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A preliminary study to evaluate the impact of problem-based learning (PBL) to a postgraduate clinical pharmacy programme in the UK

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Abstract

Background: The expanding volume of information on drugs and their application requires pharmacy educators to undertake a paradigm shift from teaching knowledge to teaching problem-solving skills.

Aim: This study compares the use of problem-based learning (PBL) to traditional tutorial sessions in an MSc in Clinical Pharmacy Programme. Evaluation considers both assessment of knowledge and understanding and student perception to the learning experience.

Method: Seventeen students were recruited to a randomised crossover trial conducted in two therapeutic modules.

Results: No significant difference was found for assessment scores. In relation to attitude, students favoured PBL. Non-attendance was an issue, as students, engaged in full time employment and additional on-call commitments, were not mandated to attend. The authors conclude that the adoption of PBL does not harm traditional educational outcomes and is preferred by students. This work provides a baseline for further studies and will assist in the introduction of PBL to the postgraduate pharmacy curriculum.

Keywords: *Education, pharmacy, postgraduate, problem-based learning, United Kingdom, assessment*

Introduction

It is known that problem-based learning (PBL) is an acceptable method of both teaching and learning on the principle of adult learning theory (Knowles, Holton & Swanson, 1998) and has many attributed advantages (Davis & Harden, 1999; Wood, 2003). PBL is used in undergraduate teaching and learning in a limited way for pharmacists in the UK (Silverthorne, Mackellar, Thomas, Price & Cantrill, 2005); however, the authors know of no contemporary published studies on the use of PBL in postgraduate pharmacy teaching in the UK.

A hospital-based MSc in Clinical Pharmacy has been available at the University of Derby since 1986 and is currently based at the Pharmacy Academic Practice Unit of the University. Students are recruited from a number of hospital sites and are full-time pharmacists working in practice. Tutorial sessions traditionally run the duration of one afternoon each fortnight for up to 25 students.

Lesson packs which are prepared by "experts" in the field contain recommended reading, self-assessment activities and information on the therapeutic topic. Packs are provided prior to the sessions. Session facilitators have been progressively adding to the breadth and depth of lesson packs since their introduction in 1997.

Students are expected to prepare for tutorials by undertaking personal learning and completing prescribed exercises. This learning is augmented with group engagement and discussion of the subject matter. Further, a "clerkship" module of experiential development supplements learning. Recently, tutors within our academic unit have formed the opinion that

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the traditional approach whereby packs of information are used to underpin clinical exercises has evolved to a point where the breadth and depth of knowledge for assimilation is insurmountable and untenable. The authors believe this approach has contributed to a deteriorating attitude to postgraduate study, lifelong learning and continuing professional development.

The ever expanding volume of information on new drugs and their application requires pharmacy educators to undertake a paradigm shift from teaching knowledge to teaching problem-solving skills in order to allow students to activate prior knowledge and build on conceptual knowledge frameworks to construct meaning. In the postgraduate field of study, it is particularly appropriate for students to bring their existing educational experiences and clinical practice to the learning experience, rather than being considered to be a "blank slate" (Knowles et al., 1998). Students need to "learn how to learn" for life-long learning in a field where continuing professional development has recently become mandatory in the UK.

A realisation of the practical difficulties of internalising vast areas of knowledge has led to limitations created by necessary timescales for students to complete the programme of study. These may appear daunting to students, turning them away from the educational experience. Accepted guidelines from recognised sources, such as the National Institute for Clinical Excellence (NICE) (National Health Service, 2005) now form part of practice and add to the problem of volume of knowledge the students are expected to learn.

There is an increasing tendency, supported by the Government, for healthcare professionals to specialise and for specialties to be recognised (Department of Health, 2005). It is no longer possible for pharmacy educators to provide all the knowledge related to these specialties. Further Higher Education Institutions (HEIs) do not have the breadth and depth of expertise to cover all areas of clinical practice.

We consider therefore that we must educate to give skills for the attainment of knowledge rather than the provision of knowledge in its own right. The difficulty is that pharmacists have historically been valued for their personal knowledge, which they take into clinical situations. The lesson packs sought to provide this. In reducing the provision of lesson pack information, through the introduction of PBL, this may be perceived as undermining pharmacist knowledge development and thus seen as detrimental in the short term.

For this reason, to contemplate changing to PBL as the fundamental learning style, there is a requirement to demonstrate that there is no adverse effect on knowledge that would render pharmacists unfit for practice.

The current study set out to investigate one postgraduate programme and to determine whether attitudes, knowledge and understanding of students is comparable between the traditional tutorial-based and PBL approaches.

It is hypothesised that there is no difference between PBL and tutorials in providing the knowledge and understanding relevant to clinical pharmacy in medicine and surgery, measured using traditional assessment tools.

Further that there will be a difference in the educational experience of pharmacists undertaking PBL and tutorial modes of teaching and learning.

Materials and methods

The method was informed by reviews of the literature on PBL (Norman & Schmidt, 1992; Albanese & Mitchell, 1993; Vernon & Blake, 1993; Newman, 2003), which point to the lack of papers with a scientific base of randomisation, crossover and critical assessment. Most studies employed a before and after design where traditional learning methods were followed by conversion to PBL.

Students were recruited to a randomised crossover trial conducted in medicine and surgery therapeutic modules. Involvement in the study was voluntary. PBL groups of 5–6 students were compared with traditional methods of learning, which included tutorial groups of 15–20 students.

Students were assigned using random number tables (Selby, 1971) to start with either PBL or traditional approaches for the first module in medicine. Those who undertook PBL in the medicine module received tutorial teaching in the surgery module. Similarly, those randomly assigned to tutorials in medicine subsequently received PBL facilitation in surgery.

There were three discrete assessment activities. All research instruments are available from the principle author.

First, students completed each module over a 3 month period and were then assessed for academic progression using only traditional methods consisting of multiple choice questionnaires (MCQ) and open-book case assessments (OBCA). A weighting of 40% for the MCQ and 60% for OBCA provided an aggregated score for assessment across learning styles. Only those who had completed either of the module evaluation forms were included in this analysis.

The intention of this study was to focus on a comparison between PBL outcomes and those from traditional teaching methods as examined by assessments of knowledge and understanding. There was no specific assessment of problem-solving skills at this stage of investigations but rather an assessment of attitude was undertaken.

Second, evaluation of the impact of PBL was determined through anonymous student feedback questionnaires given at the end of each module that

addressed issues of perceptions to the learning experience. A 10 cm visual analogue scale was developed specifically for the purpose. A value of 0 was assigned to "absolutely agree" with the statement and 100 to the 10 cm point, "absolutely disagree". Attitudes resulting from the learning experience were grouped into personal and practical. Analysis was based on responses to the six statements for each of the two sections plus an aggregate score for each section. In addition, students were given open questions inviting comment as to the ideal number for a learning group, the best and worst aspect of the two learning methods and their overall preferred learning method. Medical students from the University of Nottingham, who were experienced in PBL methods, piloted all aspects of the attitudinal research instrument. The responses were analysed thematically for key words and constructs according to the perceptions of the principle author.

Third, for discrete topics, such as diabetes, feedback was requested on whether or not specific learning outcomes were attained. Modules comprised multiple topics (17 in medicine, 14 in surgery). Five to ten learning outcomes were identified for each topic. Learning outcomes were assessed by students on an "unsatisfactory, weak, satisfactory, good or excellent" scale of attainment.

Academic progression was not dependent on this feedback as it was felt essential that students were not pressured into any one orientation and were given the freedom to express their feelings.

The first tutor was formally trained in the technique of facilitation by undertaking a 3 day training course at the Graduate Entry Medical School of the University of Nottingham. This training was then disseminated. Furthermore, direct experience of PBL facilitation was obtained during a field trip to PBL centres teaching Medicine and Pharmacy using this method at sites in Australia. A conference attended at the University of Salford gave tutors the opportunity for discussion with others on the roles of facilitation with other PBL educators (PBL: A quality experience, 2004).

Two of the authors had direct experience facilitating PBL sessions. The authors acknowledge many possible styles for PBL sessions but the sequence of events was as follows:

1. students were advised concerning the sequence of events and expectations for PBL facilitation during an introductory session when a "fishbowl" PBL session was conducted with an introductory case;
2. scenarios in the form of "trigger" texts were created to meet the learning outcomes of each module. They were not directly related or directed from the packs, rather created to encompass necessary areas of clinical practice;
3. an introductory scenario and ten trigger texts were designed specifically for the course, as they were not found elsewhere in the field of pharmacy;
4. students were allocated a group session to discuss "trigger" cases to analyse problems, generate hypotheses and decide on learning issues that warranted further exploration to meet their individual learning needs;
5. baseline core knowledge was provided by educational packs, but students were not mandated to use them. The packs were provided as an additional resource;
6. students were given 2 weeks for individual learning before attending a session to review learning, draw conclusions and gain closure to the case and
7. learning outcomes were provided at the end of each case.

Further learning issues could be discussed with local "experts" and tutors at any stage of the process as the programme incorporated a clerkship module of experiential learning.

Approval for the alteration in teaching and learning method was obtained through the programme committee attended by tutors from participating hospitals. Only students able to attend the centre were included in the study.

Statistical analysis using the SPSS 11.5 analysis package was carried out using parametric and non-parametric statistical tests. As students' feedback remained anonymous, the independent samples *t*-test was used throughout. The level of statistical significance was set at the 95% confidence interval ($p = 0.05$). Responsibility for data entry and cleaning was complete by one author, while analysis was a joint activity between two of the authors.

Results

Of the 21 students invited to participate in the study, 17 participated, 3 declined through choice and 1 was compromised by on-call and annual leave commitments.

Data collection paralleled the timetable from April to September 2004 set aside for the two modules.

Table I. Sample demographics.

	Gender*		Age†
PBL experience	Males	Females	Mean ± 95% CI
Medicine	2	9	26.53 ± 2.75
Surgery	1	5	28.44 ± 4.11

* Fishers exact test $p = 1.0$.
† Independent samples *t*-test, $F = 0.741$, $p = 0.403$, equality of variance assumed. *t* value $= -1.152$, df $= 15$, $p = 0.267$.

The student group consisted of 14 females and 3 males with an age range of 23–35 years. Table I compares the demographics of those whose PBL experience was medicine compared with surgery. There were no significant differences in gender or age between the two groups.

The 17 students that were recruited to the study completed all elements of the study. As this was a crossover study, the 17 students completed two questionnaires giving a possible 34 student responses, of which 24 were received for analysis.

Comparison of aggregated assessment results for MCQ and OBCA across learning styles showed no significant difference between the PBL and tutorial group's scores for medicine ($F = 1.359$, $p = 0.263$; $t = 0.174$, df = 14, $p = 0.865$) or surgery ($F = 0.018$, $p = 0.896$; $t = -0.054$, df = 14, $p = 0.957$).

Table II compares perceptions of PBL and tutorial styles for students' ratings of individual and aggregated attitudinal statements of "personal" and "practical" experiences. The negative *t*-value for all comparison demonstrates a clear perception of the value of PBL over tutorial styles. For the aggregated personal and practical scores, for all practical statements and the personal statements "provided a forum for checking my understanding of the topic", "developed problem-solving skills relevant to my practice" and "prepared me for continuing professional development" the differences were significant.

Students identified the ideal number of people in the PBL (mean = 6.2 ± 1.55, $n = 15$) and tutorial (mean = 12.7 ± 3.54, $n = 7$) groups and the difference in number was significant ($F = 2.360$, $p = 0.140$; $t = -5.973$, df = 20, $p = 0.0002$).

Considering the preferred learning method, student feedback demonstrated that five out of six students preferred the PBL method of learning after the medicines module, whereas, only one out of four would prefer PBL after the surgery module. Two students in the surgery PBL group preferred a

Table II. Student ratings of attitudinal statements.

	Statement	Mean	95% confidence interval	*t*-value	*P*
	Enabled me to meet my personal learning objectives	PBL 28.94 Tutorial 43.00	PBL 19.93 Tutorial 14.45	−1.768	0.091
	Developed my literature retrieval skills	PBL 36.31 Tutorial 50.75	PBL 27.16 Tutorial 15.92	−1.380	0.181
	Provided a forum for checking my understanding of the topic	PBL 28.44 Tutorial 55.50	PBL 22.30 Tutorial 17.60	−2.988	0.007
Personal	Developed problem solving skills relevant to my practice	PBL 22.69 Tutorial 57.62	PBL 18.29 Tutorial 20.41	−4.249	0.000
	Was relevant to my usual clinical practice	PBL 22.62 Tutorial 44.12	PBL 29.37 Tutorial 26.00	−1.752	0.094
	Prepared me for continuing professional development	PBL 27.25 Tutorial 52.50	PBL 28.29 Tutorial 19.29	−2.262	0.034
	Aggregated personal score	PBL 22.70 Tutorial 52.10	PBL 16.03 Tutorial 13.29	−4.465	0.000
	Encouraged me to find things out for myself	PBL 20.19 Tutorial 61.00	PBL 18.63 Tutorial 20.25	−4.919	0.000
	Provided me with a comfortable, non-threatening learning environment	PBL 25.69 Tutorial 47.12	PBL 16.75 Tutorial 20.41	−2.752	0.012
	Fostered supportive critical discussion with my fellow learners	PBL 22.75 Tutorial 58.43	PBL 16.19 Tutorial 19.98	−4.535	0.000
Practical	Provided me with enough opportunity to contribute	PBL 20.50 Tutorial 42.37	PBL 17.89 Tutorial 13.08	−3.059	0.006
	Fostered a supportive, collegiate approach	PBL 22.75 Tutorial 59.37	PBL 16.43 Tutorial 23.13	−4.494	0.000
	Was an enjoyable approach to learning	PBL 27.25 Tutorial 52.50	PBL 28.29 Tutorial 19.29	−2.322	0.034
	Aggregated practical score	PBL 27.71 Tutorial 50.58	PBL 17.91 Tutorial 11.10	−3.289	0.003

PBL ($n = 16$) tutorial ($n = 8$). Independent samples *t*-test, df = 22. In all cases, Levene's test was not significant so equal variances were assumed.

combination of methods. Excluding these students there was no significant difference between medicine and surgery for preference of learning style (Fisher's exact test, $n = 10$, $p = 0.190$).

Open comments regarding the best and worst aspect of the two learning methods identified that PBL encouraged information research in unfamiliar areas, was practice-based and promoted interaction.

Students who undertook PBL in medicine favoured PBL as a learning style, but this was less the case in the surgery group. The disadvantages of PBL identified by students in surgery were poor attendance by group members and lack of relevancy to the assessment. The number of students who attended the six surgery sessions (mean = 3.8 students per session ± 0.41, $n = 6$) compared with six medicine sessions (mean = 4.6 students per session ± 0.70, $n = 10$) was significantly less in surgery ($F = 2.559$, $p = 0.132$; $t = 2.428$, df 14, $p = 0.029$).

No significant differences were found in respondents aggregated perceptions for the attainment of learning outcomes across topics for PBL and tutorial methods ($F = 10.686$, $p = 0.004$, equal variances not assumed; $t = -1.268$, df = 13.497, $p = 0.226$).

Discussion

Changing to PBL has both advantages and disadvantages. An advantage is that there is no longer a requirement to encompass full knowledge as up-to-date packs underpinning programmes of study. Rather, students are directed to locate and assemble current knowledge in pursuit of their learning. A potential disadvantage for PBL is that there is less control over the exact knowledge that individuals take from their learning. This dilemma prompted the current study.

The findings of this study complement the growing body of literature in demonstrating no significant difference in knowledge, understanding and attainment of curriculum learning outcomes between PBL and traditional learning methods (Norman & Schmidt, 1992; Albanese & Mitchell, 1993; Vernon & Blake, 1993; Colliver, 2000; Newman, 2003). The authors conclude that the adoption of PBL does not undermine pharmacists' knowledge-development when compared with traditional methods.

In addition, the literature implies the educational attainment of transferable skills through the adoption of PBL. In common with the above studies, feedback showed that students tended to favour PBL as a method of learning. The attitudinal findings (Table II) revealed a universal direction favouring the adoption of PBL. Reassuringly, the three statements that were not significant are outcomes or skills logically common to both methods. Had significant differences been found, this would have lead to questions regarding the tutorial approach. Furthermore, those statements where one would expect PBL to be more favourably compared were very significant. From these findings, it can be taken that PBL provides a more developmental learning experience for this target audience but that both methods meet perceptions of fundamental learning experiences. With the adoption of PBL it is imperative that the skills created in students are fully recognised. The authors do believe that attainment of a certain level of knowledge must be an essential part of any clinical programme. The nature of that knowledge must be a discussion between employers and educationalists to suit local demands.

The concept of PBL is to give the student problem-solving skills for application within the workplace. Ideally, it should be considered that PBL sessions be run within the individual student's work environment. However, in order to ensure consistent facilitation it was necessary to have dialogue between the authors acting as facilitators as they crossed over in facilitating both medicine and surgery groups. Clearly, if PBL were to be ideally implemented there would have to be regular and searching dialogue between tutors at the different teaching sites. This has workload and administrative implications that necessitate a "distance-learning-like" approach. An aspect considered by the authors was that tutors of postgraduate programmes might be antagonistic towards the requirement for re-skilling as PBL facilitators and deskilling of their current role. This is a problem that has been noted in the literature (Wood, 2003). It follows that for HEIs to adopt PBL it must clearly inform tutors of these implications, support their development and make them integral to the learning process. This approach was adopted in a further study the results of which are yet to be published.

It was never the intention of the authors to adopt a complete PBL approach to a full course of post graduate learning for clinical pharmacists, as the fundamental necessity of the Clerkship in order to demonstrate knowledge in practice is considered important. However, the Clerkship is philosophically similar to the PBL approach with its observation of practice, problem-solving *in situ* and the necessity to gather and synthesise information to provide clinical pharmacy services.

From this research, PBL can be considered complementary to the clerkship in empowering students with the necessary skills of independence, enquiry, synthesis of information and critical evaluation that must be demonstrated for pharmacy practitioners in secondary care settings. As tutors are essential to the Clerkship, those in clinical specialities and with a higher level of practice knowledge will always be required; however, they may themselves evolve to be consultant practitioners. Their role may

be to ensure the attainment and maintenance of clinical competencies as their understudies specialise in later years of their careers (Department of Health, 2005).

In this initial trial, 5–7 students were in each PBL group, as identified as the optimum number from the literature of evidence (Walton & Matthews, 1989). Students identified the desired number in a PBL group to be significantly less than in a tutorial group. This has implications on human resources in the form of staff time for facilitation, organisation and training (Colliver, 2000; Wood, 2003). Since non-attendance was a problem identified in the surgery module of this study, if attendance cannot be mandated, then group size must be a balance between being small enough for group dynamics and large enough for low attendance. This is not a problem in undergraduate settings where attendance may be mandated or at the very least controlled.

Relying on the pure attainment of knowledge is a risk management issue and unsustainable in the long term. Students cannot be taught everything that they would ever need to know. This necessitates a shift in the way postgraduate pharmacists are taught. One possible solution is the adoption of PBL.

In order that PBL is accepted there is a requirement that the outcomes of PBL in terms of skill can be mapped to the emerging clinical competencies as part of Agenda for Change in the UK (Department of Health, 2004). The long-term view of adopting a PBL approach must be that they map with the emerging competencies for clinical practitioners. This is an activity that HEIs will need to prioritise in order to integrate learning with the rapid change in practice.

A methodological strength of the current study is the crossover design of the study which controlled for variables that may affect student performance such as the quality of delivery of the tutorials and facilitation skills of the tutor. Individual student performance was controlled for by randomly selecting students for each of the groups. There were no differences in gender or age for the participants in the two groups.

The limitations of this study were the small numbers of students involved and that previously validated data collection instruments were not available necessitating the use of "in-house" tools.

One reason why it was not feasible to compare PBL and tutorial groups for the claimed outcomes, such as transferable skills, was the embryonic development of assessment instruments capable of delineating the skill base development of students following the PBL experience. Whilst, there are recognised instruments there is limited experience of their use within postgraduate pharmacy education in the UK. It is however, the authors' intention to apply these assessments at a postgraduate level. Methods of assessment designed for PBL described by Macdonald and Savin-Baden (2004) include "Tripartite assessment", the "Triple jump" and the "Patchwork text".

There were several conclusions drawn from this study relating to the idea that PBL is a potential new style that may be adopted by HEIs providing postgraduate clinical pharmacy education. In addition, PBL may be a solution to the inevitable changes required of pharmacy postgraduate education in order to accommodate the rapidly evolving clinical role of pharmacists. In order to apply a smooth transition from traditional teaching methods, it has been found that adoption of PBL maintains the development of knowledge and understanding when compared with tutorial learning. Positive outcomes of the study include that students perceive significantly enhanced practical and personal experiences with PBL compared with tutorial methods. Lastly, the adoption of PBL is predicated on minimum numbers to ensure appropriate group dynamics.

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