Problem-based learning in the fourth year of the MPharm at Manchester

This article describes the implementation of problem-based learning in the fourth-year undergraduate curriculum at the School of Pharmacy and Pharmaceutical Sciences at the University of Manchester.

Problem-based learning (PBL) is a method of learning that combines aspects of collaborative and self-directed learning. Students are presented with a case or scenario and work as a small group to identify the aspects they do not fully understand; these are documented as learning objectives. Subsequently, the students carry out independent self-directed research to find explanations to the learning objectives, before returning to the group to discuss their acquired knowledge. This process is clearly defined, follows a series of steps and is facilitated by a tutor. In Manchester the students apply an eight-step process as defined in Panel 1. This is a modified version of the “seven-jump” process that originates from the medical school in Maastricht.

Theory behind PBL

PBL was first developed by Barrows at McMaster University in Canada in the mid-1960s; it is now frequently used in medical schools in the UK and worldwide. Many medical schools, including the University of Manchester, have converted to an exclusive PBL curriculum. PBL is also used in the undergraduate education of nurses and there are reports of its use in occupational therapy, chiropody and physiotherapy. Several schools of pharmacy in the UK have recently introduced some PBL sessions into their degree programmes.

PBL was developed as a teaching method by Barrows based on a desire to allow medical students to learn by working with problems. It aims to help students apply and integrate their existing knowledge and to identify and fill gaps in their knowledge. It also encourages the students to develop essential skills in problem solving, self-directed learning and teamwork. In the health care professions, the students are learning in context by working with real life patient cases. They can see the relevance of what they are learning and are forced to develop clinical reasoning skills. Furthermore the students must look for clues, analyse the information available, develop hypotheses and apply deductive reasoning to the problem. This challenges them with similar situations to those they will face in their professional careers.

The use of small group work, self-directed learning, peer support and the development of critical thinking may also help to prepare for continued learning as a postgraduate. In medicine, there is some evidence that PBL graduates keep more up to date than their traditionally taught peers.

PBL teaches essential skills where patients become taught peers. In the second review by Vernon and Blake comparing PBL with more traditional methods of medical education, the results revealed that PBL was significantly superior with respect to students' attitudes and opinions about their course. The results were also significantly superior with respect to measures of students' clinical performance, although students studying by PBL and traditional methods did not differ on tests of factual and clinical knowledge. A further study of medical students' perceptions of the skills and knowledge acquired during their course following the introduction of PBL found significant improvements in a number of important skills. These included critical thinking, problem solving and decision making.

However, a more recent review completed by Colliver in 2000 questioned the value of PBL in undergraduate medical education. The review claimed that the effect sizes between PBL and traditional student groups were usually only small revealing a lack of clear proof of PBL over traditional methods. Colliver also believed that much of the research that had been done does not provide evidence that would warrant such a major change in converting a curriculum to PBL.

What is the evidence in support of PBL?

Evaluation of PBL in undergraduate education has mainly been confined to medical education. In 1993, two systematic reviews of PBL in medical undergraduate education were published; these were cautiously optimistic about the short-term and long-term outcomes of PBL compared with traditional teaching methods. The first, a meta-analysis by Albanese and Mitchell, reported that, compared with traditional teaching, PBL is more enjoyable and graduates perform well, and sometimes better, in clinical examinations. However, students in a few instances scored lower on basic sciences examinations and viewed themselves as less well prepared in the basic sciences than their traditionally taught peers. In the second review by Vernon and Blake, comparing PBL with more traditional methods of medical education, the results revealed that PBL was significantly superior with respect to students' attitudes and opinions about their course. The results were also significantly superior with respect to measures of students' clinical performance, although students studying by PBL and traditional methods did not differ on tests of factual and clinical knowledge. A further study of medical students' perceptions of the skills and knowledge acquired during their course following the introduction of PBL found significant improvements in a number of important skills. These included critical thinking, problem solving and decision making.

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Panel 1: The eight steps of problem-based learning

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
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<tr>
<td>1. Clarify terms</td>
<td>Identify any unfamiliar words and terms; other group members may be able to provide definitions. Scribe lists unexplained terms or words.</td>
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<tr>
<td>2. Define the questions or problems to be discussed</td>
<td>All students are encouraged to contribute their view. Scribe records a list of agreed questions or problems.</td>
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<tr>
<td>3. Brainstorm</td>
<td>Students produce possible explanations to the problems, drawing on each other’s prior knowledge, experience and common sense.</td>
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<tr>
<td>4. Arrange explanations</td>
<td>Analyse explanations in detail and arrange into possible solutions.</td>
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<tr>
<td>5. Define learning objectives</td>
<td>The group works together to agree a set of learning objectives. The tutor encourages the group to make them specific, achievable in the time allocated, comprehensive and appropriate.</td>
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<tr>
<td>6. Research</td>
<td>Students use a variety of resources to find information relating to the learning objectives.</td>
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<tr>
<td>7. Share results of private study</td>
<td>Students share the results of their private study with the group and try to integrate these into a comprehensive explanation.</td>
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<tr>
<td>8. Discuss clinical experience</td>
<td>Students discuss their clinical experience in the light of their understanding. The tutor checks their learning and provides feedback on group functioning.</td>
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Comparisons between students in PBL and conventional courses are difficult because conventional testing instruments are geared towards traditional teaching methods and so tend to test knowledge recall rather than application and problem solving. In addition, PBL is composed of multiple components that interact, therefore any assessment method which does not capture all these components may minimise the differences seen.12,13

The PBL pilot project

PBL tutorials were introduced into the pharmacy degree at the University of Manchester for the fourth-year students as a pilot in 2002. Four tutorials were incorporated into the clinical pharmacy practice (CPP) course. The CPP course is taught in three teaching hospitals and is an integral part of the curriculum for all students in their third and fourth years of the MPharm course. This practice-based teaching has been designed to complement the subjects concurrently taught in lectures in pathology and therapeutics at the university.

Following feedback from the students and tutors involved in this pilot, the number of PBL tutorials for each student has been increased to 10 with no other changes made to the original pilot course. These tutorials now operate throughout the fourth year of the degree as part of the CPP course. The current course is described below.

Course structure and content

Students are allocated alphabetically to one of the three teaching hospitals at the start of their third year and attend in groups of eight to 10 on a fortnightly basis. All students remain in the same groups at their base hospital throughout the course wherever possible. This enables them to develop good working relationships with the tutors and to gain a thorough understanding of the working practices of their base hospital. Importantly, it also creates a good environment for developing group-working skills within the peer group.

The PBL course consists of 10 tutorials. Each tutorial uses a patient case to illustrate a common disease process and pharmaceutical care issues. The tutorials are timetabled to mirror clinical topics covered in lectures and take place within two weeks of the relevant lecture. The clinical topics covered in the fourth-year tutorials are heart failure, asthma, multiple disease states, diabetes, osteoporosis, infection, renal disease, rheumatology, psychiatry, and liver disease.

The cases were written by the clinical tutors. Each case is separated into at least three parts, to enable the students to concentrate on a smaller number of key issues at one time. A number of cues are included in each part of the case to encourage discussion. These could be symptoms, abnormal test results or drugs with which the students are unfamiliar.

Using the eight-step PBL process, students identify their own learning objectives. However, to ensure that all groups of students discuss the most relevant areas, standard aims and objectives are included for each case. This also means that each tutor works with the same aims and objectives irrespective of the site on which the course is taught. An example of typical aims and objectives for a tutorial is shown in Panel 2.

Student introduction to PBL

All students initially attend a two-hour introductory PBL workshop at the university at the beginning of the fourth year. The workshop begins with an introduction to PBL and the eight-step approach used at the University of Manchester. The students are then allocated into small groups and are given an opportunity to attempt a PBL case. A diabetes case is used to illustrate the format of a typical case and students are asked to work through the first five steps of PBL to identify their group learning objectives. The learning objectives identified by each group are then shared with the whole year and any problems experienced during the process are highlighted and discussed. Steps six to eight of the PBL process are not covered in the workshop. The students are also shown video clips of a group of medical students attempting the same PBL case. The medical students who appear in the video are experienced at working in PBL groups, thus providing the pharmacy students with a good example of a functioning PBL group. Students begin their PBL tutorials at their hospital base in the two-week period following the introductory workshop.

What happens in each PBL tutorial?

Each tutorial is attended by the group of students and a tutor, who facilitates the session. The students elect a chairman and a scribe to record the discussion. Each member of the group has the opportunity to be chairman and scribe for a tutorial. The role of each member of the group is defined in Panel 3.

The students work together as a group to analyse the case following the eight-step approach to PBL. Initially, the students read the case. They then discuss each part of the case in turn and the scribe documents the questions they have relating to it. Once they have identified all their questions, they return to each

Panel 2: Problem-based learning tutorial 10 — liver disease

Aim
The aim of the tutorial is to introduce the students to the practical aspects of pharmaceutical care for patients with liver disease.

Objectives
By the end of the session the students should be able to:
- Describe changes in liver function tests that occur in patients with liver disease
- Describe the rationale for prescribing the following in liver disease: lactulose, thiamine, menadione, propranolol, spironolactone
- Identify counselling points for patients with liver disease
- Discuss the drug treatments used to manage alcohol withdrawal

Panel 3: Roles of participants in the tutorials

Chairman
- Ensures the group discusses the case using the eight-step approach
- Encourages all members of the group to participate
- Keeps control of the discussion
- Keeps to time
- Ensures group keep to task in hand

Scribe
- Records the group discussions
- Works with the group to formulate the learning objectives
- Participates in the discussion

Group members
- Follow the eight-step PBL approach
- Participate in the discussion
- Listen to and respect opinions of other group members
- Ask open questions
- Research the allocated learning objectives
- Share information with the group
- Ensures the group discusses the case using the eight-step approach
- Encourages all group members to participate
- Helps the chairman with group dynamics and keeping to time
- Ensures the scribe keeps an accurate record of the discussion
- Prevents side-tracking
- Ensures group achieves appropriate learning objectives
- Checks understanding
- Gives feedback on performance

Objectives
- The CPP course is taught in three teaching hospitals at the start of the fourth year of the pharmacy degree at the University of Manchester. The students are allocated alphabetically to one of the three teaching hospitals at the start of their third year and attend in groups of eight to 10 on a fortnightly basis. All students remain in the same groups at their base hospital throughout the course wherever possible. This enables them to develop good working relationships with the tutors and to gain a thorough understanding of the working practices of their base hospital. Importantly, it also creates a good environment for developing group-working skills within the peer group.
- The PBL course consists of 10 tutorials. Each tutorial uses a patient case to illustrate a common disease process and pharmaceutical care issues. The tutorials are timetabled to mirror clinical topics covered in lectures and take place within two weeks of the relevant lecture. The clinical topics covered in the fourth-year tutorials are heart failure, asthma, multiple disease states, diabetes, osteoporosis, infection, renal disease, rheumatology, psychiatry, and liver disease.
- The cases were written by the clinical tutors. Each case is separated into at least three parts, to enable the students to concentrate on a smaller number of key issues at one time. A number of cues are included in each part of the case to encourage discussion. These could be symptoms, abnormal test results or drugs with which the students are unfamiliar.
- Using the eight-step PBL process, students identify their own learning objectives. However, to ensure that all groups of students discuss the most relevant areas, standard aims and objectives are included for each case. This also means that each tutor works with the same aims and objectives irrespective of the site on which the course is taught. An example of typical aims and objectives for a tutorial is shown in Panel 2.

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one and brainstorm the possible explanations. Here the students are required to work to-gether to draw on and share their existing knowledge and experience, and hypothesise about possible solutions. The group then collectively identify the elements of the case with which they are still unsure; these are documented as learning objectives. The learning objectives are divided equally between the group.

A variety of resources are made available to the students by their tutor. The students learn how to obtain information from many sources, including interviewing patients and reading their medical notes, speaking to ward staff (pharmacists, doctors and nurses) and by using textbooks and journal references. A significant proportion of their time is spent interviewing patients; this provides them with the opportunity to learn about the disease and its management from the patient’s perspective. Other health care professionals, eg, physiotherapists, community psychiatric nurses and dietitians, are sometimes used as additional resources.

Once students have achieved their learning objectives, this new information is integrated with their existing knowledge and the students attempt to formulate a solution to the problems identified. Finally, each tutorial culminates with all students presenting their findings to their peers. A group discussion is facilitated by the tutor and all participants reflect on how the tutorial worked.

Course evaluation

As part of the pilot PBL course a questionnaire was designed to evaluate students’ perceptions of this method of learning. The questionnaire was developed by the College of Pharmacy Practice course tutors and module leader and was based on a previously validated questionnaire used within the University of Manchester medical school. The students were asked to score their performance in the areas of group work, group interaction and activity and problem solving. They were also asked to score their confidence in PBL and to describe what they found useful and what they would change about the tutorials.

Students completed the questionnaire anonymously at the end of their final PBL tutorial. A total of 88/107 completed forms (82 per cent) were returned. To evaluate their confidence in PBL, the students were asked to rate three statements on a four-point Likert scale. The results are shown in Table 1.

When asked to describe what they found useful the most frequently cited comments were, “it developed team working skills”, “we learn from each other and get the opportunity to discuss problems”, and “it reflects real life, puts theory into practice and reinforces knowledge”. When asked what they would change about the tutorials, the most frequent comment was, “we need more sessions to get used to the PBL process”, and they proposed starting PBL earlier in the course.

Discussion

The introduction of PBL into the MPharm curriculum aims to help graduates practise effectively as pharmacists. The skills they potentially gain include teamwork, self-directed learning, patient interview and communication skills, and the ability to apply knowledge into practice.

Teamworking Regular participation in a PBL group develops teamwork skills, of which the students have limited experience elsewhere in the university curriculum. They learn what makes a successful team, including the importance of active involvement of all members of the group, listening and showing respect for each other’s views and making constructive suggestions. It is hoped that this experience will help students develop the ability to work within an effective team, whether this be in primary or secondary care. Students have the opportunity to take on the role of chairman or scribe within the group. As chairman, a student gains experience of facilitating teamwork and leading a peer group. As scribe for the group, a student develops skills in listening, presenting, collating and organising information. These skills are also important for future pharmacists in all branches of practice.

Communication skills Communication skills are practised and developed throughout the PBL process. Students use their communication skills during interviews with various members of the group. They are also encouraged to take the initiative to ask questions and to communicate successfully with their colleagues, patients and other health care professionals.

Self-directed learning The essence of PBL is self-directed learning. Discussing the example case study and real patient cases within the PBL group enables the students to apply their existing knowledge both to test their understanding of a subject and to identify gaps in their knowledge. In researching answers to learning objectives, students gain experience of using various sources of information and have time to develop knowledge of where specific types of information can be found. This observation is supported by research in medical education where PBL has been shown to increase students’ use of information sources and develop information-seeking skills at an earlier stage.

Implications for future practice

As pharmacists approach continuing professional development (CPD), it is imperative that they are able to reflect on their practice and identify areas that require further development. This concept is central to PBL since the students themselves identify and agree on learning objectives for each session. They are also responsible for deciding how they will fulfill their objectives and for considering the extent to which they have achieved this. Therefore the process follows the recommended cycle of reflection, planning, action and evaluation that is the key to continuing professional development.

Supplementary prescribing is a new challenge for pharmacists. Those involved must have a full appreciation of their role within the wider health care team and a close understanding of the patients for whom they are prescribing. PBL emphasises the use of clinical resources, which directs the students’ attention to the patient-centred approach. Being able to listen and communicate well with the patient is an essential skill for supplementary prescribers and the introduction of PBL into the undergraduate course enables this to be developed from an early stage. This teaching method may also be of use for future initiatives involving multidisciplinary learning or joint teaching of communication skills.

Limitations of the PBL course

The initial PBL pilot involved only four tutorials. Feedback from both the students and the tutors identified that introducing this new learning style at this stage of the course was too late. The students felt they did not have enough time to “get to grips with the PBL process” and therefore achieve the proposed benefits. As a result the number of tutorials was subsequently increased to 10. Extending PBL to the third year tutorials has also been considered.

Within the clinical pharmacy practice course, the time allocated for each PBL tutorial is limited to three hours. This differs with the PBL timetable used by the University of Manchester medical school, where each case is run over a period of two weeks. Pharmacy students have less time to undertake their research into the learning objectives, which may result in them researching the questions in less depth. Due to time limitations, it is also necessary for pharmacy students to divide the learning objectives between the group; thus each individual student only researches a small amount of the full information required. The students are thereby forced to rely on the research and communication skills of their other group members to obtain answers to all the problems identified. Finally, medical students may benefit from having more time to spend on the ward, interviewing patients and other health care professionals, and looking at patients’ notes.

Table 1: Student assessment of individual confidence in problem-based learning

<table>
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<tr>
<th>Percentage of students</th>
<th>Confident</th>
<th>Unsure</th>
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<tbody>
<tr>
<td>Confidence in knowledge of topics</td>
<td>66</td>
<td>24</td>
</tr>
<tr>
<td>Confidence in taking part in PBL group</td>
<td>77</td>
<td>23</td>
</tr>
<tr>
<td>Does PBL suit individual learning style?</td>
<td>55</td>
<td>45</td>
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Scored using a four-point scale ranging from very confident to very unsure.
As identified earlier, assessment methods currently used in both medical and pharmacy education may not detect the acquisition of clinical skills developed in the PBL group process. Currently pharmacy students are set coursework tasks that require groupwork. However, it is recognised that this is not a true assessment of participation in the PBL process.

Introduction of PBL into the MPharm course gave the undergraduates increased experience of group work. The tutors facilitating PBL groups noticed a wide variation in group functioning; some groups worked well together from an early stage in the course, while others did not function effectively as a team. Introducing formal teaching on group working skills at the university before starting the PBL tutorials was a later development to address this issue.

The introduction of PBL tutorials into the course was also a new experience for the clinical tutors, who needed to develop the necessary skills required to facilitate the groups. These skills are different from those involved in other, more traditional, teaching methods. Thus appropriate continuing training of the tutors has been an important element of the introduction and development of the course.

**Limitations of course evaluation**

The questionnaire used to evaluate the students’ perceptions of this method of learning was based on a previously validated questionnaire as described earlier. In the questionnaire, the students were asked to score their group’s performance in the areas of group work, group interaction and activity, and problem solving. The questionnaire did not attempt to measure their individual contribution to group functioning and group performance. Development of a new scale with two components, a measure of how well the group functions in addition to an assessment of the individuals’ contribution to the group, will be addressed in the future.

**References**

Further to the originally published information, Adele Mackellar is employed by Wythenshawe Hospital, South Manchester University Hospitals Trust, Jennifer Silverthorne is employed by Hope Hospital, Salford Royal Hospitals NHS Trust, and Suzanne Thomas is employed by Manchester Royal Infirmary, Central Manchester Healthcare NHS Trust.