EDUCATION

Problem-based learning as an alternative to lecture-based continuing medical education

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Do you pick up most of your new information in the lecture theatre? Do you believe that all-day pressure on the gluteus maximus whilst accumulating continuing medical education (CME) points is the best way to keep up to date? Do you think that Royal Colleges know best? If your answers to these questions are all yes, then this article is not for you. If, on the other hand, your experience is that there is little connection between sitting in lectures and improving knowledge and skills, and that lecture-based CME is largely a waste of time, then this article may be of interest.

TEACHER KNOWS BEST—OR DOES SHE?

Figure 1 shows two little boys in their school playground, with their teacher. The teacher decides what the boys do for each lesson; she decides which books they read; she corrects any mistakes they make; she orders their homework, and she sets and marks any tests. She also supervises them at lunch, and she helps them if they have trouble changing their clothes or doing up shoe-laces.

As one can see, the boys are very happy with this arrangement, but would grown adults like to be dressed up in a school uniform and treated in this way? Of course not. The fact is that adults (we use this term to mean being responsible for one's own life, and self-directed) are not just large children. Unfortunately, the way that children are taught at school is the only way of thinking about education that many people know, for until recently it has dominated school education, and even adult education. Table 1 summarizes the five main differences between a stereotyped traditional pedagogy ('child learning') and the model that is predicted by the adult learning theory[1]. Looking at the differences between the two models, it is plain that the standard lecture-based CME fits best with the model that one might associate with the educational needs of a small child. No wonder that many are questioning lecture-based point-collecting forms of CME[2,3].

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Figure 1 **Two boys in the school playground with their teacher**

HOW DO WE LEARN AND STORE NEW INFORMATION?

As is well known to doctors who have qualified in the UK, huge amounts of information can be crammed into the human brain. This is how we passed our anatomy, physiology and biochemistry examinations. However, much of this information rapidly evaporates.

From various experiments we know that learning is an active rather than a passive process, and the

Table 1 **Differences between the old pedagogy and adult learning behaviour**

Traditional learning model	*Adult learning model*
The concept of the learner The learner is a dependent person. The teacher has full responsibility for making all decisions about what should be learned, how and when it should be learned, and whether it has been learned	The adult learner is self-directing
Orientation to learning Learners are subject-oriented, and the curriculum is organized according to subjects	Adults are usually motivated after they experience a need in their life; they enter with a life-centred, task-centred or problem-centred orientation to learning. Learning experiences need to be oriented to life rather than to subject matter
Motivation to learn Primarily external pressures from parents and teachers, competition for grades, and the consequences of failure	Although external motivators exist, the more potent motivators will be internal: self esteem, better quality of life, greater self-confidence
Readiness to learn Learners mature from grade to grade, becoming ready to learn what they need in order to advance to the next grade level. Readiness is largely a function of age	Adults become ready to learn when they experience a need to know or do something
The role of the learner's experience Learners enter with little experience that is of value as a resource in learning	Adults enter into an educational activity with greater volume and different quality of experience. Adults are themselves a rich resource for one another

prerequisites for storage of a new item of information are as follows:

(*a*) If it is to be stored long-term, the new piece of information must be glued to a piece of information already in the memory. Loose facts have nowhere to go and are lost[4]

(*b*) Adhesion between the new and old pieces of information is much more likely if the old piece of information has been retrieved, and also cleaned and dusted (i.e. thought about and maybe modified)[5]

(*c*) When information is stored, there is simultaneous storage of irrelevant information. This irrelevant information is about the *context*. For example, when recalling details of a patient in hospital, one will also remember irrelevant information such as the location of the bed on the ward. This contextual information is important; recall of information is much more difficult when the context has changed. This explains why, when you are in the supermarket and encounter somebody from work, you may be unable to put a name to the face. Transfer of knowledge from one situation to another is generally very poor[6]. The more a new situation resembles an old situation, the better will be the transfer[7]. This is one of the reasons that learning in context is important[8].

Lectures can be defined as 'an academic period set aside for rest and recovery'. Although there are ways to liven up lectures and strategies to make them more effective, they are mostly passive experiences in practice, and they take place far from a clinical context. The prerequisites for the storage of information are not met. Lectures do not usually stimulate learners to construct explanatory models and to elaborate when acquiring new information, whereas modern theories of the science of learning and cognition emphasize the importance of active learning.

IS THERE ANY OTHER WAY?

Effective learning demands that all learners participate rather than merely act as observers. They need to choose the topic or problem, to decide how to tackle the subject and to anticipate what is likely to be learnt, and they need access to learning resources, which could be a library, an expert or the internet. One approach, which we examined as an experiment at a recent Royal Society of Medicine meeting, is to adapt problem based learning (PBL) as a tool to be used in a CME setting. We will very briefly describe PBL, explain how it works, and discuss the pros and cons of using it in CME.

WHAT IS PROBLEM BASED LEARNING?

In problem based learning, the learner (undergraduate or postgraduate) is confronted with problems. These problems are discussed in small groups, through a series of well defined steps[1]. During the discussion, learners activate their

existing knowledge. After discussion of the problem, the group identifies gaps in its knowledge and detects areas that need further study. These needs are formulated as learning objectives. Subsequently, learners spend time on self study with a view to acquiring new information that will shed light on the learning objectives that were generated. The group then reconvenes for a second meeting to share, compare, integrate and critically appraise its findings and apply the new information to the problem. Application of the newly acquired information to the problem helps to stimulate the transfer of knowledge, because the learning takes place in context.

Definition of the learning objectives is assumed to foster the learner's self-directed learning skills. During self study, the learner has to search for appropriate learning resources (e.g. library materials, computerized literature service, video material), and this too is thought to foster the development of self-directed learning skills. The role of the teacher is to design trigger and other material that will interest and motivate the learner. The teacher will also direct learners to the appropriate types of learning resources. Apart from the design and provision of the trigger material and resources, the whole educational process is in the control of the learner.

Faced with the trigger material, the learners, who are in small groups of 8–10, go through a series of well defined steps[1]. After discussion of the problem, the members agree what they need to study, their specific learning objectives. The group then reconvenes a few days later to share, compare and critically appraise its findings, and integrate new information with existing knowledge.

DOES PROBLEM BASED LEARNING WORK, AND IF SO HOW?

PBL achieves five main objectives[9,10].

Structuring of knowledge

Several studies demonstrate that students in undergraduate PBL curricula integrate their knowledge of basic science concepts into clinical problems better than students in conventional curricula[11–14]. An emphasis on patient problems is assumed to have this effect by integrating basic and clinical sciences. Clinical performance and skills of students exposed to PBL are superior to those of students from traditional curricula[15]. A possible explanation is that learning arises from patient problems that help integrate clinical and basic science knowledge. A critical issue is not 'greater knowledge' but the quality of knowledge. Through PBL, students are likely to acquire knowledge that is relevant to clinical problems, gain a deeper understanding and so better remember and recall the information.

Development of an effective clinical reasoning process

Hmelo *et al.* compared the effects of a PBL course and a traditional course on problem solving[16]. The results showed greater use of hypothesis-driven reasoning in the PBL group and a greater coherence in the learners' explanations.

Through the presentation of different patient problems in a clinical setting, PBL provides practice in analysis. The nature of problem solving changes with experience. Thus while undergraduate students may use creative strategies, graduates attending CME sessions are likely to have a data-bank of common problems and a repertoire of common solutions. One envisages that PBL would enable participants to share their solutions or experiences and spend considerable time reflecting on these.

Better retention of information

Reviewing the published work for evidence supporting the theoretical advantages of PBL, Norman and Schmidt[17] noted the observation in several studies that PBL learners retain knowledge much better than students receiving conventional teaching. PBL leads to better recall of information for three reasons[8]. First, mobilization of previous knowledge stimulates learners to construct explanatory models, and this facilitates the processing and comprehension of new information. Secondly, new information is better understood if learners are stimulated to elaborate on it. Elaboration in PBL can take several forms, such as discussion, note-taking or answering questions. Thirdly, learning in context makes information more accessible for later use.

Development of self-directed learning skills

Work by Blumber and Michael[18] supports the hypothesis that PBL enhances self-directed learning skills. During both preclinical and clerkship years PBL students borrowed more material from the library than students from a conventional curriculum. In another study, graduates from a PBL curriculum, after being in a position to observe the performance of graduates from conventional curricula, viewed themselves as better prepared in independent learning skills, problem solving and self evaluation techniques[15]. Both studies demonstrated that PBL students are good library users and that PBL students perceive themselves as good self-directed learners.

Increasing motivation for learning

The student-centred learning approach of PBL increases motivation because students themselves define the learning issues and decide for themselves what is relevant for their learning[19]. In addition, discussion of problems enhances

intrinsic interest in subject matter because it involves the learners more actively in the issues at hand[20].

COULD PROBLEM BASED LEARNING BE USEFUL IN CME?

At present, lecture-based CME seems more concerned with attendance levels than with helping adults to acquire knowledge or skills. The need to demonstrate some sort of activity (to reassure the public that professionals are doing something about keeping up to date) has eclipsed real efforts to see how professionals can improve knowledge and skills. Indeed some Colleges have ruled that self-directed activities such as reading medical journals, consulting specialists and other colleagues, or attending colleagues' ward rounds should not earn any CME credits. These startling regulations may help to explain the sight of boxes of medical journals unopened and still in their original wrappers (Figure 2). Lectures and the credit-based systems of CME have the merits of catering for large audiences of doctors and of administrative convenience, but have dubious educational impact[21]. Another failing of CME is the emphasis on content base: Harden and Laidlaw[22] argue that the presentation of a series of facts is often seen as the basis of CME. Building on previous knowledge and experience, with opportunities for immediate application, is known to facilitate adult learning.

Compared with lectures, PBL has several advantages in CME. Firstly, if CME programmes link the educational context with a professional context and emphasize identification of the learners' needs, CME will stimulate interest and motivation. This could be done by allowing doctor-learners to bring or choose problems from their day-to-day work. Not only does this make the doctors more actively involved in their own learning but it also addresses their need for security and self-esteem; a doctor who is uncertain about how to deal with a clinical problem may feel insecure. When he or she learns what to do and what to expect as the patient responds to management, the future is more predictable and satisfying.

PBL encourages integration of information through linking the educational context with a professionally meaningful context for learning. Instead of presenting a series of facts, CME programmes could encourage participants to apply what is learned to other situations and confront each other with different cases. As learners are so confronted they learn to identify which solution strategy is effective in which circumstances and why[6]. Presenting topics in a meaningful context that applies to the learners' job will improve the relevance of CME programmes. Another way that PBL could assist CME is by encouraging development of self regulatory skills. In CME programmes learners should be confronted with cases

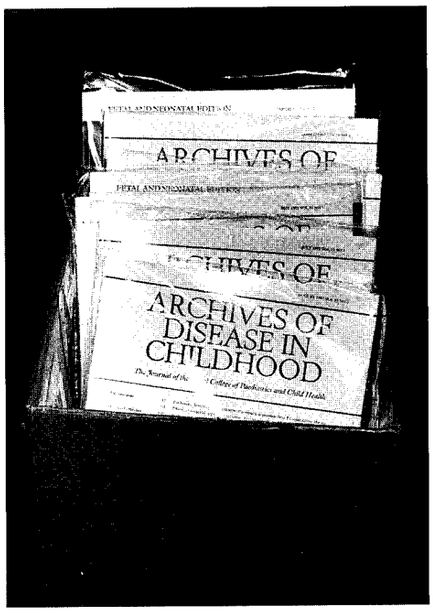

Figure 2 **Unopened *Archives of Disease in Childhood* seen in the office of a UK paediatrician**

from which they identify their own deficiencies and weaknesses and learn to remedy them by efficient use of relevant resources.

Practising doctors have many demands on their time. PBL allows exchange of information that is of greater value than lectures in terms of the amount and quality of learning per unit time. Finally, and maybe most important of all, the use of PBL may convert a passive process of observation into an active form of participation.

The difficulties that we encountered in our experiments with PBL at the RSM are organizational and psychological. One is the requirement for the same group to reconvene a few days after meeting for the first time, in order to share information. Trying to assemble a group of doctors on one occasion is hard enough, but to get the same group together a few days later is near impossible. Another difficulty is how to persuade doctors to produce details of problem cases; doctors often seem reluctant to admit ignorance, an inhibition that is lethal to PBL.

As far as one-day meetings at the RSM are concerned, a variation on the PBL process as described above could be to discuss problems in the first part of a morning session. Identification of gaps in the participants' knowledge would generate learning objectives; then, for the second half of the morning and part of lunchtime, the participants could use the RSM library and spend time on self study to acquire new information. In an afternoon session the participants could meet again and apply their new findings to the problems discussed in the morning.

There has been one randomized controlled trial of PBL in CME[23]. A group of 1500 family physicians attending a one-day CME course were randomly allocated to three

groups—traditional didactic lecture, large group case discussion, and PBL. This study had methodological limitations, notably a much lower response rate by the traditional teaching group (53%) and the case discussion group (46%) than by the PBL group (96%). A particular difficulty is the lack of information both about what was meant by the term PBL and what learning resources (if any) were available to the participants. For what it is worth, this study documented that those allocated to the PBL group rated the short course more favourably than those who attended the other two groups.

CONCLUSIONS

As a tool, PBL may have more to offer CME than the 35 mm slide. An essential feature is active involvement of all participants, as opposed to the passive activity of sitting in a lecture theatre. The availability of a well-stocked medical library and rooms for small group work means that the RSM would be well placed to evaluate PBL in a CME setting. The RSM experiment on 25 March 1997 demonstrated two things. One is that, with the help of experienced PBL tutors, doctors who are total strangers to PBL can rapidly pick up the skills to participate in PBL small group sessions. The other is that PBL is fun.

Acknowledgments On 25 March 1997, the Section of Paediatrics conducted an experiment in the use of PBL rather than a lecture-based format for a one-day meeting. This article arises out of this meeting, and we thank all the participants for their comments. We are especially grateful to Dr Tim Dornan for his helpful advice on the paper.

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