0.001$). When students were specifically asked whether the course taught them to be a lifelong learner, the mean difference between the results of the precourse satisfaction survey tool (2.8 ± 1.2) and those of the postcourse satisfaction survey tool (4.5 ± 0.6) was 1.7 ± 1.4 ($p < 0.001$). When students were asked whether the course allowed them to

focus on learning and retaining information rather than simply getting a good grade on an examination or assignment, the mean difference between the results of the precourse satisfaction survey tool (2.1 ± 0.8) and the postcourse satisfaction survey tool (4.4 ± 0.9) was 2.3 ± 1.4 ($p < 0.001$). Most importantly, when students were asked about confidence in practicing as an independent pharmacist, the mean difference between the results of the precourse confidence survey tool (2.9 ± 1.0) and those of the postcourse confidence survey tool (3.8 ± 0.6) was 0.9 ± 1.1 ($p < 0.001$). Table 3 contains additional pre- and post-course survey tool results assessing students' confidence and satisfaction relating to lifelong learning.

DISCUSSION

The goal of the course development was to increase knowledge related to medication use in pregnant and pediatric patient populations, and the goal of the course design was to develop the skills necessary for a career dependent on lifelong learning. After course completion, faculty members evaluated course design, goals, and outcomes and identified opportunities for improvement.

The 2 courses described in this paper account for the majority of the lecture credit hours comprising the

pediatric concentration. Because of the highly interactive nature and resource intensity of these courses, along with limited pediatric experiential site availability, the concentration was limited to 25 students. This small class size allowed for effective classroom discussion. Students were asked to transition from the familiar passive learning environment into 1 that required active, self-directed learning. This transition required substantial mentoring from faculty members. Maintaining an intimate classroom environment was extremely helpful in the provision of continuous feedback. Faculty members also observed a progressive decrease in apprehension about public speaking throughout the semester. This was realized through an observable improvement in presentation skills along with an increase in quality classroom discussions. We believe small class size was an integral component in the effectiveness of the course design. A possible limitation of this study, however, is the relatively small sample size. We plan to continue assessing our development and design goals in successive classes. Several other course coordinators have since adopted similar course designs. Data will be collected and analyzed in these courses and compared with our initial findings to assess for differences across the curriculum.

Limiting class size to 25 students also ensured that we had 5 groups within each course, each comprised of 5 students. This small group size was manageable for students and faculty members alike. Five groups allowed for multiple cases per week and the inclusion of various topics within each case. On average, 4 topics of varying complexity were introduced within each case, allowing for adequate discussion of each topic. The majority of course work was completed in a group environment. Because of this, we allowed students to choose their group members at the beginning of the semester. This seemed to decrease accountability and collaboration-related issues. One limitation of group work was the inability of the instructor to accurately assess each student's contribution to the group. To account for this, we plan to add peer assessments as part of each student's grade in the future.

Using a Web-based wiki to organize both courses resulted in a current, organized, and easily accessible electronic resource created by the students for the students. Access to the wiki was limited to students enrolled in the course. Each student had an individual username and password. All topics listed in Table 1 had a dedicated page on the wiki, which included presentations, journal articles, reference summaries, and handouts. The wiki was a product of over 45 in-class hours devoted to drug literature retrieval and analysis, resulting in over 300 files being uploaded onto the wiki throughout the semester. In

addition to serving as a central repository of information, the wiki allowed files to be readily retrievable and served as a convenient and efficient way to facilitate student presentations in a classroom setting. It also allowed for student collaboration outside of the classroom setting. Student groups were able to update and revise presentations from remote locations and communicate instantly through comment postings. Instructors monitored and updated the wiki throughout the semester to ensure accuracy and relevance of posted material. A new wiki site is created each year with each successive class. Therefore, wiki sites are not updated or monitored by course faculty members after course completion. Students are reminded that they are ultimately responsible for ensuring that any information accessed on their class's wiki post-course is timely and accurate. Judging by students' continued use of the wiki, it was a highly regarded resource. Over 75% of students continued to use the wiki after the conclusion of the course, with 40% continuing to access it 6 months after course completion.

The pharmacist grab-bag assignment was an innovative exercise developed by course faculty members. Allowing students to create the question bank provided them with a vested interest in the material that would be covered. The submission of similar questions allowed faculty members to incorporate additional questions to assure adequate coverage of all topics of student interest. The presentation of the pharmacist grab-bag assignments served as a nice interlude between case presentations. Student feedback regarding this exercise provided in the open-ended section of the instructor evaluations was positive.

The pro-con debate was a capstone project designed to introduce students to current controversies in the medical field and to mentor them in developing and professionally defending a position. Given that their assigned position may not have been the same as their personal position, this exercise required them to research and analyze opposing viewpoints. The final debates exceeded expectations in terms of preparation, energy, and creativity invested by the students. Previous experiences had shown that the amount of time students invested into assignments often correlated with the percentage of points allotted to the assignment with respect to the overall course. In the current study, however, students spent an impressive amount of time and energy preparing despite the debates accounting for only 20% of their total course grade. Confidence survey tool results showed that students also found this assignment beneficial. They felt more confident in gaining knowledge on multiple viewpoints of current issues in order to make and support personal decisions after participating in the pro-con debates. (Table 3)

Course evaluations and the pre- and post-knowledge tests revealed that the course design described in this paper was effective in increasing knowledge related to medication use in the pregnant and pediatric populations within this cohort. Although the weekly presentations and wiki postings were graded course evaluations, there was a significant improvement in pre- and post-test knowledge scores despite these tests not being part of the students' grades. We believe that these scores are a more accurate reflection of true knowledge gained over the entire semester, as they cannot be attributed to memorization or cramming.

The results of the pre- and post-confidence survey tool revealed significant improvements in 8 of the 9 domains related to patient care after completion of both courses, while the results of the pre- and post-satisfaction survey tool revealed significant improvements in 7 of the 9 domains. In addition to the current assessment methods being used to evaluate knowledge gain, we plan to initiate the use of an objective structured clinical examination as a final evaluation of pediatric/pregnancy clinical competence. We felt that the most accurate way to assess lifelong learning skills was through drug literature retrieval and evaluation. Therefore, a significant amount of class time was devoted to this exercise, and an improvement in these skills was observed throughout the semester. There was an increase in student confidence in performing skills related to lifelong learning, along with satisfaction with the way both courses were designed to achieve this goal. Upon completion of both courses, there was a significant increase in the results of 6 confidence and 8 satisfaction survey tool items relating to lifelong learning skills. Most students perceived these learner-centered courses as more beneficial than their previous faculty-centered courses. This was an interesting finding, given that over half of the class, all of whom were in their last semester of didactic classes, stated that they spent more time preparing for these 2 courses than they had most other courses within the pharmacy curriculum. Along with the students, we feel confident that we met our first goal of developing the skills necessary for a career dependent on lifelong learning.

CONCLUSION

Two problem-based courses on pregnancy, lactation, and pediatrics used a student-centered, problem-based learning model and improved knowledge and confidence.

Students were satisfied with the course design. While this pedagogical style required a significant investment of time from students and faculty members, the process was successful. The enhancement of these 2 learning courses through a preceding lecture-based course and a culminating patient-care experience created a comprehensive concentration using various pedagogical methodologies. Assessment strategies revealed that the combination of teaching methods used in these 2 pregnancy/pediatric-concentration courses is an effective teaching model that can be easily adapted to other therapeutic areas.

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