TEACHERS' TOPICS

A Model for Small-Group Problem-Based Learning in a Large Class Facilitated by One Instructor

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Objective. To implement and evaluate a model for small-group problem-based learning (PBL) in a large class facilitated by 1 instructor.

Design. A PBL model that included weekly assignments, quizzes, peer feedback, and case wrap-up sessions was developed and implemented in the final year of the pharmacy program to allow 1 instructor to facilitate PBL for up to 16 student teams in a large classroom.

Assessment. Student and team scores on multiple-choice examinations confirmed achievement of learning objectives. Students reported on course evaluation surveys that they were able to engage in the learning process and were satisfied with the new PBL model. This model achieved a cost savings of \$42,000 per term.

Conclusions. A revised PBL model without individual group tutors allowed students to achieve the required learning outcomes in an interactive and engaging atmosphere, avoided classroom-scheduling conflicts, and produced a large cost savings for the university.

Keywords: problem-based learning, tutor, group facilitators, case-based learning, class size

INTRODUCTION

The faculty of Pharmaceutical Sciences at The University of British Columbia (UBC) offers a 1 + 4-year bachelor's degree program in pharmacy, with a class size of 155 students per year that increased to 224 students in September 2011. To achieve the entry to practice outcomes defined by the Association of the Faculties of Pharmacy of Canada (AFPC) and align with the Blueprint for Pharmacy, a series of problem-based learning (PBL) courses were incorporated into the pharmacy program.^{1,2} These Cases in Pharmaceutical Sciences courses are offered in each of the 4 years of the program. The courses integrate content across the curriculum, build students' working knowledge of topics covered in lectures, and provide an opportunity for students to work in teams on real-life pharmacy cases. The students identify and resolve drug-therapy problems while practicing the AFPC outcomes of care provider, communicator, collaborator, scholar, and professional.¹

The use of PBL in pharmacy has continually expanded since introduced as a process to help students acquire and apply knowledge while developing problem-solving,

critical-thinking, and decision-making skills.³ It is important to focus on process to help students gain the outcomes expected via PBL.⁴

While pharmaceuticals, pharmacology, medicinal chemistry, and basic sciences courses have been modified to incorporate PBL elements, the Cases in Pharmaceutical Sciences courses are part of a comprehensive curriculum focused on developing a working knowledge for specific disease states through PBL principles, similar to the model outlined by Fisher.^{3,5-7} Recognizing that PBL may not be suited to teach all types of courses, the purpose of the Cases in Pharmaceutical Sciences courses is not to replace lectures, but to work in parallel with the established classroom curriculum.^{7,8} The parallel system of the Cases in Pharmaceutical Sciences courses and lecture-based courses was key to implementing a PBL model that did not require group facilitators.

In the traditional PBL process, the instructor prepares cases for discussion by several small groups, each of which is monitored by a specially trained tutor or facilitator. Each case is designed to stimulate discussion and study of specific learning objectives, from which students generate learning issues for self-directed learning.⁹ In our faculty of pharmaceutical sciences, the increase in class size to 224 students increased the number of small groups required from 24 to 35. Thus, 35 facilitators would need to be hired, trained, and paid to run traditional PBL sessions. This would be costly, time-consuming, and require access

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to a large number of suitable PBL rooms. The costs and space requirements became a barrier to providing effective PBL courses throughout the curriculum.

To address these concerns, the fourth-year Cases in Pharmaceutical Sciences course was designed and implemented to function without individual small-group facilitators. As such, instead of having a dedicated facilitator for each group, the instructor acted as the overall facilitator, providing guidance for all teams simultaneously. This paper describes the implementation and evaluation of this model for conducting PBL with a large class. We also describe the advantages to providing this type of learning environment as well as barriers and ways to overcome them.

DESIGN

The overall goal of the Cases in Pharmaceutical Sciences IV course is to provide fourth-year pharmacy students with the opportunity to integrate and apply relevant information and knowledge acquired in other courses to solving patient-specific problems. Student learning occurs in 3-hour classes called tutorial sessions and during self-directed, independent research into learning issues, outside scheduled class times. Students are expected to use the pharmaceutical care practice model to integrate and apply knowledge learned in other courses to the tutorials, and to actively participate in all discussions.

The learning objectives for Cases in Pharmaceutical Sciences IV are listed below. Some of these objectives were derived from the ability-based outcomes of the Faculty of Pharmaceutical Sciences.

- (1) Demonstrate critical thinking and problem solving when presented with a patient-specific case.
- (2) Demonstrate the ability to acquire, evaluate, organize, and disseminate relevant information to various audiences (peers, patients, and other health-care providers).
- (3) Demonstrate effective communication using a variety of methods to achieve optimal patient care and to promote health.
- (4) Demonstrate the ability to work with others (ie, continue to develop interpersonal and teamwork skills).
- (5) Further develop personal learning strategies through self-directed learning when researching patient cases.
- (6) Incorporate the philosophy and process of pharmaceutical care when researching patient cases.
- (7) Develop skills to integrate relevant knowledge acquired in other courses with patient information, provided through patient cases, to effectively

identify and resolve potential and actual drug-related problems.

- (8) Demonstrate the ability to apply evidence-based medicine to clinical decision-making.

The 3-credit hour Cases in Pharmaceutical Sciences IV consisted of two 3-hour tutorial sessions and a 1-hour lecture session each week taught by a single instructor. For this study, the class of approximately 100 students was divided into 16 teams of 5 to 6 students each. The class met in a large, 240-seat lecture hall where students separated into teams. To ensure an equal distribution of learner types, we created teams with an equal distribution of students who had earned relatively high and low grades the previous year. We minimized the formation of *sub-groups*¹⁰ by ensuring that teams did not contain 2 or more students who were socially connected, eg, a dating couple, fraternity members. To foster cohesiveness, the teams were permanent for the duration of the course.

To further encourage cohesiveness, each team composed a list of “ground rules,” which were part of a team contract that all members agreed to adhere to for the duration of the term. In this contract, teams documented rules of conduct and rules regarding timelines for completion of shared work. Team members also tracked their grades on weekly assignments and quizzes, and their impressions of the team’s overall efficiency, which was assessed by members’ verbal and written feedback at the end of each class and each weekly case. This information formed the team progress document, which was maintained by each team in a dedicated folder. Teams were also encouraged to decide if they wanted to assign specific jobs to each team member, such as mediator or transcriber, and whether the jobs should be rotated each week. The instructor provided guidance about team facilitation and provided a copy of the “Questioning Guide for Facilitators” (Appendix 1), a document created to encourage accountability, participation, and critical thinking, and to keep the discussion focused and productive (Price I. Lecture notes; 2010).

In the first weekly tutorial session, teams worked through a patient case that included multiple disease states and drug-therapy problems. Each weekly case was constructed to help students achieve the course objectives and to develop a working knowledge of the topic through active learning (Appendix 2).

Information about each case was provided as a patient profile handout and through a patient interview session. The patient interview session was structured to allow the entire class to ask patient-specific questions, with the instructor playing the role of the patient. Each team then identified areas requiring additional research and generated learning issues on those topics. The instructor reviewed all

learning issues to ensure that the students had not missed any key issues in the case. At the end of the first session, team members provided each other with verbal feedback on team function during the tutorial.

Students researched their learning issues outside regular class time and generated a summary that they presented to their team in the second weekly tutorial session. Each team then discussed the information presented and identified patient-specific problems relating to the case. The teams then completed an assignment based on the patient case and handed it in before the end of the tutorial session. To keep the exercise from becoming frustrating to accomplish as a team, the assignments were kept simple and realistic, and involved minimal writing. Examples of team assignments included: providing patient recommendations relevant to the case and writing recommendations in a SOAP (subjective, objective, assessment and plan) note, prescription, chart order, or letter to a primary care provider, etc.

Throughout both tutorial sessions, the instructor was present in the classroom to provide guidance to each of the 16 groups and answer questions. When several groups had related questions or problems, the instructor initiated a class discussion for clarification. By linking the classroom projector screen to an online tool, such as Poll Everywhere or Twitter, students could text questions to the instructor. In response, the instructor could project the answer for the whole class to see, or initiate and facilitate a class discussion.

The instructor distributed the case-learning objectives to the teams to review at the end of the second tutorial session, and then led a class discussion to answer any questions. This helped teams to identify any important aspects of the case that they had missed and therefore to be better prepared for the weekly case quiz.

A weekly lecture session was held after the 2 weekly tutorial sessions in which the instructor administered student and group quizzes, returned graded assignments to students, and answered any outstanding questions about the case or the associated content.

EVALUATION AND ASSESSMENT

Ongoing, or formative, assessment is a key component for facilitating student learning.¹¹ Formative assessment provides the best learning support because it allows the student frequent opportunities to perform and receive suggestions for improvement. Keeping this pedagogical theory in mind, Cases in Pharmaceutical Sciences IV was designed to provide weekly feedback on individual and team success.

A multiple-choice case-content quiz was administered to students during the weekly lecture session to test knowledge related to the learning objectives of that

week's case. The quiz was first completed as an individual quiz using a Scantron card, and then the team completed the same quiz using a "scratch and win" card or an Immediate Feedback Assessment Technique (IF-AT) card. The benefit of using IF-AT cards was that teams were provided with immediate feedback regarding the accuracy of their answers.¹² Teams could submit an appeal for any question and/or answer they deemed unclear or incorrect. Graded assignments were returned to teams before the end of the lecture session. The instructor graded all assignments using a grading rubric.

In addition to weekly quizzes, midpoint and final peer evaluations were conducted based on the criteria of preparation, contribution, respect for others' ideas, and flexibility. Students assessed these 4 equally weighted areas by distributing a total of 200 points among team members, based on their contribution to the team (Table 1). The students also provided written feedback to justify the points distributed to their team members. To ensure that an objective grade was assigned, the online peer evaluation process was completed anonymously. The peer evaluation grade, as a percentage, was multiplied by each student's team score. This way, the team score more accurately reflected each team member's contribution to the team.

At the end of each weekly case, teams completed a case evaluation form to assess the case content and flow, and to report mistakes, difficulties, and any areas of confusion or outstanding questions. This provided information to further improve the cases as well as input on the perceived difficulty and effectiveness of the cases. Comments from weekly case evaluations demonstrated that the students were generally happy with the cases and their difficulty.

Table 1. Cases in Pharmaceutical Sciences IV Team and Individual Grading

Score Component	Grade, %	Portion of Total Grade, %
Team scores		30
Team assignments	10	
Team quizzes	20	
Peer evaluations	Calculated based on total ^a	
Individual scores		70
Individual quizzes	70	

^a To calculate the final team score for each student, the peer assessment scores (0-100%) received from each student in the group were averaged, and then that score was multiplied by the combined scores for quizzes and assignments, eg, 90% [peer evaluation score] × 25% [8 of 10 on team assignment and 15 of 20 on quizzes] = final team score of 22.5% of the possible 30%.

Course evaluations for 7 classes have been completed over the last 5 years, from 2006-2010, with class participation rate ranging from 40% to 95%. Of 412 students surveyed, 239 responded. Ninety-two percent of the students agreed or were satisfied that the facilitator-less format was beneficial to their learning. Also, 92% were satisfied that the format helped them develop their own facilitation skills. Responses on the course evaluations also demonstrated that 92% of students were satisfied that the instructional methods (lectures, case studies, tutorial sessions, group projects, presentations, laboratory activities, etc) facilitated the achievement of the learning objectives.

Students responded to the following statement, "Considering everything, I learned a great deal in this course," consistently higher on student evaluations for the revised Cases in Pharmaceutical Sciences IV course than in the other Cases in Pharmaceutical Sciences courses that used small-group facilitators. Confounding factors such as differences in students' ages and experiences and differences in course content makes it difficult to compare course evaluations from different years. However, in 5 years of collecting course evaluation data, there have been no negative comments reported regarding teams not having facilitators. Students expressed only positive sentiments about this portion of the course. They commented that this model encouraged them to think more deeply about unresolved patient issues, rather than waiting for someone else to prompt them. Students also appreciated the opportunity to improve their facilitation and teamwork skills as well as the increased autonomy and responsibility for their own learning.

DISCUSSION

The purpose of the Cases in Pharmaceutical Sciences courses is to address the need to provide PBL in the form of complex, real-life, patient-centered paper cases in each year of the BSc pharmacy degree program. PBL is an important part of the curriculum that integrates content and prepares students to provide patient-centered care, as outlined in the Blueprint for Pharmacy, and addressed by the AFPC Educational Outcomes.^{1,2} In the past, many scheduling conflicts resulted from the sharing of small PBL rooms among the 4 Cases in Pharmaceutical Sciences courses. The model presented here, conducted in a large classroom, simplifies scheduling and allows classes to be held more often (twice weekly vs. every 2 weeks), as there is no competition for space, allowing for a larger amount of cases to be covered in one term. As a comparison, the traditional-format PBL courses cover only 2 cases per term, while the revised course covers 10 cases per term.

Another advantage of this model is that the instructor does not need to train facilitators on the case content or in facilitation methods, which is costly in terms of instructor time and energy. Additionally, facilitators must be paid for the time they spend training. In this model, the instructor has greater control over the case content, especially during role-playing, where facilitators could inadvertently introduce variation into the case by improvising certain parts to answer student questions. Having a single instructor also ensures that all teams identify the same set of learning issues for the case before each session ends. Furthermore, the instructor can address any misunderstanding of content by initiating a discussion involving the whole class. This kind of "teachable moment" is not possible when the instructor has facilitators working with teams in separate PBL rooms.

The model also results in significant cost savings because paid facilitators are not required. For our school, the cost savings was approximately \$42,000 per term (\$120 per session x 2 sessions per week x 16 teams x 11 weeks = \$42,240), and would have increased by 47% after the larger class size was introduced in the fall of 2011.

While the literature is supportive of using PBL methods to achieve active learning, reliance on a format that does not require individual small group facilitators may not be appropriate when certain components are absent from the curriculum.^{8,9} The main barrier to implementation of some of the different PBL models developed is that the traditional role of facilitator must be taken on by the students.^{7,9,13,14} As concluded by Duek and colleagues, the key to replacing the role of the facilitator is for students to complete basic content-specific courses (eg, pathology, physiology, pharmacology) to gain the necessary knowledge and facilitation skills prior to beginning the PBL process.⁹ In Cases in Pharmaceutical Sciences courses, students acquire prior knowledge by attending lectures and practicing facilitation skills (motivational interviewing, peer evaluation, and feedback) in the pharmacy laboratory, in parallel with the PBL course. This method is a modification of the traditional PBL method in which students start on a case with no prior knowledge of that specific area.¹³ To implement our PBL class model successfully, it is essential for students to have prior knowledge of the specific area addressed by the case study.

A significant barrier to providing a PBL class model has been the scheduling of an appropriate classroom (large, with separate tables and chairs) for two 3-hour time blocks per week. In the meantime, we have tried using a large classroom with a traditional lecture-theatre setup. Although large lecture halls are not ideal for team-based

activities because chairs are fixed and face in one direction, limiting team size to 5 enabled students to situate themselves in a way that was conducive to group discussion.

Another barrier associated with large class sizes is the fear of the instructor losing control of the classroom.⁸ Although a 100-student PBL class seemed chaotic at first, the class became manageable after the students were divided into groups and were engaged in the process. It was also helpful to use a larger classroom than needed to allow the students to spread out. This provided the instructor easy access to each group and kept the noise from as many as 16 teams discussing cases at the same time under control. We also observed that the students quickly become cognizant of the noise level and made a conscious effort to speak more quietly to avoid disturbing other teams.

Attention to a structured process that helps guide students is important for developing a PBL course that functions well without group facilitators.⁴ To address these concerns, we designed the cases so that information was provided in a logical sequence, with the instructor available to immediately address any questions or concerns. We also attempted to create balanced teams and a framework for the teams to use in solving the cases. Weekly assignments, quizzes, peer feedback, and case wrap-up sessions provided formative assessment. This ongoing and immediate feedback provided many opportunities for monitoring and adjusting the development of the teams. Team assignments have been a particularly valuable tool in this problem-based learning model because they forced teams to keep their research discussions patient-centered as they had to resolve the problems identified and provide recommendations for the patient.

SUMMARY

In a teaching environment in which classes are large, resources are limited, and classroom scheduling is a challenge, a PBL model that allowed groups to work without a facilitator provided students with the required learning outcomes in an interactive and engaging atmosphere. The key to implementing a PBL model that did not require group facilitators was ensuring that students learned the basic knowledge and facilitation skills needed for the PBL process prior to beginning the fourth-year PBL course. Overall, this model of PBL helps to prepare students for

their role as patient-care providers and self-directed, life-long learners.

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REFERENCES

1. Association of Faculties of Pharmacy of Canada (AFPC) Educational Outcomes. http://afpc.info/downloads/1/AFPC_Education_Outcomes_AGM_June_2010.pdf. Accessed June 9, 2012.
2. Blueprint for Pharmacy: The vision for pharmacy; June 2008 <http://blueprintforpharmacy.ca/docs/pdfs/2011/05/11/BlueprintVision.pdf?Status=Master>. Accessed July 22, 2012.
3. Culbertson VL, Kale M, Jarvi EJ. Problem-based learning: a tutorial model incorporating pharmaceutical diagnosis. *Am J Pharm Educ*. 1997;61(1):18-25.
4. Duncan-Hewitt WC. A focus on process improves problem-based learning outcomes in large classes. *Am J Pharm Educ*. 1996;60(4):408-416.
5. Sims PJ. Utilizing the peer group method with case studies to teach pharmaceuticals. *Am J Pharm Educ*. 1994;58(1):78-81.
6. Herrier RN, Jackson TR, Consroe PF. The use of student-centered, problem-based, clinical case discussions to enhance learning in pharmacology and medicinal chemistry. *Am J Pharm Educ*. 1997;61(4):441-446.
7. Fisher RC. The potential for problem-based learning in pharmacy education: a clinical therapeutics course in diabetes. *Am J Pharm Educ*. 1994;58(2):183-189.
8. Reddy IK. Implementation of a pharmaceuticals course in a large class through active learning using quick-thinks and case-based learning. *Am J Pharm Educ*. 2000;64(4):348-354.
9. Duek JE, Wilkerson L, Adinolfi T. Learning issues identified by students in tutorless problem-based tutorials. *Adv Health Sci Educ*. 1996;1(1):29-40.
10. Michaelsen LK, Knight AB, Fink LD. *Team-Based Learning: A Transformative Use of Small Groups*. Praeger Publishers; 2002.
11. Gibbs G, Simpson C. Conditions under which assessment supports students' learning. *Learn Teach Higher Educ*. 2004;(1):3.
12. Epstein Educational Enterprises. IF-AT - Immediate Feedback Assessment Technique (IF-AT). <http://www.epsteineducation.com/home/about/default.aspx>. Accessed June 9, 2012.
13. Woods DR, Duncan-Hewitt WC, Hall FL, Eyles CH, Hrymak AN. Tutored versus tutorless groups in problem-based learning. *Am J Pharm Educ*. 1996;60(3):231-238.
14. Duch BJ, Groh SE, Allen DE. *The Power of Problem-Based Learning: A Practical "How To" for Teaching Undergraduate Courses in Any Discipline*. Stylus Publishing, LLC. 2001.

Appendix 1. Questioning Guide for Facilitators

Check for accountability:

- How do you know that?
- Can you explain that in more detail?
- Where did you find that information?

Increase participation/discussion:

- John, what do you think about. . . ?
- Does anyone have any questions about. . . ?
- Is there anything else we need to consider?
- How does this link to. . . ?

Keep the discussion focused/on track:

- How does this relate to the case?
- How can this help us solve the problem?
- Why is this information relevant?

Encourage critical thinking/problem solving:

- How does this compare to. . . ?
- How can you resolve this problem?
- What are the key elements to the problem?
- What must you keep in mind when defining the solution?

Appendix 2. Example Case

An elderly female patient is admitted to the acute care department of a hospital from long-term care. The patient is diagnosed with an acute pyelonephritis and has underlying Alzheimer's disease, osteoarthritis, and hypertension. The physician requires advice on how to empirically treat this patient. Students must come up with an empiric treatment recommendation followed by more specific recommendations once they have received further information from the patient's chart, cultures and sensitivities, and discussion with the patient's daughter regarding her medication experience and specific drug information questions. Students will find out that the patient is allergic to the standard empiric treatment, as further development of the case results in drug-induced rash. They will also discover from the history and chart that the patient has acute, drug-induced renal failure and that her Alzheimer's, hypertension, and osteoarthritis treatments need reevaluation. Students learn to use a hospital formulary and hospital prescribing rules and tools to come up with patient-specific recommendations. Following discussion of their individual research, students complete an assignment, which is to write a verbal order in an official hospital physicians' order form. They must also provide an evidence-based rationale for all orders.