The problem-based learning tutor: Teacher? Facilitator? Evaluator?

ALAN J. NEVILLE
McMaster University, Hamilton, Ontario, Canada

Introduction

Despite the structural heterogeneity of problem-based learning (PBL) curricula, most PBL schools have embraced self-directed learning, emphasizing the use of small-group discussion and integration of the basic medical sciences with clinical problems. Self-directed learning is but one of the many terms such as discovery method or study-centred education adopted by authors since Dewey to describe an educational approach that places the learner in control of his or her learning (Knowles, 1975). The putative benefits of self-directed learning include enhanced opportunities to elaborate one's knowledge through active involvement and verbalization, enhanced motivation through an increase in relevance and personal control, and the practice of skills needed in lifelong learning (Schmidt, 1983).

In this educational milieu, the role of the 'teacher' requires revision; new skills are required of the teaching faculty so that they are willing and competent to allow students to take an active role in guiding their own learning and in teaching one another (Barrows & Tamblyn, 1980).

This review explores the literature that has developed around the definition of the teacher or tutor role in 'facilitating' the learning of students in a PBL setting. Several controversies have arisen over the optimal role of the faculty person in facilitating a PBL tutorial group, including level of participation, content knowledge and involvement in student evaluation. While it appears that there is probably no completely satisfactory resolution of these controversies, from a review of the frequently conflicting pieces of evidence, an attempt will be made to synthesize from the literature a coherent picture of an effective tutor in the PBL setting.

The PBL tutor: issues defining the debate on roles

Barrows has claimed that the task of the tutor in a problem-based tutorial group should be to facilitate the learning of students rather than to convey knowledge (Barrows & Tamblyn, 1980). In developing this educational approach, Barrows considered that tutors must allow students to determine on their own what they need to know, and to learn through the study of varied resources. Rather than telling students what they should learn and in what sequence they should learn, the tutor must help students determine this for themselves (Barrows & Tamblyn, 1980). By 'facilitation of learning', Barrows clearly emphasized process-facilitation skills as crucial for the learning of students, in contradistinction to tutors' relevant subject-matter knowledge, a distinction which has been the subject of much debate and considerable controversy. Barrows stated bluntly, "A faculty person who is a good tutor can successfully tutor in any area" (Barrows & Tamblyn, 1980, p. 107).

Before dissecting the arguments for and against the particular issue of content knowledge as a prerequisite for successful PBL tutoring, some background discussion is required of the factors that relate to the role of students and tutors in the PBL small-group tutorial.

In his monograph on self-directed learning, Malcolm Knowles described the 'fundamental and terribly difficult' change in self-concept in moving from 'teacher' to 'facilitator of learning' (Knowles, 1975). He wrote: "It required that I focus on what was happening to the students rather than on what I was doing. It required that I divest myself of the protective shield of an authority figure and expose myself as me—an authentic human being, with feelings, hopes, aspirations, insecurities, worries, strengths and weaknesses. It required that I extricate myself from the compulsion to pose as an expert who had mastered any given body of content and, instead, join my students honestly as a continuing co-learner". Later, he added "I found myself, for example, functioning primarily as a procedural guide and only secondarily as a resource for content information".

The debate about what constitutes effective 'facilitation' of student learning in PBL merits close scrutiny, since I believe that the evidence cited in the literature favouring a role dichotomy between process facilitator and content resource may be more apparent that real and that there is evidence pointing towards consideration of a balanced interaction of these functions as the optimal tutor role. This is an important concept to consider, as faculty, familiar with directing students in lectures or seminars, can have difficulty adopting the role of PBL tutor, even after faculty development training sessions (Neufeld & Barrows, 1974) and, mistakenly, may develop the belief that tutoring is nothing more than the observation of process and tutorial dynamics. Thus they may feel that they have little to contribute. The result is a polarization of faculty attitudes to PBL, whereby tutors feel constrained to act either as 'wallflowers' in the group or, alternatively, as directive lecturers. Neither of these behaviours facilitates tutorial process or learning.

A second issue requiring clarification relates to the learning process. Andragogical self-directed learning in a PBL environment stresses a student-centred approach to learning where students determine their learning objectives, how to learn them and to evaluate what they have learned (Walton & Matthews, 1989). During the course of 'problem

Correspondence: Professor Alan J. Neville, McMaster University, Faculty of Health Sciences, Undergraduate Medical Programme, HSC, Room 2E18, 1200 Main Street West, Hamilton, Ontario, L8N 3Z5, Canada. Tel: +905 525 9140; fax: +905 528 4727.

ISSN 0142-159X print/ISSN 1466-187X online/99/040493–09

solving' students identify knowledge deficiencies of their own, a process that epitomizes self-directed learning as espoused by Coulson (1983). Yet it is fallacious to assume that to be successful the entire educational process of PBL must be entirely self-directed. Faculty design the overall curriculum to a greater or lesser extent in most institutions and often design the vehicle of instruction, i.e. the written health-care problem. One can contrast highly student-centred curricula (such as the New Mexico Primary Care track, where faculty-generated objectives are not available to the students) with the relatively faculty-centred curriculum of the PBL track at Michigan State University (Blumberg *et al.*, 1990).

The Undergraduate MD Programme at McMaster University is somewhere between these two extremes (Neufeld & Barrows, 1974). Whether the curriculum itself appears to be student or faculty centred need not in itself influence the effectiveness of the tutor in facilitating the learning process within tutorials; in other words, a faculty-centred curriculum can be associated with a tutorial process wherein student-centred self-directed learning can flourish.

Thus sceptical and confused faculty need some guidance in developing their role as PBL tutors, balancing a natural desire to be directive and 'teach' with the desired goal of enhancing student-centred self-directed learning. One significant area to be addressed is the following: What evidence can be adduced from the literature to enable tutors to avoid the false role dichotomy described above? Some answers can be found in both the cognitive psychology literature and in empiric studies of PBL tutorial function.

Second, if there is an argument for tutors acting as a content resource in tutorials, one can ask "how much content knowledge should the tutor process and what is the most effective way of expressing this knowledge? Third, is it worth considering the merits of varying the degree of tutor 'directiveness' in learning facilitating depending on the level of PBL training of the students? Given the emphasis on process facilitation by some authors, one could argue for the development of student or peer tutoring rather than the more 'expensive' use of faculty tutors. In assessing the literature relevant to these issues, one must be cognizant of the different outcomes being measured, i.e. student satisfaction, student performance or both. Studies relating to tutor involvement in tutorials, tutor content knowledge expertise and the role of peer tutoring will be described in the next three sections of this review. Following this, the role of the tutor in student evaluation will be explored briefly, since this is an area of tutor function that has been studied very little.

Tutor involvement in tutorial and small-group learning

The development of PBL approaches to medical education, with learning taking place in small-group tutorial settings, has taken place alongside increasing interest in psychological research into the effects of cooperative small groups on learning. The research into educational achievement has in, general, produced results favourable to the concept of cooperative group learning (Webb, 1982), although not all reviews have concluded that working in small groups is beneficial for learning. For example, Michaels (1977) concluded that individual competition consistently produced greater achievement than group conditions. Discrepancies in the psychology literature relating to group learning and individual achievement have been attributed to particular cooperative learning techniques, settings, measures, experimental designs, student characteristics and subject-matter. From a thorough review of the existing evidence published in 1982, Noreen Webb (1982) concluded that an individual's role in group interaction is an important influence on learning—and that interaction can best be predicted from multiple characteristics of the individual, group and setting. These studies from the psychology literature suggest a complex interaction of student and tutor variables and bear closer scrutiny by those developing PBL curricula.

As an example, in describing the decision-making processes when the McMaster Undergraduate MD Programme was being planned, William B. Spaulding, in his book *Revitalising Medical Education*, writes: "They [the planners] made some naive assumptions, chief of which was that the only necessary ingredients for a successful tutorial group were a small number of students and a faculty member. Little or no consideration was given to group dynamics. They did not foresee the difficulties that can arise when a group of people of diverse personalities, backgrounds, and ages mix in an intense learning situation; it was taken for granted that students and tutors would be considerate of each other's learning needs and altruistic enough to help each other find approaches and solutions to the topics under discussion" (Spaulding, 1991, p. 42). Implicit in these words is that the underlying assumptions made by programme planners were sometimes proved false in the light of early experience of running PBL tutorials.

In reflecting on how the prospective PBL tutor might prepare for the role of learning facilitator, Malcolm Knowles (1975) identified seven elements for an andragogical learning process design. These can be paraphrased as follows:

(1) *Climate setting*: helping the learners become acquainted with each other as persons and as mutual learning resources, develop the skills of self-directed learning and understanding the role of the tutor;
(2) *Planning*: deciding on how tutorials will run and how tutorial process and function decisions are to be made;
(3) *designing needs for learning*: consideration of how the tutor can frame content objectives so that students can take ownership of the learning process and compare their existing knowledge with the required objectives;
(4) *setting goals*: helping the students translate the diagnosed needs into clear, feasible learning objectives;
(5) *designing a learning plan*: helping the students design their learning plans, develop strategies for accessing resources etc.;
(6) *engaging in learning activities*: whereby the tutor considers what part of the learning should be his/her responsibility and what the students should be responsible for, collectively or individually;
(7) *evaluating learning outcomes*: how to give constructive feedback to the students so as to enhance the self-directed learning process.

Armed with Knowles's elements of facilitation, one can begin to explore the literature describing empiric studies of PBL in action.

Perhaps the most important problem facing the faculty individual in a PBL tutorial setting is determining the degree of 'directiveness' to assume to achieve the necessary learning

facilitation without detracting from student self-directed learning. It would be wrong to assume that the concern is only on the part of the tutors. Many students enter a PBL learning situation feeling a need for the security of a clear structural plan, i.e. a course outline or syllabus, time schedule etc. They may feel 'at sea' in the somewhat structureless environment of PBL. In addition students have concerns about whether they are going to 'get' the required content to pass their exams (Knowles, 1975, p. 37). Several studies reporting on students' perceptions of PBL curricula suggest that students would prefer more 'direction' than they are getting. Blumberg & Eckenfels (1988) reported that students were dissatisfied with the lack of structure in their PBL curriculum. In addition, McMaster students identified the lack of definition of core material as a weakness in their Undergraduate MD Programme (Woodward & Ferrier, 1982).

Other groups have reported some unease on the part of students, particularly when they first approach the PBL tutorial method. In Maastricht, medical students at the University of Limburg were uncomfortable with the tutorial process at first and the tutorial interactions were of highly variable quality (de Vries *et al.*, 1989). Unfamiliarity with the PBL process and poor feedback were cited by students at Michigan State University who were dissatisfied with the PBL track (Shope, 1989). Davis *et al.* also noted that students who were led by more directive tutors rated their enjoyment of PBL in small groups more highly (Davis *et al.*, 1982).

The discomfort that students themselves may have in the PBL setting is not to be taken as an argument for the tutor to be 'directive' throughout the tutorial process. The concerns raised by Knowles earlier have been echoed by others. Neame & Powis (1981) have addressed the issue of structure in tutorial and the role of the tutor in tutorial discussion. They firmly believe that the development of students as independent learners requires deliberate curricular planning. They envisage a PBL curriculum in which there is a gradual progression toward total independence of learning "via a graded reduction of imposed structure". "In this regard, earlier course segments would be prepared with precise objectives specified and with directive materials provided while the student becomes familiar with the language, discipline, basic concepts and outline of medical studies" (p. 889). This implies that as students' competence and knowledge increase, the tutor's role or style should change. Thus one might be tempted to conceive of the novice and expert PBL student whose needs would mature over curricular time and the requisite tutor role would need to adopt *pari passu*. We will return to this issue in the section on tutor content expertise.

It is from this perspective that one can perhaps judge the findings of other studies that have attempted to define the processes and dynamics of the PBL tutorial. Wilkerson *et al.* have defined five qualities that they felt discriminated self-directed as opposed to faculty-directed tutors: (1) who initiates topics for discussion; (2) the style and pattern of tutor talk; (3) the use of questions; (4) the pattern of student–tutor interaction; (5) silences and interruptions. These parameters of tutorial function were defined from observations of four tutorial groups in action (Wilkerson *et al.*, 1991). Thus, in this framework, it is the tutor who is defined as student directed or not, rather than the tutorial process itself. Wilkerson's group would describe student-directed tutors as allowing students to initiate and sustain discussion, using infrequent questions to guide group process. Such tutors probe for understanding, encourage students to listen to one another, tolerate silence and collaborate by postponing their own suggestions, acceding to students' selection of objectives, fostering a feeling of cooperation rather than competition (Wilkerson *et al.*, 1991).

In a subsequent study, Wilkerson was able to condense this descriptive framework into two general skills that both students and faculty agreed were important. The first desired skill or behaviour was 'guiding the work of the group', i.e. essentially the roles of probing, questioning, achieving a balance of clinical and basic science emphasis, and the second skill, 'promoting interaction', described issues relating to successful tutorial dynamics (Wilkerson, 1992). These two studies did not particularly address the issue of student familiarity with the PBL process at the time the tutorial observations were being made, but one can perhaps envisage a mechanism whereby the relative emphasis on the five factors described by Wilkerson *et al.* could be modified to optimize the climate of learning for different PBL learners.

It is important, however, for new tutors to resist the temptation to share their knowledge over-enthusiastically with their tutorial groups. In one study, Thomas (1992) reported that new tutors might dominate up to 80% of tutorial time. A similar desire to share expertise was noted by DesMarchais *et al.* (1992). In a contrasting vein, tutor directiveness has been related to the time-efficiency of the tutorial process. Gruppen *et al.* (1992) were able to demonstrate a potential 50% time savings in tutorial time if the tutors were clearly directive. While this finding might be appealing to those in the administration of PBL curricula, the potential for detrimental effects on students' satisfaction and self-directed learning is clearly significant, albeit as mentioned earlier, dependent on the familiarity of the students with PBL.

Thus far, the evidence points towards steering a path between the Scylla of stifling student discussion by authoritative intervention and the Charybdis of unconcerned detachment, insensitive to student learning needs. Equally problematic, according to Collier (1980) is the "constructively" aggressive tutor who "counters the collusion of some groups to deny conflict to arrive at a quick consensus" (p. 58). Preferable to this is the tutor "who acts as a catalyst, clarifying and amplifying without prescribing" (p. 58).

Obviously related to how 'directive' the tutor might be in tutorial is the issue of how much the tutor knows about the content material being discussed. Frustration of faculty who are new to the PBL situation reflects the desire to do what teachers traditionally do—impart knowledge. Clearly the more knowledge faculty have about the matter at hand (i.e. content expertise) the greater the temptation to 'direct' the tutorial process. Before reviewing the evidence from studies examining the controversial educational value of 'expert versus non-expert tutors', two related issues need to be addressed: cognitive aspects of the tutor role and peer or student tutors.

Cognitive aspects of the tutor role

The first issue relates to the educational value in cognitive terms of the input of the tutor into tutorial discussion. The strategy of problem solving which best describes the activities within the PBL small-group tutorial is the hypothetico-deductive model. Within this context, the role of the tutor in the problem-solving process can be defined. Many PBL curricula are designed so that the students receive the 'problems' first and attempt to work through them 'cold'. The rationale is that problem-oriented processing may promote eventual processing of an analogous problem (Szekely, 1950). The first study to address this was reported in the 1940s by Szekely, who compared the effect of two instructional sequences on a student's eventual ability to solve a problem in momentum physics. Students were asked to study a text explaining principles relevant to the eventual test problem. One group who had to solve an analogous problem and were given corrective feedback prior to reading the text solved the test problem more frequently than did the group that read the text and then had the solution of the analogous problem presented as an example (Szekely, 1950). Similar results were reported by Schmidt *et al.* (1989) in a study of medical students at the University of Limburg. Group discussion prior to the study of a text concerning osmosis and diffusion facilitated eventual recall of the contents of the text.

A third study which not only confirms the potential value of the 'problem first' approach to PBL but says much about the role of the tutor was reported by Needham & Begg (1991). They attempted to show that problem-oriented training promotes spontaneous analogical transfer of information, i.e. promotes the ability to use information from one problem to solve another problem without an explicit hint to use the previous information. The experiments, which were carried out using first-year psychology students as subjects, basically showed that, if subjects tried to solve a training problem before hearing its solution, or tried to explain a training story's solution before hearing the correct explanation, spontaneous transfer was more likely than it was if subjects had studied the same training passage for memory before hearing its solution or explanation. Of more significance for the tutor role in PBL was the finding that corrective feedback during the preliminary problem solving was important. Without feedback, problem solution rates dropped to about 66% for the 'problem-oriented processors' (from 90%) and to about 57% for the 'memory-oriented processors' (from ~ 70%). In other words, if students are in a problem-solving situation, working through a clinical problem, and are allowed to proceed with incorrect conceptual or procedural understanding of the relevant issues, the benefit of the problem-solving approach to explain future analogous problems is lost. The tutor becomes central, therefore, in 'facilitating' learning by stepping in to correct basic misconceptions that might be leading individuals (or the group as whole) astray. This is not to assert that the tutor should become the self-promoted expositor of all the basic conceptual issues in tutorial but that he/she should remain alert to the discussion, able to step in and steer the discussion appropriately. This epitomizes the role of facilitator. Clearly the tutor needs to know when to step in—and can only do so if he/she understands something of the content under discussion. Again, this brings up the issue of content expertise of tutors, which will be discussed in full in the next section.

In her review of problem-based learning, Laenora Berkson (1993) questions the validity of accepting these three studies at face value. She compares the problem-solving context of each of the three studies, which are the relatively well-structured domains of physics, biology and logic, respectively, with what she defines as the ill-structured domain of medicine and finds that direct extrapolation of the results might be inappropriate. In ill-structured domains, the number of problems to which a student is exposed or their prototypicality may influence eventual success in analogical problem solving. In addition, the Needham & Begg study (1991) did demonstrate that memory-oriented processing was a powerful way to ensure subsequent success at analogical problem solving (0% success, attempting to problem-solve cold, rising to 69% after memory-oriented processing). Despite these caveats, however, there is some evidence from the educational and psychology literature to support and define the learning facilitator role of the tutor.

Peer (student) tutoring

In developing the 'facilitator' role theme a little further, the faculty at the medical school at the University of Limburg in The Netherlands considered the issue of student or peer tutors (De Grave *et al.*, 1990). They compared staff and student tutors with respect to tutor behaviour, group function and test achievement of students. Their rationale for considering students as tutors rested on two theoretical behavioural constructs, Role Theory, described by Allen in 1976, and Cognitive Congruence Theory, published by Cornwall in 1979 (quoted in De grave *et al.*, 1990, p. 124).

Role theory suggests that teachers and students have different stereotypical roles with different expectations, responsibilities and status. Theoretically, the role similarity of student tutors and students should have beneficial effects on motivation owing to active, committed enthusiastic student tutors.

Cognitive congruence theory states that experts differ from novices in their cognitive structures. Thus there exists cognitive incongruence between students and staff tutors, but cognitive congruence between students and student tutors. The result of cognitive congruence would be better assessment of prior knowledge of the students when explaining something, and greater familiarity with the language, concepts and examples used by the students (De Grave *et al.*, 1990). These two theoretical constructs were examined by analysis of a questionnaire administered to medical students in a PBL curriculum. The students were also given a true/false (76-item) factual knowledge achievement test. From the 26-item questionnaire, a series of discriminant analyses was performed to discriminate between student-led and faculty-led tutorial groups.

The results indicated that if one used the test achievement score as an outcome, tutorial process-trained undergraduate students perform the role of tutor as well as faculty, since the scores were similar in each group. Thus, for this test of 'factual recall', the cognitive congruence theory was not supported. In terms of tutorial process variables, as assessed by the questionnaire, students from faculty-led groups experienced the tutorials as 'more pleasant' than the student-led tutorials, which tends to

contradict the role theory assumptions described earlier (However, student-tutors were felt to be more concerned with the emotional climate of the tutorial group, thereby supporting role theory). Irrespective of these findings and their putative consonance or dissonance with the two theories laid out in the premise of this study, one significant result was that subject-matter expertise of either type of tutor was a crucial factor in the functioning of tutorial groups on most aspects of tutorial process addressed by the questionnaire. Although those identified as subject-expert student tutors and subject-expert faculty tutors led student tutorials which were overall more 'satisfying', this was not reflected in the achievement test scores. The results from this Dutch study suggest that if student satisfaction is the outcome of interest, content-expert student tutors may perform as well as faculty tutors but the findings have not been replicated elsewhere. A similar study of law students at the University of Limburg purported to show that student-tutored groups scored higher on essay-type questions of 'higher order' concepts compared with students in faculty-led groups (Moust *et al.*, 1989). Quite frankly, the data from this study and a similar study of medical students by Moust & Schmidt (1992) show minimal differences between study groups. The evidence for using students as peer tutors therefore remains unconvincing.

The tutor as content expert

There is a clear divergence of opinion in the literature as to the benefit or disruptiveness of tutor content-knowledge expertise on the facilitation of student learning and tutorial function in PBL. The issue is clearly linked to but remains distinct from directiveness addressed earlier in this review. This is important, because, in some reports, the concern is not only that content expert tutors detract from students' self-directed learning by 'teaching' or 'lecturing' the students with their expertise, but also that they dominate the group dynamic, resulting in less collaborative learning (Zeitz & Paul, 1993). One can examine the topic from the point of view of learning outcomes, student satisfaction or both parameters.

An important aspect of the expert tutor debate relates to the definition of expert (Camp & Anderson, 1993; Zeitz & Paul, 1993). When the McMaster Undergraduate MD Programme was being planned, the term 'expert tutor' was applied to "someone combining clinical and physiological expertise whose research and care of patients focused on one body system" (Spaulding, 1991, p. 43). At the time, the McMaster Education Committee advocated and supported a role for the 'non-expert tutor', reasoning that the non-expert would be less inclined to emphasize detail and more inclined to see things from the view point of students. Later, Spaulding averred in his history of the early days at McMaster that "the notion of an expert tutor was a fallacious simplification" (Spaulding, 1991, p. 43).

Others have defined the term 'expert' very narrowly. Davis *et al.* (1992) studied 201 students in 27 groups in a second-year problem-based course in microbiology. They applied an extremely strict definition of what constitutes an expert tutor. Only those who had an active research interest in the specific topic being covered by the students were considered content experts, i.e. research microbiologists. In comparing groups led by expert and non-expert tutors, it appeared that, indeed, expert tutors showed a trend towards using behaviours such as lecturing or directing the discussion, leaving students less time to introduce their own ideas. Conversely, students in groups led by expert tutors not only scored higher on microbiology items in the final examination but also rated their PBL experiences higher in terms of being time well spent and enjoyable. They gave themselves higher ratings in self-assessment and ability to apply relevant information to the problems being studied (Davis *et al.*, 1992).

An earlier study was carried out in 1988 at Harvard and published by Silver & Wilkerson (1991). The tutorials of four randomly selected first-time tutors (out of a pool of 15) were audiotaped. The research was carried out during an 11-week interdisciplinary course in pathology, immunology and microbiology. Two sessions on two separate cases were taped for each of the four tutors, for a total of eight tutorial sessions. Content expertise of the tutors was assessed by asking the tutors to rate their expertise on each of the topics discussed using a five-point scale. Silver & Wilkerson showed that tutors with expertise played a more directive role in tutorials, spoke more often and for longer periods and provided more direct answers to the students' questions. Expert tutors also suggested more of the topics for discussion. The authors noted that tutor-to-student exchanges predominated, with less student-to-student discussion. They concluded that these behaviours of expert tutors would endanger the development of students' skills in active, self-directed learning, although their results did not explicitly demonstrate this.

Using quite different methodology, de Volder (1982) studied the relationship between tutors' self-perceived subject-matter expertise and students' evaluations of the tutors' functioning. 'Functioning' was assessed by means of a 13-item questionnaire, consisting of items such as 'The tutor intervened when the discussion became incoherent'. Tutor content expertise was positively correlated with items reflecting somewhat directive behaviour, a finding that de Volder interestingly interpreted as reflecting characteristics of more effective tutor functioning.

Somewhat akin to the Davis study is the work of Eagle *et al.* (1992), who demonstrated that content experts were superior to non-experts for both process and outcome measures. Eagle *et al.* studied 70 students at the University of Calgary during an eight-week integrative course, which consisted of 24 ill-defined clinical cases portrayed by simulated patients and supported with added written material. The 17 tutors were all clinicians, and expert tutors were defined as clinicians who would be likely to see the particular type of clinical problem in their practice. Thus tutors were experts for some problems and non-experts for others. The results demonstrated that students guided by content experts produced more then twice as many learning issues for self-directed learning and spent almost twice the amount of time in self-study. Expert-led students also generated two to three times more learning issues congruent with the learning objectives of the problems.

Contrary to the positive outcome measures in the Eagle study, investigators at Sherbrooke found little to support the need for expert tutors (DesMarchais & Black, 1991). They analysed achievement data of two consecutive cohorts of students, 200 in total, and 170 tutors, half of whom were

considered to be content experts. The latter term was defined in terms of the tutor belonging to the appropriate clinical discipline. Three elements of achievement were evaluated: a multiple-choice test, short essay questions and a tutor judgement regarding the individual student's performance. While some differences emerged in one of the classes on the essay tests, overall a composite score of the three measures revealed no significant differences for groups led by expert tutors. Similar results were published by Calvin & Wetzel (1989) in a study of the New Pathway at Harvard.

While assessing objective learning outcomes or observable tutorial processes, some studies have also canvassed student opinions about their level of satisfaction. Davis *et al.* (1992) included student ratings in their study and an Australian study from the University of Newcastle (Feletti *et al.*, 1982) specifically addressed medical students' evaluation of tutors in a PBL curriculum. Feletti *et al.* constructed a 19-item questionnaire and administered it to 50 first-year medical students at the regular end-of-term programme evaluation sessions. Twenty-seven tutors were evaluated. A varimax rotated factor analysis was performed on the questionnaire results and resulted in the identification of four major factors in tutors' behaviour which were important in the rating process. These factors were (a) ability to care for students, (b) a knowledge of course structure and teaching staff philosophy, (c) ability to encourage independent thinking in students and (d) knowledge of the specific medical problems being studied. Using discriminant analysis, the authors found that a thorough up-to-date knowledge of the particular problem being studied was the item that discriminated best between tutors rated in the upper and lower half of the group according to their perceived effectiveness. Clinician experts were rated highly in their willingness to allow students to develop and explore problem solving, a finding similar to Wilkerson's (1992) study which showed that students preferred physician tutors to PhD tutors in balancing basic science and clinical applications, promoting critical appraisal and synthesising multiple perspectives.

In an attempt to resolve some of the discrepancies among the studies debating the value of tutor content knowledge, I have deliberately left until last a review of the bulk of the research from the University of Limburg and a more recent study from the University of Michigan (Davis *et al.*, 1994) because this body of work brings into stark relief the issue of 'oversimplification' alluded to so presciently by William Spaulding (1991).

The early studies assessing the impact of tutor content expertise at Maastricht defined expertise in terms of whether the tutor came from biomedicine, clinical medicine or the social sciences (Schmidt, 1977; Swanson *et al.*, 1990). Both of these studies demonstrated, in end-of-unit multiple-choice tests, achievement levels unrelated to content expertise of the tutor. Clearly this definition of expert differs from that of several of the other authors quoted in this review. Thus, as the authors at the University of Limburg and authors elsewhere have pointed out, the variability in definition of tutor content expertise may partly explain the discrepant findings. Schmidt *et al.*, in Limburg, took this issue a step further in a study published in 1993 (Schmidt *et al.*, 1993). In this study, Schmidt *et al.* chose to adopt the definition of expert employed in the Sherbrooke study of DesMarchais & Black (1991). This wide-ranging studied covered 1120 medical students in four curriculum years and included 152 tutors participating in 336 tutorials. Achievement was measured by 100–150 item true–false tests for first-year students and by short essay questions for subsequent years. An 11-item Likert-type rating scale was used to assess tutor functioning (addressing a variety of tutor behaviours). Students' estimates of self-study time was also measured in light of the findings of Eagle *et al.* (1992) described earlier.

Schmidt *et al.* found that students tutored by experts spent more time on self-directed study and had higher achievement scores. These findings were most noticeable for first-year students, suggesting that novice students were more dependent on their tutors' expertise than advanced students. In addition to the tutors' knowledge-related behaviours, process-facilitation skills affected student achievement. Indeed, these two sets of behaviours were correlated, suggesting that both were necessary conditions for effective tutoring (Schmidt *et al.*, 1993).

Reflecting on the diverse results from studies at his own institution and work elsewhere, Schmidt sought to resolve some of the inconsistencies in tutor expertise research by re-analysing the data from the University of Limburg (Schmidt, 1994). From his survey of the literature, two issues emerged, over and above the definition of the term expert tutor discussed earlier.

The first observation is that, depending on the tutor-training provided, expert tutors may not always demonstrate their content expertise in tutorials to assist students' problem solving. Such was the case in the Sherbrooke study, where the ratings of various facilitative behaviours were equivalent for expert and non-expert tutors for six out of seven criteria evaluated (DesMarchais & Black, 1991). Schmidt also points out that some studies that do show differences in behaviour between expert and non-expert tutors do not report student achievement (e.g. see earlier, the studies of Wilkerson, 1992 and Feletti *et al.*, 1982).

The second issue relates more to the students themselves in the PBL setting. Schmidt declares that it is often observed that students who have little or no experience with PBL rely more heavily on their tutors as sources of guidance and information. Consequently, if these tutors are familiar with the subject-matter, this may have an effect on student achievement. This hypothesis could explain the findings from Limburg that positive effects on achievement of expert tutors were most obvious for first-year students. In a similar vein, the 1992 findings of Davis *et al.* at the University of Michigan could reflect that the PBL microbiology course was undertaken in a curriculum that was otherwise relatively conventional and thus the students were not particularly familiar with PBL (Davis *et al.*, 1992). In addition, the Michigan study, like several others, addressed a single course, rather than an entire curriculum or large block of curricular units.

From this body of research, Schmidt develops a hypothesis that the novice student arrives to begin a PBL curriculum with little prior content knowledge and unfamiliar with the PBL process. Thrust into a self-directed environment which is unstructured, the novice student with little prior knowledge on which to build a scaffolding for

new knowledge needs guidance and relies on the content-expert tutor. If the curriculum itself is heavily structured, such as at Sherbrooke, the effect of tutor content expertise might be lost. Curricular structure and students' prior knowledge are thus viewed by Schmidt as interrelated factors in determining both students' learning strategies and the extent to which the content expertise of the tutor might impact on the learning. Schmidt argues, quite reasonably, that curricular and student heterogeneity across medical schools studied could account for the differences in observed effects of tutor content expertise on student satisfaction and achievement. He concludes that students need a minimum level of structure in order to profit from problem-based instruction. Structure can be provided either internally by prior knowledge or, if prior knowledge is lacking and the curriculum lacks structure, by falling back on the tutor for 'content' support. These conclusions of Schmidt have implications not only for tutors and tutor training, but also for curriculum design in PBL.

One last comment on curriculum structure and its relationship to tutor content expertise can be left to Wayne Davis's group at the University of Michigan. Having reported in their 1992 study on the positive effects of achievement and student satisfaction of 'very expert' tutors, this group repeated their examination of this issue (Davis *et al.*, 1994). In this more recent iteration, all tutors (expert and non-expert) were given highly structured and comprehensive information about a particular case the students were about to study, i.e. the situation was highly focused. Results using multiple-choice test achievement as an outcome showed no significant effect of tutor content expertise, which was mirrored in the assessment of student satisfaction. As Schmidt would probably concur, if enough highly focused curricular structure is achieved, the significance of tutor content knowledge expertise may be diminished.

From this review of the literature on the debate surrounding the issue of PBL tutor content expertise, one can conclude that if the conditions of study are varied enough, either beneficial or detrimental effects on PBL self-directed, student-oriented learning can be inferred. When one combines the results of the empiric studies with information gleaned from the cognitive psychology literature, one gets the impression that problem solving in a knowledge vacuum, without corrective feedback, is frustrating for the learner and inefficient or ineffective in terms of educational achievement. The degree of tutor content knowledge required for effective learning facilitation in PBL is not an absolute quantity but needs to be tailored to the particular student groups' level of prior knowledge and familiarity with PBL.

Tutor as student evaluator

The debate surrounding the use of the tutor in PBL as a student evaluator remains as unresolved as that of the issue of knowledge content expertise. A significant difference is the lack of studies to address the former question.

Tutorial evaluation is central to the entire evaluation process at McMaster (Neufeld &Barrows, 1974). Tutor, peer and self-ratings are used to evaluate many domains such as knowledge, effort, self-directed learning, group skills and communication skills. This is entirely consistent with the philosophy of problem-based learning in small groups which encourages these attributes. Assessing one's own knowledge deficits as a springboard to self-directed learning would also clearly represent the same educational philosophy.

Application of some basic psychometric principles to tutorial evaluation, however, unearths some significant problems with the use of tutorial ratings. In addition, at least one PBL medical school has refused to utilize tutor and peer ratings in summative evaluation because of a 'belief' that the tutor (teacher) and evaluator roles are *incompatible* (van der Vleuten & Verwijnen, 1990). This has not really been formally tested.

What has been tested extensively is the relationship between self-assessment and objective (written or faculty observed) performance (Gordon, 1991). In all but a few instances where the criteria for self-assessment were very explicit (Geissler, 1993), the validity and reliability have been low (van der Vleuten & Verwijnen, 1990). Inter-item correlations related to process issues are frequently high, however, suggesting that raters are providing only a 'global' impression, rather than identifying individual attributes (Gordon, 1991). Blumberg *et al.* at McMaster, however, have challenged the notion that tutorial assessment provides only global impressions by performing a cluster analysis of six dimensions or domains evaluated in tutorials (i.e. problem solving, knowledge, critical appraisal, clinical skills, learning skills and personal qualities) (Blumberg *et al.*, 1994). They found, surprisingly, that the six domains appeared to be evaluated relatively independently with no single domain particularly influencing the outcome of others.

Cohen *et al.* (1993) from the same group have also reported troubling evidence of faculty reluctance to award students unsatisfactory tutorial evaluations. While there may be several reasons for this, it would appear that agreed 'valid' criteria for levels of performance need to be stated explicitly and understood by tutors and students alike (Cohen *et al.*, 1993). Even though much of what is evaluated in tutorials appears to relate to process issues, students with repeated significant deficits can potentially be identified (Blumberg *et al.*, 1995), especially if previous evaluations are forwarded to subsequent tutors (Cohen & Blumberg, 1991). In contrast, Blake *et al.* (1996) found that written tutorial evaluations (accumulated over multiple curricular units or blocks) did not predict performance on a practice licensing examination.

Given that the Association of American Medical Colleges (AAMC) has recommended that subjective faculty assessments should be the main focus of performance evaluation and that psychometric 'solutions' should serve as supplements to, not substitutes for, faculty judgement, it would seem from the evidence presented here that much work needs to be done to increase the 'credibility' of tutorial (tutor and peer) assessment (DaRoza, 1993).

Conclusions

In 1981, Johnson *et al.* published a meta-analysis of the effects of cooperative, competitive and individualistic goal structures on achievement (Johnson *et al.*, 1981). In a very wide-ranging review, not restricted to studies of learners in the health professions, Johnson *et al.* demonstrated the superiority of cooperative learning over interpersonal competition in terms of achievement, knowledge retention,

satisfaction and development of interpersonal communication skills. In this domain of cooperative or collaborative learning, students teach one another; however, PBL medical school curricula have modified this domain by adding a faculty *tutor*.

From all that has been reviewed to this point, one may perhaps need to take issue with Barrow's comment, quoted earlier: "A faculty person who is a good tutor can successfully tutor in any area" (Barrows & Tamblyn, 1980).

The evidence presented suggests that the presence of a tutor facilitates both tutorial process and learning achievement. The matter is not completely closed, however, since there are no studies directly comparing the learning of tutorial groups with or without tutors.

At UCLA School of Medicine, a tutorless format of PBL has been introduced to reduce the demand on faculty time (Duek *et al.*, 1996). From a study conducted in that institution of learning issues identified by students in tutorless tutorials, it was found that the mean core overlap of student and faculty-derived objectives was only 25%, compared with 41% in a study from Limburg using faculty-tutored tutorials. These findings from UCLA suggest that, at least in terms of defining the learning issues, tutors do play a role, especially if other sources of structure are absent from the curriculum.

Employing advanced students as tutors puts these students in the same role as faculty tutors and should not be confused with peer collaborative learning. Parenthetically, the literature on the educational value of student tutors comes mostly from one institution and I think the data are confusing and inconclusive.

Most authors have therefore agreed that faculty should maintain a facilitative role, but the word facilitation is open to interpretation and clearly has elements of both tutorial process and tutorial learning. The degree of directiveness of tutors in tutorials and the content knowledge they are expected to display are widely debated in the literature, and perhaps the best conclusion that can be drawn from the literature is that the tutor's leadership behaviour should not remain the same in all PBL situations, but needs to be varied according to student level or curriculum as described by Schmidt (1994). There is some congruence in this developmental approach to teaching between Schmidt's proposal and Neame & Powis's (1981) conclusions described earlier, which I think are germane to tutor function. The common link is structure. Novice students, with little experience of PBL or prior knowledge, probably benefit from directive and knowledge expert tutors to provide the necessary structure or foundation upon which to build their learning. Davis *et al.* (1994) would add that a highly focused curriculum might compensate to some extent for the level of knowledge expertise on the part of the tutor. As students mature, in knowledge as well as familiarity with PBL, the tutor should become more participatory or delegatory, allowing the students more leeway in deciding what and how they will learn. Simply put, novice students in PBL need some direction or structure, or they may flounder. Mature students can flourish in a far less structured learning environment as they become more self-sufficient. Indeed, directive tutoring for the latter may frustrate and antagonize such students.

As an interesting postscript to this issue, it should be pointed out that the majority of studies cited in this review have described 'context-free' generalizations that assume constant tutor behaviour in different situations, i.e. tutors in different tutorial groups, courses, subject-matter, etc. A recent study by Gijselaers from Maastricht (1997) raises some concerns about interpreting previous work in the field. Using a previously validated evaluation instrument comprising a 12-item questionnaire of tutor behaviour administered to medical students, Gijselaers assessed (a) stability of tutor behaviour, i.e. the extent to which a tutor's behaviour as measured in one course correlated with the same measure in a different course, and (b) generalizabilty of tutor behaviour, i.e. the extent to which measures of tutor behaviour were stable across courses. He also considered the effect of departmental affiliation of PBL tutors.

This study showed that the stability and generalizabilty of tutor behaviour were low and, interestingly, moderately related to departmental affiliation. This study in no way invalidates previous research in the area of effective PBL tutoring but emphasizes that different situations require different tutor behaviour to facilitate student learning, consistent with the thesis proposed earlier by Schmidt (1994). The caveat, however, is that future studies of effective PBL tutoring should probably consider context-specific characteristics and, perhaps, departmental and/or organizational background of PBL tutors.

Finally, as observers of tutorial process, tutors may be able to evaluate certain aspects of professional behaviours and interpersonal communication skills, but there is really very little evidence, from the sparse literature available, that confirms the tutor as an effective evaluator of student performance, particularly knowledge. It would appear that assessment of student achievement is best left outside tutorials.

The extent to which faculty influence learning in PBL remains the subject of debate and further research is required to elucidate the effects of the tutor on the extent or breadth of learning and the development of self-directed learning skills.

However, one can discern from the literature a picture of the ideal tutor who is flexible and sensitive to the student's learning needs and knowledgeable about the curriculum.

Note on contributor

Professor Alan J. Neville is Associate Professor of Medicine and Chair of the Undergraduate MD Program at McMaster University, Hamilton, Ontario, Canada.

References

Barrows, H.S. & Tamblyn, R. (1980) *Problem-Based Learning: An Approach to Medical Education* (New York, Springer).

Berkson, L. (1993) Problem-based learning: have the expectations been met? *Academic Medicine*, 68(10) Suppl, pp. 579–588.

Blake, J.M. *et al.* (1996) Validity of Progress Tests and Tutorial Assessment in Predicting Licensing Examination Performance, unpublished paper.

Blumberg, P. & Eckenfels, E.A. (1988) Comparison of student satisfaction with their preclinical environment in a traditional and a problem-based curriculum, in: *Research in Medical Education: Proceedings of the Twenty-Seventh Annual Conference*, pp. 60–65 (Washington, DC, Association of American Medical Colleges).

Blumberg, P. *et al.* (1990) Roles of student-generated learning issues in problem-based learning, *Teaching and Learning in Medicine*, 2(3), pp. 149–154.

Blumberg, P. *et al.* (1994) Analysis of academic problems encountered by medical students, *Teaching and Learning in Medicine*, 6(2), pp. 96–191.

BLUMBERG, P. *et al.* (1995) The progress of students who encounter repeated difficulties in a problem-based medical school, *Teaching and Learning in Medicine*, 7(1), pp. 23–28.

CALVIN, R.B. & WETZEL, M.S. (1989) Pathology in the new pathway of medical education at Harvard Medical School, *American Journal of Clinical Pathology*, 92(Suppl., October), pp. S23–S30.

CAMP, M.G. & ANDERSON, A.S. (1993) Expert tutors versus non-expert tutors in PBL (letter), *Academic Medicine*, 68, p. 353.

COHEN, G. & BLUMBERG, P. (1991) Investigating whether teachers should be given assessments of students made by previous teachers, *Academic Medicine*, 66, pp. 288–289.

COHEN, G.S. *et al.* (1993) Do final grades reflect written qualitative evaluations of student performance, *Teaching and Learning in Medicine*, 5(1), pp. 10–15.

COLLIER, K.G. (1980) Peer-group learning in higher education: the development of higher order skills, *Studies in Higher Education*, 5, pp. 55–62.

COULSON, R.L. (1983) Problem-based student-centered learning of the cardiovascular system using the Problem-Based Learning Module (P.B.L.M.), *Physiologist*, 26, pp. 220–224.

DAROZA, D.A. (1993) Commentary on 'Do final grades reflect written qualitative evaluations of student performance?', *Teaching and Learning in Medicine*, 5(1), pp. 16–17.

DAVIS, W.K. *et al.* (1992) Effects of expert and non-expert facilitators on the small-group process and on student performance, *Academic Medicine*, 67, pp. 407–474.

DAVIS, W.K. *et al.* (1994) Influence of a highly focussed case on the effect of small-group facilitator's content expertise on students' learning and satisfaction, *Academic Medicine*, 69, pp. 663–669.

DE GRAVE *et al.* (1990) Peer teaching and problem-based learning: tutor characteristics, tutor functioning, group functioning and student achievement, in: Z.M. NOOMAN, H.G. SCHMIDT & E.S. EZZAT (Eds) *Innovation in Medical Education: An Evaluation of its Present Status*, pp. 135–137 (New York, Springer).

DE VOLDER, M.L. (1982) Discussion groups and their tutors: relationships between tutor characteristics and tutor functioning. *Higher Education*, 11, pp. 269–271.

DE VRIES, M. *et al.* (1989) Dutch comparisons: cognitive and motivational effects of problem-based learning on medical students, in: H.G. SCHMIDT, J.R. LIPKIN, M. DE VRIES & J.M. GREEP (Eds) *New Directions for Medical Education: Problem-Based Learning and Community-Oriented Medical Education*, pp. 230–238 (New York, Springer-Verlag).

DESMARCHAIS, J.E. & BLACK, R. (1991) Effect of tutor content expertise on student academic achievement in the Sherbrooke Problem-Based Curriculum, unpublished manuscript, Université de Sherbrooke, Quebec, Canada.

DESMARCHAIS, J.E. *et al.* (1992) From traditional to problem-based learning: a case report of complete curriculum reform, *Medical Education*, 26, pp. 190–199.

DUEK, J.E. *et al.* (1996) Learning issues identified by students in tutorless problem-based tutorials, *Advances in Health Sciences Education*, 1, pp. 29–40.

EAGLE, C.J. *et al.* (1992) Effects of tutors with case expertise on problem-based learning issues, *Academic Medicine*, 67, pp. 465–469.

FELETTI, G.I. *et al.* (1982) Medical students' evaluation of tutors in a group-learning curriculum, *Medical Education*, 16, pp. 319–325.

GEISSLER, P.R. (1973) Student self-assessment in dental technology, *Journal of Dental Technology*, 37(9), pp. 19–21.

GIJSELAERS, W.H. (1997) Effects of contextual factors on tutor behaviour, *Teaching and Learning in Medicine*, 9(2), pp. 116–124.

GORDON, M.J. (1991) A review of the validity and accuracy of self-assessments in health profession training, *Academic Medicine*, 66, pp. 762–769.

GRUPPEN, L.D. *et al.* (1992) Tutor-led and student-led small groups: no differences in learning?, paper presented at the Annual Meeting of the American Educational Research Association, San Francisco, California, April.

JOHNSON, D.W. *et al.* (1981) Effects of cooperative, competitive and individualistic goal structures on achievement: a meta-analysis, *Psychological Bulletin*, 89(1), pp. 47–62.

KNOWLES, M. (1975) *Self-directed Learning. Guide for Learners and Teachers* (Toronto, Prentice Hall, Canada).

MICHAELS, J.W. (1977) Classroom reward structures and academic performance, *Review of Educational Research*, 47, pp. 87–98.

MOUST, J.H.C. & SCHMIDT, H.G. (1992) undergraduate students as tutors: are they as effective as faculty in conducting small-group tutorials?, paper presented at the Annual Meeting of the American Educational Research Association, San Francisco, California, April.

MOUST, J.H.C. *et al.* (1989) Peer teaching and higher level cognitive outcomes in problem-based learning, *Higher Education*, 18, pp. 737–742.

NEAME, R.L.B. & POWIS, D.A. (1981) Toward independent learning: curricular design for assisting students to learn how to learn, *Journal of Medical Education*, 56, pp. 886–893.

NEEDHAM, D. & BEGG, I. (1991) Problem-oriented training promotes spontaneous analogical transfer: memory-oriented training promotes memory for training, *Memory and Cognition*, 19, pp. 543–557.

NEUFELD, V.R. & BARROWS, H.S. (1974) The 'McMaster Philosophy': an approach to medical education, *Journal of Medical Education*, 49, pp. 1040–1050.

SCHMIDT, H. *et al.* (1989) Explanatory models in the processing of science text: the role of prior knowledge activation through small-group discussion, *Journal of Educational Psychology*, 81, pp. 610–619.

SCHMIDT, H.G. *et al.* (1993) Influence of tutors' subject-matter expertise on student effort and achievement in problem-based learning, *Academic Medicine*, 68, pp. 784–791.

SCHMIDT, H.G. (1977) Niet-medicials tutor: maakt het een vershil? (Non-medical staff as tutors: does it make a difference?), internal report, University of Limburg, Maastricht, The Netherlands.

SCHMIDT, H.G. (1983) Problem-based learning: rationale and description, *Medical Education*, 17, pp. 11–16.

SCHMIDT, H.G. (1989) Resolving inconsistencies in tutor expertise research: does lack of structure cause students to seek tutor guidance, *Academic Medicine*, 69, pp. 656–662.

SHOPE, T.R. (1989) Student-initiated analysis and change of a medical school curriculum, *Academic Medicine*, 64, pp. 330–301.

SILVER, M. & WILKERSON, L. (1991) Effects of tutors with subject expertise on the problem–based tutorial process, *Academic Medicine*, 66, pp. 298–300.

SPAULDING, W.B. (1991) *Revitalising Medical Education. McMaster Medical School. The Early Years 1965–1974* (Hamilton, B.C. Becker).

SWANSON, D.B. *et al.* (1990) Effect of tutor characteristics on test performance of students in a problem-based curriculum, in: W. BENDER, R.J. HIEMSTRA, A. J. J. A. SCHERPBIER & R. P. ZWIERSTRA (Eds) *Teaching and Assessing Clinical Competence.*, pp. 129–134 (Groningen, The Netherlands, BoekWerk Publications).

SZEKELY, L. (1950) Productive processes in learning and thinking, *Acta Psychiatrica*, 7, pp. 388–407.

THOMAS, R.E. (1992) Teaching medicine with cases: student and teacher opinion, *Medical Education*, 26, pp. 220–297.

VAN DER VLEUTEN, C. & VERWIJNEN, M. (1990) A system for student assessment, in: C. VAN DER VLEUTEN & M. VERWIJNEN (Eds) *Problem-Based Learning: Perspectives from the Maastricht Approach* (Amsterdam, Thesis-publ.).

WALTON, H.J. & MATTHEWS, M.B. (1989) Essentials of problem-based learning, *Medical Education*, 23, pp. 542–558.

WEBB, N.M. (1982) Student interaction and learning in small groups, *Review of Educational Research*, 52(3), pp. 421–445.

WILKERSON, L. *et al.* (1991) A case study of student-directed discussion in four problem–based tutorial groups. In research in medical education, *Academic Medicine*, 66(Suppl., September), pp. S79–S81.

WILKERSON, L. (1992) Identification of skills for the problem-based tutor: student and faculty perspectives, paper presented at the Annual Meeting of the American Educational Research Association. San Francisco, California, April.

WOODWARD, C.A. & FERRIER, B.M. (1982) Perspectives of graduates two or five years after graduation from a three-year medical school, *Journal of Medical Education*, 57, pp. 294–302.

ZEITZ, H.J. & PAUL, H. (1993) Facilitator expertise and problem-based learning in pbl and traditional curricula (letter), *Academic Medicine*, 68, pp. 203–204.