

Comparative Trial of Problem-Based Learning Versus Didactic Lectures on Clerkship Performance

Leslie J. Nii and Alfred Chin¹

School of Pharmacy, University of Southern California, Los Angeles, CA 90033

With the advent of pharmaceutical care and a tumultuous health care environment, there is a need for pharmacy educators to produce pharmacists that not only possess knowledge but the skills necessary to adapt to the changes and challenges that the future holds for the profession. Problem-based learning (PBL) is a teaching method that has been used in medical and pharmacy school curricula that gives students knowledge through an active learning process which requires students to problem solve, make decisions, and communicate effectively. PBL offers an advantage over the traditional didactic lecture (DL) where students learn through a passive rote method. Drawbacks of PBL include the fact that the approach is time and labor intensive, not well described in the literature, and controversy exists as to the potential benefits of PBL over conventional DL curricula. In this study, grade point average (GPA) in clerkship rotations was used as measure of practice capability to compare students who were taught using PBL versus DL before the rotations. The study group consisted of 118 students who graduated from a four-year PharmD program. All students went through similar course work for the first two years of the curriculum and then were randomly assigned to one of two groups which were taught by PBL or DL in the third year. The students then all completed six clerkships (four required and two elective) in the final year of the program. There were 58 students in the PBL group and 60 students in the DL group. The results demonstrated that the average GPA for both required and elective clerkship rotations in the PBL group was significantly higher ($P < 0.05$) than the average GPA in the DL group.

INTRODUCTION

The movement towards pharmaceutical care and increased pharmacist involvement in expanded patient care responsibilities has many pharmacy schools revising courses in their curriculum to provide their graduates with the skills necessary to perform these activities(1). The pharmacists' role in today's health care system requires greater problem-solving capabilities, effective thinking abilities, sound decision making skills, and effective communication skills(2-3).

In order to produce pharmacists that possess these talents, one approach that pharmacy educators implement is the problem-based learning (PBL) method. This system of teaching gives students knowledge through an active learning process which is believed to be recalled better than that learned through conventional passive rote methods. The rationale for PBL focuses on the idea that PBL improves inductive reasoning strategies that may be more effective for learning(4). Conventional didactic lectures (DL), while to some extent essential, fail to address the increasing complexity of clinical practice in where independent clinical judgement and therapeutic problem-solving skills are required. Controversy still exists as to the potential benefits and overall outcome of PBL over DL. Schmidt and colleagues reviewed 15 studies that compared various outcomes of PBL and conventional curricula. In general, the differences tended to be very small, and most important, the evidence of differences in clinical competence was inconclusive(5).

The incorporation of PBL and pharmaceutical care into the curriculum poses several difficulties including increased burdens on human and financial resources and lack of availability of well described methods of teaching. Since

clerkship rotations provide the closest experience to actual practice in the pharmacy education process, the purpose of this study is to compare clerkship performance (as measured by grade point average) of pharmacy students who were taught using PBL to those who received DL prior to clerkship rotations.

METHODS

Randomly selected pharmacy students from the graduating classes of 1994 and 1995 who completed a four-year PharmD program were studied. The students all had similar course work and didactic lectures for the first two years of the curriculum. The students were then randomly assigned to two groups receiving PBL or DL in one class for two semesters in their third year and then were assigned to clerkship rotations in the final year of the program. The DL format course was taught in traditional style where the presentations are lecturer focused. The PBL format course applied the principles, goals, and methods used by other authors(2,3,6,7) (See Tables I and II).

The mean grade point average (GPA) of the two groups before being taught using PBL versus DL in the third year and of the four required (acute care medicine, ambulatory care, psychopharmacy and community pharmacy) and elective clerkship rotations were compared by Student's *t* test for independent samples(8). The method of assessment in clerkship rotations were similar. No plus or minus grades were used in our system. The evaluation of performance in clerkships is skills oriented and included interpretive and drug information abilities. All values are reported as means + the standard deviations. Data analyses were performed using PC-SAS (Personal Computer Statistical Analysis Software)(9), and differences were considered significant at the level of $\alpha = 0.05$.

¹Corresponding author address. USC/Norris Cancer Center and Hospital, 1441 Eastlake Avenue Rm. 2407, Los Angeles CA 90033

Table I. Elements of a problem-based learning course

- Active learning organized around problems with an integrated curriculum.
- Problem solving is used to enhance functional knowledge and motivational outcomes.
- Problems are presented as a case study (real cases or simulated patients) in small groups.
- Uses minimum amount of lecture time, only to present the problem.
- Solving problems prompts the acquisition of knowledge and cognitive skills.
- A facilitator is used for the discussion of the problem.
- Faculty members are used as resources for investigation into the knowledge surrounding the problem.

Table II. The problem-based learning course**Goals and Objectives**

The goal of this course is to use procedural problem solving methods to teach the student the skills and knowledge necessary to practice pharmaceutical care.

1. To allow students to acquire and/or reinforce their skills at managing individual patient problems which are related in some manner to the patient's drug therapy with emphasis on oral and written communication skills.
2. To incorporate a major emphasis on the process utilized by the pharmacist to examine and consider patient specific disease, disease treatment, and drug information to determine if a patient's problem is drug-related.

Teaching and Learning Methodologies

- Small class size (approximately 45 students).
- Speakers are practitioners and/or specialists in the topics they present.
- Topics are selected to complement other coursework.
- Emphasis is placed on skills necessary to practice pharmaceutical care.
- Speakers use discussion, demonstration, and case format.
- Practical applications, problem solving, and critical thinking is encouraged.
- Students do a patient work up precepted by a faculty coordinator.
- Students do a presentation of the patient work up to the class and faculty coordinators and writes a SOAP note evaluation.

Examination

- Topic knowledge is tested by examination (midterm and final).
- Material is cumulative; students are expected to apply previously learned topics to more complex situations as the course progresses.
- Examinations are presented in short answer, case format and is application oriented. Multiple choice and true/false questions are not used.
- In the second semester of the course, the final examination is administered entirely in case format; the students are given four days to complete the exam. To successfully complete the test, the student must apply skills learned in the class as well as apply material learned from other classes and utilize drug information sources.
- The students are also graded on the patient presentation exercise and note writing.

RESULTS

One hundred and eighteen students were compared in this evaluation of PBL versus DL on clerkship performance from the 298 students in the two graduating classes. There

Table III. Student characteristics

	Group	
	PBL	DL
Number of students	58	60
Sex		
Male	22	21
Female	36	39
Age ^{a,b,c}	22.5 ± 3.1	22.3 ± 3.2

^aAge at start of pharmacy studies.

^bUnpaired t-test: $P=0.1$.

^cValues expressed as mean ± standard deviation.

Table IV. Summary of GPA^a

	Group		
	PBL	DL	<i>P</i>
First two years of Pharmacy School	2.88 ± 0.44	2.90 ± 0.38	0.1
Clerkship rotations (Required)	3.29 ± 0.36	3.09 ± 0.40	< 0.05
Clerkship rotations (Elective)	3.38 ± 0.43	3.11 ± 0.46	< 0.05

^aValues expressed as mean ± standard deviation.

were 58 students in the PBL group and 60 students in the DL group. The PBL group was made up of 22 males and 36 females with an age range at the start of pharmacy school of 22 to 28 years. The DL group was made up of 21 males and 39 females with an age range at the start of pharmacy school of 21 to 29 years (Table III). The mean GPA of the PBL and DL students for the first two years of pharmacy school were 2.88 ± 0.44 and 2.90 ± 0.38, respectively. The mean GPA of the PBL and DL students in required rotations were 3.29 ± 0.36 and 3.09 ± 0.40, respectively. The mean GPA of the PBL and DL students in elective rotations were 3.38 ± 0.43 and 3.11 ± 0.46, respectively (Table IV).

The mean GPA of students for the first two years of Pharmacy School was not statistically different between the two groups ($P = 0.1$). Significant differences in GPA for the PBL group and DL groups were noted in both required and elective clerkships ($P < 0.05$).

DISCUSSION

The concept of pharmaceutical care has stimulated significant interest in curriculum reform. The evolution of the concept of pharmaceutical care as the mission of pharmacy schools represents a new opportunity to enhance the status of the profession and to restore the relationship between education and practice. Practice competency expectations of entry level pharmacists are now greater and educators will play an important role in developing the knowledge and skills required to practice. The use of PBL has been established in response to a set of perceived problems in medical and pharmacy education. These problems include emphasis on fact memorization over problem solving skills, the limited direct orientation of basic science education to clinical career, and the need to develop habits of life long learning(10-12).

The advantages and disadvantages of PBL and DL have been evaluated by numerous investigators and there is no

consensus on a solution(13-18). The major advantage of PBL is the development of an effective, readily accessible knowledge base that is stored in long-term memory and recalled better than information learned by more conventional methods. A study by Patel, Groen, and Norman compared a PBL curriculum to a conventional curriculum. The authors demonstrated that PBL is an effective way of improving cognitive thinking and enhancing long-term memory of information(19). The use of PBL in a pharmaceuticals course was described by Duncan-Hewitt. The course provided the integration of fundamental knowledge with practical problems and demonstrated the difficulties associated with the use of PBL as well as its benefits(20).

In this study, there were no statistically significant differences in the GPA of the two groups prior to the third year of pharmacy school. The study demonstrated that students who received PBL in their third year had a significantly higher GPA in the fourth year elective and mandatory clerkship rotations.

The results of our study demonstrate that the time commitment to PBL produces positive outcomes in fourth year rotations, which are similar to functions and responsibilities required of pharmacists providing pharmaceutical care. PBL teaches students to become active learners, rather than passive recipients of instruction and to be less teacher-dependent for learning. PBL also gives students skills for acquisition of usable competencies required for reliable decision-making. Faculty members in PBL act as facilitators of active learning which places a high demand on faculty time and support. Conventional courses and PBL courses can co-exist in the same curriculum if an orientation is used prior to PBL encounters(21). As demonstrated by our results, cognitive based teaching methods such as PBL are favorable with students and are needed to bridge the gap between clinical pharmacy education and practice. The experience from our program and those of other innovative pharmacy school programs also raises new questions which should foster new experiments and encourage continuing progress in preparing the contemporary pharmacist for expanding professional roles and lifelong self-education.

Conducting high-quality evaluative research on PBL is difficult. The independent variable, PBL, is more than just a simple teaching method. It is a complex mixture of general teaching philosophy, learning objectives and goals, and faculty attitudes and values. These variables are difficult to regulate and define. The limitations of our results include different preceptors students may have had in the fourth year clerkship rotations. The courses had similar criteria for evaluation however, subjective influences could have been a factor in determining final grades. In conclusion, students that receive problem-based learning in the third year prior to fourth level clerkships have better performance as indicated by improved grade point averages.

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