Innovations in Teaching

Innovative Enabling Strategies in Self-Directed, Problem-Based Therapeutics: Enhancing Student Preparedness for Pharmaceutical Care Practice[1]

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The objectives of this innovation were to enhance student learning in therapeutics taught in a large-group, problem-based format in third and fourth professional years of the program and to increase student preparedness in providing pharmaceutical care. Feedback from students and instructors helped identify some limitations to learning and included limitation of breadth of knowledge learned, increasing students' awareness of the patient's perspective of illness, and students' ability to verbally justify recommendations. Alignment of the courses in relation to students' expected competency were also considered. Strategies to address limitations included development of criterion-based assessments, oral examinations, use of real patients, and development of a web infrastructure. The innovation resulted in an enhancement of student learning in a self-directed problem-based environment and a better understanding of the patient's perspective of illness. It can be concluded that preparedness for pharmaceutical care practice by the student increased motivation to pursue self-directed, life-long learning.

INTRODUCTION

In 1994, the Faculty of Pharmacy at the University of Toronto changed its existing four-year curriculum to a new 1+4-year undergraduate pharmacy program, leading to a baccaulaurate in pharmacy. The emphasis in the new curriculum was on the students' ability to provide pharmaceutical care upon graduation(1). Therapeutics, taught in a problem-based format and offered in the fourth year of the old program(2) was expanded significantly to two courses, to be taught in the third and fourth year of the new program(1). In addition to the lecture compo-

nent in the courses, five small group seminars on key disease states were incorporated into the two therapeutics courses, Pharmaceutical Care II and III(1). The new Therapeutics courses were initiated in 1996-97 (Pharmaceutical Care II - offered in third year) and 1997-98 (Pharmaceutical Care III - offered in fourth year). During the last semester of fourth year, students undergo 16 weeks of structured practical experience in community and institutional practice sites. Hence, therapeutics plays a significant role in building students' knowledge and skills in preparation for practice.

Underlying Principles of Teaching and Learning in Therapeutics

Therapeutics is taught in a large-group format of 120 students, using self-directed, problem-based learning. Underlying the courses are also the principles of Pharmaceutical Care(3). Students in the class are divided into groups of eight to facilitate group work. Paper patient cases, along with required readings from course textbook and/or journal articles, are provided in advance. Students, working within their groups, are expected to carry out an assessment of the patient utilizing the pharmaceutical care process(2) and identify and resolve any drug-related problems, in preparation for class discussion. An expert instructor facilitates the discussion during class time. Each case discussion takes 1.5 hours. The classes are all taught by practicing pharmacists.

Development of Knowledge and Skills within the Curriculum

Students are evaluated using criterion-based assessment in most of the pharmacy practice courses. In ensuring that students meet the required level of knowledge and skills upon graduation, a well-defined admissions process is used to ensure that students entering the program can perform at the interface of the Uni- and Multistructural level(4) (see Appendix A) of competence in communication skills as a condition of entry. During the first year of the program, a communications course emphasizes listening, verbal and written communication skills at the Unistructural-Multistructural level. Students are also guided through self-assessment skills starting in the first year. The curriculum is aligned with respect to communication skills and students' development of knowledge and skills are built on each other over the four years.

The overall goal of the therapeutics courses is to enable students to optimize their knowledge and skills required to provide pharmaceutical care. During the two-year therapeutics courses, students are gradually exposed to therapeutic problems that range from being well-defined and routine (see Appendix B), to ill-defined and non-routine problems, thus ensuring that their knowledge and skills are developed to a multistructural (Appendix A) level in the third year and bridging between a Multistructural and Relational level in the fourth year, in preparation for their practical experience. Upon graduation, students should be at a Relational level of learning. The alignment of skills throughout the curriculum ensures that students entering Pharmaceutical Care II in third year can be expected to function at a beginning Multistructural level of knowledge acquisition and skill.

Based on formal and informal student feedback and assessing the knowledge and skills required to be able to provide pharmaceutical care during their practical training period, several limitations to student learning were identified. These include:

- In the large group setting, not all students are prepared for class discussions; hence, many times the instructor would have to 'lecture' to complete the course material. Not receiving timely feedback for their participation has been identified as one of the reasons why students are not motivated to increase their participation.
- As one case is discussed for each therapeutic topic, students indicated a limitation to the breadth of knowledge learned.
- Students were unclear of the expectations of the examinations, based on the one case.
- The one patient case did not always give students an understanding for the types of problems seen in patients with that particular disease state.
- Students would have liked to have the opportunity to apply their knowledge beyond class discussion.
- The need for increased instructor-student interaction in preparation for cases, when needed beyond the usual office hours.
- A difficulty for students in sometimes arranging for regular face-to-face group meetings.
- Due to the dynamic nature of the material, treatment information learned in third year is sometimes 'out-of-date' by the time students start their practical training during the last semester of fourth year.
- Preceptor feedback from clinical training in previous years indicate that students may know the information but are not always able to verbally justify their recommendations.

Many of the issues identified relate to the limitations of large group problem-based learning. These include limitation of the breadth of knowledge learned, lack of opportunity to apply knowledge beyond the case discussion, lack of understanding of the types of problems seen in patients beyond the case discussed in class and difficulty in coordinating face-to-face team meetings. Other issues relate to the student's need to gain a better understanding of 'patient issues' related to their illness. In order to address these issues and to optimize student learning, new educational and assessment strategies were integrated into the Therapeutics courses.

The Desired Outcomes of the Innovative Strategies
- to enhance student learning by identifying and addressing limitations to learning in a large-group, problem-based format;
- to increase the student's understanding of the patient's perspective of the illness; To increase the student's ability to 'care' for the patient;
- to facilitate the development of verbal communication skills, with respect to discussing therapeutics issues and making recommendations; and
- to motivate students to develop self-directed learning skills, thus enabling and promoting life-long learning.

The innovative strategies were targeted to address these outcomes.

METHODS
Changes to the courses were incorporated gradually over the past four years. The following lists the changes that have been integrated into the two courses and the year the change was initially made:

Teaching and Learning Strategies

1. Student learning objectives to be developed for each case (1996)
2. Integrated cases incorporated into the course schedule (1996)
3. Discussion of common drug-related problems within each therapeutic area (1996)
4. Use of real patients for selected cases (1997)
5. Development of a web infrastructure to complement classroom learning (1999-2000)

Changes to Student Assessments

1. Assessment of group contribution to class discussions with timely written feedback (1997-98)
2. Final oral examinations at the end of each year (1996)
3. Case study seminars (small group seminars): change in assessment of performance during seminar (1996-97)
4. Case study seminars—incorporation of verbal and written, self and peer assessment (1996-97)

Teaching and Learning Strategies

1. Development of student Learning objectives for each therapeutic case
2. Goals
   - To increase students' breadth of knowledge learned
   - To provide students with guidelines on expectations for examinations

Rationale

Students enter therapeutics in third year at a beginning Multistractural(2) level of knowledge acquisition and skill. They have not yet developed the judgement required to decide on what may be relevant information to learn within each therapeutic area. Often the patient case discussed in class may deal with one main problem. Hence, providing students with specific learning objectives gives them a clear indication of the material that they should be familiar with, within each disease topic, beyond the one problem discussed in class. Additionally, these objectives provide a guideline for examinations, which creates an affective environment that is conducive to learning.

Process

In addition to the development of the case, the instructor developed a set of clear learning objectives for that specific topic. These provided the students with a guideline on the breadth of information to be learned within that area. The Student Learning Objectives precede the case. In preparation for class discussions and examinations, students are asked to review these objectives and to be familiar with the information covered within the objectives. Learning objectives are incorporated into all therapeutic cases for third and fourth year.

Examples

- For pneumonia, the case discussed in class could be a patient with community-acquired pneumonia. Students are also expected to understand the pathophysiology and treatment of other types of bacterial pneumonia, such as hospital-acquired pneumonia, aspiration pneumonia, etc.
- Acute migraine management may be the focus of the case discussed in class. However, students are also required to be able to assess and recommend prophylactic therapy for a patient with migraine.

2. **Incorporation of Integrated Cases**
   Goal

   To provide students with an opportunity to gain insight into patient problems that are ill-defined and/or non-routine (refer to Appendix II) in nature (*i.e.* a realistic patient case).
   Rationale

   Simulated paper patient cases used for each therapeutic area usually deal with a primary issue related to the disease topic. Although the paper cases are developed from real cases, the patient's other medical conditions and concerns may be simplified to ensure that the application of information related to the new topic is clearly understood. However, in order to prepare students for practice, it is important to expose them to patients with multiple issues and a number of drug-related problems. This emphasizes the interrelationship between conditions and how to set priority in resolution of drug-related problems.
   Process

   Integrated cases are scheduled at various times during the two courses and are taught in a three-hour teaching block. The integrated cases usually incorporate one to two new therapeutic areas, along with two or three disease conditions that have already been covered. In addition to teaching students how to deal with multiple problems, the case serves as a review of information already covered, clarifying any issues from previous discussions.

3. **Discussion of Common Drug-Related Problems**
   Goal

   To provide students with an understanding of the types of problems seen in patients with a particular disease state.
   Rationale

   As students lack practical experience, the clinical significance of the patient case problem discussed in class is often unclear to them. Hence, providing students with common types of problems encountered by pharmacists related to drug therapy in patients with a particular disease provides a context for understanding of the case problem.
   Process

   Upon completion of the case discussion, the instructor provides an insight into the clinical significance of the types of drug-related problems that he/she sees in practice. This provides students with an appreciation for the pharmacist's role in identifying and resolving problems for patients with specific types of illness. With the development of the web site, a discussion of the common types of drug-related problems for each disease area is included on-line for easy student access.

4. **Use of Real Patients for Selected Cases**
   Goals

   - to create authenticity within the problem-based learning environment;
   - to provide bridging for students between caring for simulated paper cases to real patients during their experiential training;
   - to provide students with an opportunity to interact and care for patients with ill-defined, non-routine problems.

   Background Information

   Students are exposed to graduated levels of complex

ity of therapeutic issues over the two years. During the fourth year of the program, students are provided with an authentic experience with patients with complex therapeutic issues. The interaction with patients is correlated with the level of student's knowledge and skills/competencies. Students can be expected to gather, select, process, manage and present issues for patient problems that are well defined and routine. For patients with ill-defined and/or non-routine problems, students can manage patient problems, with the guidance and expertise of the respective care provider. Hence, students interact with the patients at different levels during the course.

Process

Patients are invited to the classroom to help address four different therapeutic areas. These include cardiology (post-myocardial infarction management), neurology (Parkinson's disease) and Psychiatry (Psychosis and Bipolar Affective Disorders). Earlier in the course, students interact directly with patients with routine and/or well-defined problems. With increasing complexity of the patient's disease, students interact with the patient under the guidance of a health care practitioner, and gain experience in dealing with ill-defined and/or non-routine problems.

Cardiology

Earlier in fourth year, upon completion of the cardiology block, a patient with multiple cardiac issues is invited to the class and provides the basis for the Integrated Cardiology Case discussion. Prior to class, four student volunteers discuss the interview strategy with the instructor. During the first half of the integrated case, the volunteer students interview the patient in front of the class. The instructor is also present. At the completion of the interview, other students may ask questions of the patient or the interviewers. Information from the patient is gathered and selected. The patient is encouraged to share his/her views on their relationship with health care practitioners, especially pharmacists. The patient then leaves. During the second half of the class, the instructor elicits information from the interviewers and asks them to share their thoughts about the interview with the class. Following this, the instructor facilitates the class discussion on the 'patient case'. Real and/or potential drug-related problems are identified and potential solutions discussed. Following this, the instructor discusses the students' recommendations with the patient and encourages the patient to discuss these with his/her physician. The instructor follows-up with the patient at a later date to determine any alterations to therapy; this information is then shared with the students.

Students enjoy this experience very much and get satisfaction in knowing that some changes were made to the patient's therapy based on their recommendations.

Neurology - Parkinson's Disease

Week 1. Two patients are invited to the class with dramatically different presentations of Parkinson's disease. The pharmacist-instructor conducts the interview with both patients, eliciting information regarding their condition and treatment. Following the interview, students are encouraged to ask questions of the patients or instructor. Students gain an appreciation for issues that impact on the patients' quality of life and the role of drug therapy in their disease management. At the end of the interview, patients leave the room. The instructor provides students with a brief overview of the discussion. Students are required to carry out an assessment of the patient's medical conditions, which will be discussed the following week in class. Students are expected to work within their groups, to identify the patient's drug-related problems and make recommendations to resolve them.

Week 2. At the beginning of class, a video is shown to demonstrate the classic symptoms of Parkinson's disease. As patients visiting the class are usually controlled on medications, the symptoms are not obvious. Hence, this visual depiction provides students with a better understanding of the clinical presentation and treatment. The video is followed by an instructor-facilitated discussion of Parkinson's disease and the patient's management. Following the class, the instructor discusses any identified drug-related problems and potential recommendations with the patient. The patient is encouraged to then discuss these with his/her physician. Later, students are provided with an up-date on any changes in therapy that resulted from their recommendations.

Psychiatry - Psychosis and Bipolar Affective Disorders

Two patients, one with psychosis and one with bipolar affective disorder, are invited to the class, along with their psychiatrist. The pharmacist-instructor is also present.

Week 1. The psychiatrist conducts an interview of his/her patients, providing students with a history of the mental illness and various interventions, including drug therapy, that have been tried. Following the interview, students are encouraged to ask questions of the patients or the psychiatrist. This session provides students with an insight into the complexity of psychiatric illnesses, with respect to both diagnosis and treatment. Following the interview, the patients and the psychiatrist leave. The pharmacist-instructor provides an overview of the discussion and clarifies any issues for the students, who are then expected to work-up the two patients, in preparation for class discussion the following week.

Week 2. The instructor facilitates the class discussion related to the management of the two patients, in two separate lecture times. Any identified drug-related problems and potential recommendations are discussed with the psychiatrist by the instructor. A follow-up is provided at a later date to students regarding any changes to patient's therapy as a result of student recommendations.

5. **Development of a Web Infrastructure to Complement Classroom Learning**

   Goals
   - to address limitations to student learning in a large-group, problem-based format;
   - to enable students to optimize their knowledge and skills required in providing pharmaceutical care.

   Rationale

   Several limitations to problem-based learning could be addressed by a well planned web site. Allowing the student to access supplemental information promotes greater understanding of the therapeutic area and supports the development of self-directed learning. It also ensures that students become familiar with information technology

resources. The site would allow for easy access to course-related information.

Process

Various courseware tools were reviewed and a web framework was designed using the WebCT courseware package. Information is added to the site on an ongoing basis. Each therapeutics course has its own web site. All students registered in the course are given login identification and an initial password to access the site. Student feedback is sought continuously in the development of the sites. The Pharmaceutical Care III site (course offered from September to December) for fourth year students and the Pharmaceutical Care II site (course offered from late October to April) for third year students, went live on September 15, 1999 and January 25, 2000, respectively. The site also has the capability to track student use and posting of student evaluations.

The web infrastructure provides information and/or activities related to the following:

• learning objectives, cases and required readings;
• common drug-related problems experienced by patients with a specific disease;
• key treatment principles and/or a brief summary of key points discussed in class which is made available to students upon completion of class discussion;
• mini case scenarios and/or quizzes for practice in each area;
• supplemental readings for students who may be interested in going beyond what is 'required' - this may include links to reputable medical and patient information available on-line, e.g. The Arthritis Society - www.arthritis.ca;
• a "hot, hot news..." section that provides ongoing updates on new therapies - this is especially beneficial due to the dynamic nature of therapeutics;
• evaluation forms are available on-line to assess instructors and/or course;
• instructions for examinations/exam review.

The web site also provides students with an opportunity to carry out the following:

• 'virtual group work' to facilitate group discussions;
• a bulletin board to discuss "cases for the week" with the instructor;
• a course calendar that lists course milestones and instructor availability; students are encouraged to list their on-line group meetings so that the instructor can be available at this time, if needed.

Changes to Student Assessments

1. Assessment of Group Contribution to Class Discussions with Timely Written Feedback
Rationale

To encourage student participation in class discussions, three or four of the 15 groups in class are called upon randomly at the beginning of each session. The selected groups are assessed by the instructor during class discussion. Students not in these groups are also encouraged to participate. Each group is called on six times during the duration of the course. Assessments from the best five of the six discussions account for a component of the group mark. Students are provided with a final group mark for their participation at the end of the year. A more time

ly and detailed feedback would motivate the students and allow them to improve their performance.

Process

A detailed written feedback is provided to students in the selected groups at the beginning of the next class. Criteria for assessment include the group's preparedness for class, their problem solving/critical thinking ability and verbal communication skills. Groups are also encouraged to discuss their assessment with the instructor, especially if the mark does not reflect their impression of their performance. Although time intensive for the instructor, students have indicated that this timely feedback provides them with clears expectations for participation and guides them through the quality and quantity of discussion that is required. This process takes place in both the third and fourth year therapeutics courses.

2. Oral Examinations
Goals

• to assess the student's ability to integrate and apply information to a patient case with multiple conditions and several drug-related problems.
• to assess the student's ability to verbally present information related to the identification and resolution of the patient's drug-related problems.

Process

Time of Examination. Students are given an oral examination at the end of the third and fourth year therapeutics courses. All 120 students are examined on one day. The same process is followed for third and fourth year exams. **Development of Examination.** The exam consists of an integrated case in which a patient with several medical conditions and many drug-related problems is used. Utilizing the pharmaceutical care process, questions and appropriate responses are written out for the identification of the drug-related problems and development of an integrated pharmacy care plan. Responses are based on class discussion and relevant readings. Typically about 60 to 80 questions relating to the case are identified. The questions are reviewed and eight groupings of questions are determined based on the difficulty and ease of the response. Each student will be asked one group of questions. The questions will be spread out throughout the case. This pre-assigned balance in the questions ensures that each student's exam is of a similar level of difficulty and that each student has the opportunity to demonstrate their ability to integrate and apply information related to diseases and drug therapies. All examiners receive this key and review the information for correctness and completeness. **Preparation for the Examination.** All examiners are instructors in case study seminars or have facilitated a lecture in one of the two therapeutics courses. In preparation for the examination, a three-hour workshop is held and 17 examiners (16 examiners and one back-up examiner) are trained on the assessment process for the examination. Examiners are pre-assigned two groups of students to examine. To eliminate bias, examiners who have previously assessed a student in any capacity are not assigned to be an examiner for that student.

Student groups are randomly assigned an examination room and time slot. The examination consists of a two-hour oral component, followed by an hour written exam. The sessions take place in two sittings; in the first sitting from 9 AM to Noon, eight groups are examined (eight

exams in eight different rooms) and in the second sitting from noon to 3 PM, seven groups are examined (for a total of 15 groups). The time schedule for each group, along with specific student instructions with respect to the format of the examination, a copy of the assessment forms, and expectations for the exam are provided to all students well in advance of the exam date.

Exam Format. Each group is assigned one examination room. Two examiners are assigned to assess each group to ensure reliability. All examinations are audio-taped. At the beginning of the examination, students are given the integrated case. They then have 15 minutes to review the case on their own. The examination then begins with the examiner asking students the pre-determined questions. Each student will be asked approximately eight questions, spread throughout the examination period. If a student provides an incomplete answer or incorrect answer, then an 'open format' question may be asked and students may volunteer to clarify the response. On completion of the examination, the examiners leave the room. The students are then given a one-hour written exam. During this time, the examiners complete the assessment for the first group.

Student groups who are to be examined in the second sitting are asked to assemble in an assigned room for roll-call 20 minutes before the completion of the first sitting; this ensures that information is not shared between the students in the first and second sessions.

Student Evaluation. Two examiners are assigned to each exam room. One examiner asks the questions, while the other is responsible for writing down supporting evidence for each student and audio-taping of the exam. On completion of the session, each examiner completes the evaluation forms individually. A global rating scale is used in assessing the students. The two examiners are then required to arrive at a consensus in deciding the level for the student. Students are assessed on their ability to integrate and apply the information and on their verbal presentation skills.

3. **Case Study Seminars (small group seminars): Assessment of Student Performance**
   Goal
   To align the assessment process with the student's expected level of knowledge and skills (*i.e.,* criterion-based assessment).

   Background
   In addition to the large group class discussions of about 25 cases in each course, students participate in small-group seminars. These include discussions on Infectious Diseases, Asthma/COPD and Diabetes Mellitus during the third year (Pharmaceutical Care II) and Hypertension and Congestive Heart Failure in the fourth year (Pharmaceutical Care III). The seminar discussions are three hours in duration with another half-an-hour allotted specifically for assessment. One expert instructor facilitates the discussion among the eight students in each group. For each seminar topic, 15 individual small group sessions are organized. The same process is followed for both courses.

   Process
   The Structure of the Observed Learning Outcome (SOLO Taxonomy) by Biggs (see Appendix A) was used

to develop the criteria for assessment of student performance in seminars. Students are assessed in their Therapeutic Knowledge, the Application of this Knowledge and in Interpersonal and Group Skills. All case study seminar instructors are trained each year to ensure consistency in assessment between group leaders. Students at the end of the third year are expected to be at a Multistractural level. Students at the end of therapeutics in fourth year are expected to be bridging the Multistructural and Relational levels in knowledge acquisition and application of skill. When considering only well-defined, routine problems (see Appendix II) most students are likely at the Relational level.

3. **Case Study Seminars: Incorporation of Verbal and Written, Self and Peer Assessment**
   Goals
   • to foster a positive attitude toward self-improvement and life-long learning;
   • to help foster team-building skills.

   Rationale
   In PBL, self-assessment is an important indicator in helping students in their learning. This will also help students in acquiring life-long learning skills. Verbal self- and peer-assessments are more easily done in a small group setting. In case study seminars, eight students carry out a discussion in a therapeutic area with one facilitator. The seminars provide an ideal setting in helping students develop their self and peer-assessment skills.
   Process
   The last half-hour of the seminar is set aside for the assessment component. At the end of the seminar, all students complete a written assessment for each student member in their group and themselves, clearly stating the student's strengths and areas for improvement. Following this, each student is asked to verbally self-assess their performance during the seminar with respect to the Application of Knowledge/Problem-Solving skills and Group Interaction Skills. A peer member is then asked to assess the student, which is followed by the instructor providing feedback on the accuracy of both the peer- and self-assessment. Feedback from peers and the facilitator greatly assist the student in developing their self-assessment skills. This is seen by an increasing accuracy in their self- and peer-assessments as they move through the five seminars.

RESULTS

Students are evaluated using criterion-based assessment in Therapeutics. Students' knowledge and skills are expected to be at a Multistructural level (Biggs) for well defined, routine problems (see Appendices A and B) by the end of Pharmaceutical Care II in third year and at a Relational level for well defined, routine problems at the end of Pharmaceutical Care III in fourth year. With ill-defined and/or non-routine problems, students bridge between Multicultural and Relational levels. The assessment of performance in case study seminars and in the oral examination is aligned with the SOLO Taxonomy and assesses the student's development and integration of the required knowledge and skills. The written exams are more content-based assessments. Group marks (instructor's and self- and peer-assessments) comprise the remaining 10 percent of the course mark.

Evidence of Learning
Oral Examinations. In the 1998-99 year, based on the oral examination at the end of the course, 75 percent of students in the class had developed their knowledge and skills at the Multistructural level. In the 1999-00 academic year, at the end of Pharmaceutical Care III (December 1999), about 85 percent of the same group of students were between the Multistructural-Relational level. The oral examination tests the application of knowledge and skills to a patient (paper case) presenting with several routine and non-routine problems. This indicates the gradual development of the students' knowledge and skills in the progression from one course to the next.
Case Study Seminars. In the performance of the case study seminars in 1998-99, about 70 percent of students were at the Multistructural level for those which represented well-defined, routine problems. In 1999-00 among the same group of students, about 75 percent were at a Relational for well-defined, routine problems. For ill-defined and/or non-routine problems, about 10 percent of students were at a Relational level.
Overall Course Standing. The final class average for the two courses in the new curriculum has gradually increased from a 70 to 75 percent over the last three years. This is likely a combination of student caliber with better admissions screening and the endeavor by faculty to continuously improve teaching.

Overall Evaluation of Pharmaceutical Care II and III
Students in the fourth year complete all their academic component in December, including Pharmaceutical Care III. They then undergo their practical training from January to April. At the end of the practical training, students were surveyed in relation to the usefulness of the pedagogy related to therapeutics in Pharmaceutical Care II and III. One hundred and twenty students were surveyed in April 1999 and 70 students responded. They indicated the following:

- 97% found the small group seminars (case study seminars) to be useful or very useful in their practice.
- 96% were somewhat comfortable to very comfortable in their knowledge in cardiology.
- 78% were somewhat comfortable to very comfortable in their knowledge in psychiatry.
- 87% were somewhat comfortable to very comfortable in their knowledge in neurology.
- 64% were somewhat comfortable to very comfortable in their knowledge in infectious diseases.
- 96% were somewhat comfortable to very comfortable in their knowledge in bone and joint disorders.
- 96% were somewhat comfortable to very comfortable in their knowledge in other areas (thyroid disorders, anemia, oral contraceptive use).

The feedback indicates that students are not as comfortable with some of the information learned in third year (infectious diseases). Other written comments were also provided. Limitations identified by students have been partly addressed with the implementation of the web sites the following year.

Student Feedback Related to the Use of Real Patients in the Classroom
In 1998-99 academic year, students were surveyed at the end of Pharmaceutical Care III, during which real patients are invited to the classroom. Eighty-nine students responded. Ninety-five percent of those who responded indicated that they found the use of real patients in this course enhanced their learning in the area of cardiology, Parkinson's disease, psychosis and bipolar affective disorders.

Specific Student Comments
- I found this very beneficial to my learning experience.
- These are real patients with real problems, so it was great to see the true application of the material learned in class.
- Drug-related problems were unclear sometimes in patients.
- It is very helpful to hear first hand about patient's experiences versus paper cases.
- Provided real-world perspective.
- Great for students who do not know people suffering from those diseases to get a glimpse of the 'real life' scenario.
- Much easier to understand and identify problems when you see it in a real patient. Do it more often!
- It was interesting to meet these people and I'm glad we had the chance to ask them questions. However, it was hard to work up cases on them.
- Excellent opportunity to 'personalize' the diseases.
- Could we have more?
- Added insight into what they felt about their disease state and treatment they were on.
- Real-life situations - even if it was difficult to identify drug-related problems, it made it more like life!
- It makes you realize that real patients are much more complicated than on paper.
- Super! Interesting! This is what we want to see - real cases.

Evaluation of the Web Site
The web site went live on September 15, 1999. All fourth year students registered in Pharmaceutical Care III were given access to the site. The information on the site was supplementary only and students were encouraged to use it in a self-directed manner. Between September 15th and December 10th, the site received 550 hits. A survey was conducted in December to obtain student feedback. Sixty-seven of the 120 students responded to the survey.
The survey indicated the following:
- 82% indicated that the web site is a useful tool in supplementing class room learning
- 78% rated the web site as easy to use
- 91% rated the appearance of the site very highly
- 95% indicated that they would like access to the web site during their practical rotations
- 93% indicated a strong interest in having access to the site after graduation as a means of continuing education.

The development of the web site is scheduled to be completed by the fall of 2000. Student feedback will be considered in further expanding the site. Due to the dynamic nature of therapeutics, the web site will require on-going revisions and updates.

DISCUSSION
In PBL, the responsibility for the learning is placed on the student. Students entering the third year may not be willing to take this responsibility completely and may not have the necessary motivation and skills to do so. Hence, the teacher's role is to initially coach students and to guide them through their learning. As students gain confidence, skills and comfort in the environment, they are then ready to take on more responsibility. The teacher needs to be able to listen and work in partnership with the students in order to create and nurture the atmosphere that is conducive to the students' learning.

Students at the Faculty are trained to provide pharmaceutical care by identifying, resolving and preventing patients' drug-related problems. Students need to be guided through the curriculum to ensure that they are provided with the right atmosphere and an adequate opportunity to acquire the desired knowledge and skills.

The strategies described here form an integrated approach to the creation of an environment in which students can engage in effective learning. This occurs with the use of PBL, shared criterion for assessment and use of the various teaching and learning techniques to optimize student learning. As students enter therapeutics, the content becomes increasingly complicated and the skills required in communicating the content in a meaningful manner needs to be more sophisticated. By understanding at what level students enter the course, by developing clear criteria that are reliable (based on the SOLO Taxonomy) and understood by both students and instructors, and by establishing various teaching and learning approaches, the creation of a collaborative learning environment is ensured. The implementation of the teaching, learning and assessment strategies, will enhance student learning, and facilitate their development towards becoming effective practitioners. The strategies implemented within the Pharmaceutical Care II and III courses will also help foster self-directed independent learners, promoting life-long learning skills.

All of the strategies described here have been well received by students. There are continuing challenges to the course that relate to instructors, oral examination and information technology. In addition to the coordinator, several guest instructors teach various components of this course. It is important that all instructors understand the expected level of student performance and the relevance of information required to be made available to all students in a timely manner. To maintain consistency in assessment, facilitation of class discussion (how to facilitate and not to lecture), and how to best address students' learning needs, requires regular meetings and workshops for instructors. Two workshops are held during the summer, one for each course, to assist guest instructors in case development and class facilitation. In addition, two meetings and a workshop are carried out for each of the five case study seminars. With an increase in turnover of clinical practitioners at the teaching hospitals, it requires more time to train new instructors.

The oral examination assesses individual student and is conducted in a 'group' format. The ideal examination should evaluate the student's ability to integrate and apply information to a patient case in order to effectively identify and resolve that patient's drug-related problem, on a one-on-one basis (vs. assessment within the group). Other options for verbal assessment include an Oral Structured Clinical Examination (OSCE) format, which will provide an assessment of the student's ability to apply information to multiple, short scenarios. These are also resource intensive, both with respect to human resources and finances. The format of the current oral examination is presently being reviewed.

The web infrastructure was implemented in September 1999 and work is ongoing with the two sites at present. One limitation to student use of the web is students' difficulty in having access to a computer on a regular basis. The university is presently promoting the use of information technology in teaching and learning, and is considering making more computers available to students. Some students also need to become more comfortable with the use of technology and have indicated this as a reason for not having tried using the information presently available on the web. Also, maintenance and up-keep of the web site is time intensive for the coordinator, in addition to the usual course responsibilities.

FUTURE PLANS

The web sites will continue to be modified and expanded over the next few months with much of the work being completed by the spring of 2001. For the following year, a 'live' orientation will be provided to the web site to all students in class, to increase their familiarity with this information resource. With the proposed increase in student numbers, consideration may have to be given to making more information available on-line, including all required cases and readings. Students have requested access to the web site after graduation as a means of ongoing learning while in practice. There is potential for the site to the modified to meet the needs of alumni for continuing education.

Students have responded very positively to the use of real patients and have indicated a preference for this strategy to learning. Incorporating real patients into the classroom learning is time intensive in ensuring that the patient is comfortable in being interviewed and in sharing information with 120 students and in providing appropriate guidelines and support to students in working with real problems. Consideration is being given to the incorporation of this approach to learning to other cases.

Students have indicated that case study seminars, where learning takes place within a small group, creates a very positive and 'safe' environment for learning. A challenge in this setting, however, has been to strive for consistency in assessing students. Although instructors are trained, variation in assessments between groups are still perceived by students. To ensure reliability in assessments, it would be ideal to have a separate instructor, different from the facilitator, to carry out the assessment process. This is resource intensive, both in personnel and finances. Ways to increase consistency in seminar assessment is being considered.

CONCLUSIONS

An approach to education in which the integration of teaching and learning are truly collaborative creates an atmosphere that is conducive to effective student learning. Problem-based learning (PBL), which is self-directed, is one means of enabling this. However, there are limitations to PBL, especially in a large group setting. Appropriate modifications to PBL can create an effective learning environment for the student in an undergraduate pharmacy program, thus enabling them to become effective pharmaceutical care practitioners.

References
(1) Perrier, D.G., Winslade, N., Pugsley, J., Lavack, L. and Strand, L.M., "Designing a pharmaceutical care curriculum," *Am. J. Pharm. Educ.,* **59**, 113-125(1995).
(2) Winslade, N., "Large group problem-based learning: A revision from traditional to pharmaceutical care-based therapeutics," *Am. J. Pharm. Educ.*, **58**, 64-73(1994).
(3) Hepler, CD. and Strand, L.M., "Opportunities and responsibilities in pharmaceutical care," *Am. J. Hosp. Pharm.,* **47**, 533-543(1990).
(4) Biggs, J., *Teaching for Quality Learning at the University,* Society for Research in Higher Education, Buckingham, England (1999).

APPENDIX A. THE GROWTH AND STRUCTURE OF LEARNING.(4)

The Structure of the Observed Learning Outcome - The SOLO Taxonomy

5   *Extended abstract:* The learner now generalizes the structure to take in new and abstract features. This level represents a higher mode of intellectual operation.

4   *Relational:* The learner now integrates the parts with each other, so that the whole has a coherent structure and meaning.

3   *Multistructural:* The learner picks up more and more relevant or correct features, but does not integrate them.

2   *Unistructural:* The learner focuses on the relevant domain, and picks up one aspect to work with.

1   *Prestructural:* The task is engaged, but the learner is distracted or misled by irrelevant aspects or data.

APPENDIX B.

Problem Definitions
Developed by Cleo Boyd, University of Toronto

KEY TERM
Problem: A problem arises when the achievement of a goal is initially unclear, or characterized by any degree of ambibuity.

KINDS OF PROBLEMS
Well-defined problem: A well-defined problem is one in which the path to the goal is clear and unambiguous and for which a correct answer exists.
Ill-defined problem: An ill-defined problem is one for which the path to the goal is unclear or ambiguous and for which one correct answer may not exist.
Routine problem: A routine problem requires the problem-solver to apply known information using predictable, systematic processes and procedures to achieve the goal.
Non-routine problem: A non-routine problem requires the problem-solver to apply information, processes, and/or procedures that may be new and unfamiliar to achieve the goal.