

Learning in practice

Problem based learning in continuing medical education: a review of controlled evaluation studies

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Problem based learning is one of the best described methods of interactive learning, and many claim it is more effective than traditional methods in terms of lifelong learning skills, and is more fun.¹ In the early 1990s, four systematic reviews of undergraduate medical education cautiously supported the short term and long term outcomes of problem based learning compared with traditional learning.²⁻⁵ Since then, many medical curricula have changed to problem based learning, but a recent review has questioned the value of problem based learning in undergraduate medical education.⁶

Postgraduate and continuing medical education differ from undergraduate education in that they go beyond increasing knowledge and skills to improving physician competence and performance in practice, ultimately leading to better patient health.⁷ Problem based learning may also be effective in this context.⁸ There is some evidence that interactive sessions can change professional practice, but there have been few well conducted trials.^{9 10}

We could find no reviews of the effectiveness of problem based learning in continuing medical education. Controlled evaluation studies provide the best evidence of effectiveness of educational methods, in line with the movement of best evidence medical education.¹¹ We therefore conducted a systematic review of the literature to find out if there is evidence that problem based learning in continuing medical education is effective.

Methods

Literature search

We searched the databases Medline, Embase, PsycLit, the Educational Resources Information Centre (ERIC), the *Cochrane Library*, and the Research and Development Resource Base in CME on the Internet (RDRBWEB) from 1974 (the year Neufeld and Barrows published their new approach to medical education) to August 2000. We searched for studies with the keywords "problem-based (PBL)," "practice-based," "self-directed," "learner centred," and "active learning." We combined the search results with another search using the keywords "continuing medical education (CME)," "continuing professional development (CPD)," "post-professional," "postgraduate," and "adult learning." Finally, we conducted a manual search of relevant references in the included studies.

Summary points

Reviews of undergraduate medical education cautiously support the short term and long term outcomes of problem based learning compared with traditional learning

The effectiveness of problem based learning in continuing medical education, however, has not been reviewed

This review of controlled evaluation studies found limited evidence that problem based learning in continuing medical education increased participants' knowledge and performance and patients' health

There was moderate evidence that doctors are more satisfied with problem based learning

Inclusion criteria

We included studies in which the author(s) had indicated that the educational intervention was problem based and in which the learning process in essence resembled the methods used at McMaster University or the University of Maastricht.^{12 13} This consists of a tutor facilitated, problem based learning session in which a small, self directed group starts with a brainstorming session. A problem is posed that challenges their knowledge and experience. Learning goals are formulated by consensus, and new information is learnt by self directed study. It ends with a group discussion and evaluation.

For this review, we included keywords to find relevant educational articles in the total domain of postgraduate and continuing medical education and continuing professional development. We scanned all the studies collected for controlled trials with a pretest/post-test design. Because of the small number of randomised trials, we did not exclude other types of controlled trial. With this strategy, we hoped to find all relevant controlled studies on problem based learning in continuing medical education.

Review method of selected studies

Two reviewers (PBAS and JHAMV) independently assessed the quality of the studies using five quality

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Details of criteria
used to assess
quality of studies
appear on bmj.com

Table 1 Quality assessment of six studies evaluating effectiveness of problem based learning in continuing medical education

Study	Scores for quality criteria*						Quality of study†
	Randomised assignment to group?	Follow up sufficiently long and complete?	Intention to treat analysis?	Participants and observers blinded?	Groups similar at start?	Total score	
Chan et al 1999 ¹⁵	10	5	10	0	10	35	High
Heale et al 1988 ¹⁶	5	8	0	0	0	13	Low
Doucet et al 1998 ¹⁷	5	8	10	0	5	28	High
Benjamin et al 1999 ¹⁸	5	8	10	0	0	23	Low
Moran et al 1996 ¹⁹	0	8	10	0	0	18	Low
Premi et al 1994 ²⁰	0	8	10	0	0	18	Low

*Each criterion has maximum score of 10, and maximum total score is 50.

†Total scores ≥ 25 indicate high quality, and scores < 25 indicate low quality.

criteria. Each criterion was allotted a maximum of 10 points, making a maximum possible score of 50 points (see appendix on bmj.com for more details). We discarded a sixth possible criterion, that groups should be treated equally, with the exception of experimental education.¹⁴ Many factors may influence the outcome of education (tutor, educational materials, lecture rooms, etc), and it was not possible to extract this information from the studies: we therefore could not assess equal treatment of groups.

Studies with a total score of ≥ 25 points were considered to be of high quality, and those with < 25 points were of low quality. We distinguished two different categories of study by the control groups: in one category problem based learning was compared with a more lecture based programme, while in the other it was compared with no educational intervention.

Outcome variables

For each study, we looked for four outcome variables—participants' knowledge, performance, and satisfaction and patients' health—and assessed the level of evidence on these. We graded the evidence for the effectiveness of problem based learning as strong if there was a positive outcome in two high quality studies, as moderate if there was a positive outcome in one high quality and one low quality study, as limited if there was a positive outcome in one high quality study or one or more

low quality study, and none if there was a contradictory outcome or no outcome.

Results of literature search

Six controlled trials met our inclusion criteria.^{15–20} A manual search of references from these studies did not yield any new trials that met our criteria. Five of the studies assessed the effect of continuing medical education on general practitioners. Four studies contained over 50 participants,^{16–18 20} and two had fewer than 20.^{15 19}

Table 1 shows the results of our quality assessment of the six studies. Two studies were of "high" quality,^{15 17} and the others were "low." Two of the trials were randomised trials.^{15 16} In Heale et al's study, however, the group of randomly allocated doctors was combined with a group who did not want to participate in the entire study.¹⁶ Whether the randomisation is valid in terms of equality of groups is unclear.

Results of studies

Table 2 shows the results of the six studies. Outcome measurement was often restricted to only one variable. No study measured both the preferred outcome variables—participants' performance and patients' health. In one of the high quality studies—problem

Table 2 Results of six studies evaluating effectiveness of problem based learning in continuing medical education

Study	Participants	Study design	Educational intervention		No of participants		Outcome variables (PBL v control)				
			PBL	Control	PBL	Control	Participants' knowledge	Participants' performance	Participants' satisfaction	Patients' health	Follow up
Chan et al 1999 ¹⁵	General practitioners	RCT	Email PBL	Internet resources	8	11	No effect	NA	NA	NA	NA
Heale et al 1988 ¹⁶	General practitioners	RCT	Small group PBL	Large group discussion, didactic lecture	22*	39*	No effect	No effect	Higher†	NA	No effect‡
Doucet et al 1998 ¹⁷	General practitioners	CT	PBL	Lecture format	34	29	Positive	Positive	Higher	NA	NA
Benjamin et al 1999 ¹⁸	Staff of outpatient clinic	CT	PBL	None	~50§	~50§	NA	NA	NA	Positive	Positive¶
Moran et al 1996 ¹⁹	General practitioners	CT	Learner centred small group	None	5	10	NA	Positive**	NA	NA	Positive¶ **
Premi et al 1994 ²⁰	General practitioners	CT	Practice based small group	None	78	46	Positive**	Positive††	High score‡‡	NA	NA

RCT=Randomised controlled trial. CT=Controlled trial. PBL=Problem based learning. NA=Not assessed.

*No information on number who completed knowledge test at end of trial.

†P value not given in article.

‡Only participants' knowledge tested on follow up.

§Information from author, not given in article.

¶Only participants' performance tested on follow up.

**PBL group's post-intervention scores compared with own pre-intervention scores.

††75/78 participants reported 127 practice changes as result of PBL.

‡‡Mean (SD) score of 5.8 (0.9) on 7 point scale for PBL group.

based learning via email versus use of internet resources—neither educational programme increased participants' knowledge, but group size was small.¹⁵ The other high quality study—problem based versus lecture based learning—showed positive results for problem based learning in terms of participants' knowledge, clinical reasoning, and satisfaction.¹⁷ It is unclear whether these effects can be attributed to the problem based learning format, however, because of differing periods of educational exposure.

Table 3 shows the level of evidence we found for the outcome variables. With the three studies that compared problem based learning with another educational format, we found no evidence that problem based learning affected participants' knowledge and performance and moderate evidence that it increased participants' satisfaction. None of the studies measured patients' health. The other three studies compared problem based learning with no educational intervention and were of low quality. They show limited evidence that problem based learning was effective in improving participants' knowledge and performance and patients' health (table 3). Differing degrees of satisfaction cannot be compared in this study design.

Conclusions

We found few relevant studies, of varying quality. There is no consistent evidence that problem based learning in continuing medical education was superior to other educational strategies in increasing doctors' knowledge and performance but moderate evidence that it led to higher satisfaction. There is limited evidence that problem based learning increased doctors' knowledge and performance and patients' health more than no educational intervention at all.

However, the studies in which the control group received no educational intervention can give information only on the effects of receiving education, not of the specific educational method. With the studies that compared problem based learning with another method, in order to deduce that one educational intervention is more effective, the content, process, and influencing variables in both interventions must be clearly stated. The information on the educational interventions given in the three studies can be rated as completely absent,¹⁶ poor,¹⁵ and reasonable.¹⁷

In studies not restricted to problem based learning, there is some evidence that interactive educational methods in continuing medical education are more effective in changing doctors' performance and patients' health.⁹ The results of this literature study on problem based learning in continuing medical education seem to be comparable with those on problem based learning in undergraduate medical education.²⁻⁴

Studying the effectiveness of education is complex,^{21 22} but we should be able to perform studies of higher quality than those reviewed here, especially when comparing educational methods. As our review found, it is apparently not impossible to randomise participants to different educational methods. We have to do better in defining an educational method and controlling what actually happens in educational practice. We also have to clarify the aims of our education. Is our objective to increase knowledge, change

Table 3 Level of evidence on outcome variables measured in six studies evaluating effectiveness of problem based learning in continuing medical education

Outcome variable	High quality studies		Low quality studies		Level of evidence*
	Positive result	Negative result	Positive result	Negative result	
Problem based learning v other educational interventions					
Participants' knowledge	1	1	0	1	None
Participants' performance	1	0	0	1	None
Participants' satisfaction	1	0	1	0	Moderate
Patients' health	0	0	0	0	None
Problem based learning v no educational intervention					
Participants' knowledge	0	0	1	0	Limited
Participants' performance	0	0	3	0	Limited
Patients' health	0	0	1	0	Limited

*Possible levels of evidence: strong, moderate, limited, or none (see Methods for details).

attitudes, or improve health care? Outcome variables should correspond with our objectives, and preferably several different variables should be measured, including participants' performance and patients' health.⁹ There seems to be agreement that a small significant effect found is evidence of effectiveness.^{21 23} Evaluation is further complicated by professional and social context, as is shown in research on implementation of guidelines.²⁴ This calls for randomisation, because observational studies can easily be biased by these factors.

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Learning needs assessment: assessing the need

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Learning needs assessment has a fundamental role in education and training, but care is needed to prevent it becoming a straitjacket

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It might seem self evident that the need to learn should underpin any educational system. Indeed, the literature suggests that, at least in relation to continuing professional development, learning is more likely to lead to change in practice when needs assessment has been conducted, the education is linked to practice, personal incentive drives the educational effort, and there is some reinforcement of the learning.¹ Learning needs assessment is thus crucial in the educational process, but perhaps more of this already occurs in medical education than we suspect. The key lesson might be for those who design new systems of education and training: for example, the postgraduate education allowance system in general practice was felt to fail the profession because it did not include needs assessment and so led to ad hoc education to fulfil the time requirements of the system rather than the needs of individual doctors or the profession as a whole. On the other hand, basing learning in a profession entirely on the assessment of needs is a dangerous and limiting tactic. So a balance must be struck.

Learning needs assessment in medicine

In 1998 both individual and organisational needs assessment became part of government policy in relation to the continuing professional development and personal development plans of all healthcare professionals.² Thus, it has a role in the clinical governance of the service³ and is therefore much more than an educational undertaking. This integration of needs assessment, education, and quality assurance of the service was first made explicit in 1989 in relation to clinical audit, which would identify practices in need of improvement and ensure that educational and organisational interventions were made to address these needs.⁴ Accordingly, audit was described as "essentially educational" and the educational process surrounding it described.⁵

Long before these recent developments, needs assessment outside medicine was presented as an important part of managed education and learning contracts, which are the predecessors of the personal development plans to be developed for all NHS healthcare professionals.⁶ In his descriptions of adult

Summary points

Learning needs assessment is a crucial stage in the educational process that leads to changes in practice, and has become part of government policy for continuing professional development

Learning needs assessment can be undertaken for many reasons, so its purpose should be defined and should determine the method used and the use made of findings

Exclusive reliance on formal needs assessment could render education an instrumental and narrow process rather than a creative, professional one

Different learning methods tend to suit different doctors and different identified learning needs

Doctors already use a wide range of formal and informal ways of identifying their own learning needs as part of their ordinary practice

These should be the starting point in designing formalised educational systems for professional improvement

learning Knowles assumed (he did not claim to have research evidence) that learners needed to feel a necessity to learn and that identifying one's own learning needs was an essential part of self directed learning.⁷ In medicine a doctor's motivation to learn would therefore derive from needs identified during his or her experience of clinical practice. So the pedigree and practice of learning needs assessment, if not the evidence, are well established.

The definition of need

As in most areas of education, for many years there has been intense debate about the definition, purpose,