Viewpoint: Leaving the “Empty Glass” of Problem-Based Learning Behind: New Assumptions and a Revised Model for Case Study in Preclinical Medical Education
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Abstract
The popularity of problem-based learning (PBL) reflects medical educators’ recognition that case study can enhance the preclinical medical school curriculum. However, the PBL method itself has features, particularly its reliance on small-group work with tutor–facilitators, that are expensive to implement and that limit the potential educational value of case study. The author systematically analyzes specific aspects of the PBL methodology and concludes that the PBL approach misuses the faculty, tends to compromise the authenticity of cases, and results in an unnecessarily varied and impoverished educational experience for students. Approaches to case study with different assumptions need to be devised. A model is proposed that shifts the goal of case study from development of problem-solving skills to development of ideas that allow meaningful engagement in sophisticated discussions of medicine. In this model, the method shifts from self-directed learning to independent study guided by the expertise of the faculty. One possible approach to case study based on this model is briefly described. It consists of reading published cases from the medical literature, with analysis and discussion of the cases led by faculty experts in large-group format. The approach immerses students in an authentic, state-of-the-art discussion of medicine and is easily incorporated into any curriculum structure at limited cost. The author argues that, contrary to the claims of proponents, the glass is “mostly empty” for PBL and that we can generate the higher-level discussion that case study merits only by moving away from PBL’s extraneous assumptions.

Recently in this journal, Distlehorst and colleagues1 reported their experience comparing a problem-based learning (PBL) track with a parallel standard curriculum track at Southern Illinois University School of Medicine (SIUSM) and concluded that for PBL, the glass was “half full.” This optimistic conclusion was based on the outstanding performances of PBL-track students in some clerkships (notably psychiatry) and the lack of evidence that students choosing the PBL track were disadvantaged in any measurable way. PBL has dominated the discussion of curriculum for several decades, and reports such as Distlehorst et al’s abound. These studies, with their confounded results (in this case by, among other things, the profile characteristics of the self-selected PBL students), their weak effects,2 and their futile preoccupation with “outcomes,”3 distract attention from a long-overdue inquiry into the philosophical foundations of PBL and analysis of the question of whether the PBL method can even theoretically maximize the potential of case study. This is especially important given the costs and difficult logistics of the PBL approach.

In this article, I argue that the potential benefit of studying cases in the preclinical medical school curriculum is unnecessarily constrained by widespread use of the methods of PBL. This may at first seem a paradoxical statement because, in many minds, PBL is equivalent to the very idea of studying cases. In this article, however, I will show that the value of case analysis can be separated from several poorly conceived peripheral aspects of the PBL methodology. I will analyze each of these aspects, showing how they degrade the educational experience of case study, and then I will outline a set of new assumptions that should drive the development of future approaches. Finally, I will briefly describe a method of case study that aligns with these new assumptions and that has been successfully incorporated into our curriculum at the State University of New York (SUNY) Upstate Medical University College of Medicine. I will conclude with the suggestion that case study, freed from the constraints of PBL methodology, leads to a deeper level of discourse at a much lower cost.

Why Study Cases?
There is probably no approach more likely to generate interest and a sense of obvious relevance to future professional goals for medical students than the study of authentic clinical cases. There is almost unanimous agreement that case study raises morale and enthusiasm for learning.4 It can be argued that case study significantly contributes to achieving cognitive goals as well. It lends itself to active, self-structured learning, which fits with current constructivist models of learning and promotes activities required for continued professional education. The use of cases as concrete examples to support the study of concepts and principles also enhances knowledge acquisition and transfer.5 Most physicians have the experience of learning from case discussion, an experience that sustains such traditions as the grand rounds CPC (clinicopathologic conference).6 Intuitive

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acceptance of the benefits of careful case study also rightly sustains momentum for case-based education, despite the lack of objective evidence of its effectiveness and its inefficiency in achieving such secondary objectives as preparation for licensing examinations.

What Is PBL?

Case-based education has a long history, and many case-based methods exist. In recent decades, PBL has come to dominate case study in medical education. The idea for this approach was born from frustration with traditional discipline-based medical education that was perceived as failing to put information in a context useful for solving clinical problems. Thus, an overall curriculum structure where content was delivered around case problems rather than around disciplines was devised. The literature promoting, evaluating, and refining this idea has defined an era of research in medical education. In the end, though, because of the costs, the resistance of faculty, and the inability to deliver a comprehensive view of the basic and clinical sciences, PBL has failed to take hold as a curriculum-wide design in other than around disciplines was devised.9 The literature promoting, evaluating, and refining this idea has defined an era of research in medical education. In the end, though, because of the costs, the resistance of faculty, and the inability to deliver a comprehensive view of the basic and clinical sciences, PBL has failed to take hold as a curriculum-wide design in other than around disciplines was devised.9 The literature promoting, evaluating, and refining this idea has defined an era of research in medical education. In the end, though, because of the costs, the resistance of faculty, and the inability to deliver a comprehensive view of the basic and clinical sciences, PBL has failed to take hold as a curriculum-wide design in other than around disciplines was devised.9 The literature promoting, evaluating, and refining this idea has defined an era of research in medical education. In the end, though, because of the costs, the resistance of faculty, and the inability to deliver a comprehensive view of the basic and clinical sciences, PBL has failed to take hold as a curriculum-wide design.

Small Groups Don’t Work

The commitment to tutored small-group activity accounts not only for most of the cost and logistical difficulties of PBL, but it is also the basis for an unacceptable variability in the student experience, a general low level of discourse, and an inherent conflict with the professed principle of self-directed learning.

Anyone who has ever used small-group teaching has heard student feedback that “small groups don’t work” because of inevitable differences in ability, motivation, and grading practices among tutors. One might argue that the variability could be countered with instruments to assess tutor effectiveness and programs for faculty development, but all this adds to the costs, and there is no assurance of a successful outcome. Seeking solutions to the problems with small-group dynamics in PBL seems to be spawning an industry among educationalists. The need for some perspective on group work as a means to an end rather than an end in itself has been discussed.

The sophistication of discussion in an educational exercise is limited by the knowledge of the participants. Slavin, an articulate proponent of small-group teaching, discusses the potential cognitive advantages of collaboration with peers. Slavin states that students can benefit either in the role of tutor through the opportunity to elaborate ideas, or in the role of tutee, guided by a more capable peer who is likely operating within one’s “zone of proximal development” (Vygotsky’s term to describe the trajectory of potential growth from a student’s current lower level of competence under the guidance of someone more accomplished). Allowing some assumptions about positive group dynamics and shared motivation, there is some initial appeal to this vision of a group potentially achieving more in the cognitive realm than any individual could accomplish alone. The problem is that the zone of proximal development among peers is very small, but the world of ideas in medicine is very large. The student centeredness of the small-group process (which, in “pure” PBL, includes allowing students to set the agenda of study issues) tends toward an amateurish and dissipated experience that can never get beyond the students’ own resources. Schmidt suggests that students need at least some minimum level of structure, and that if it is not provided by prior knowledge or cues as to what to focus on from the environment of the exercise, students will look to tutors.

For purposes of this discussion, and consistent with recent formulations of the essential components, I define PBL as a method of case study that features (1) piecemeal presentation of cases to students as “problems,” (2) self-directed framing of issues by students for independent study, and (3) small-group work with tutor–facilitators as the primary means of instructional interaction.
Unfortunately, in the multiple small-group setup, content expertise among tutors will be the exception rather than the rule,25 and thus there is no one authoritative to turn to for expert insight. Even the most committed proponent of PBL would be hard pressed to defend the position that this setup leads to a high-level, realistic discussion of medical issues. Transcripts of actual discussions in PBL group that proponents select as examples of “effective collaboration” speak for themselves.9

Finally, there is the question of whether mandatory small-group participation is appropriate at this level of education and how it can be reconciled with the idea of self-directed learning. Tennant (summarized by Miflin27) observes that among adult learners, a fundamental tension exists between the “ethic of individualism and the spirit of collectivism” and that this tension threatens to undermine the small-group process. The spirit of collectivism is captured in Slavin’s “motivational perspective” on small-group success, which requires that shared goals and social cohesiveness drive the process.22 One might legitimately ask to what extent this is realistic in medical school. The ethic of individualism, which could include respect for personal preference for independent modes of study, seems incompatible with a system where grades depend on participation in small-group activities. At some fundamental level, PBL is at odds with itself on this point. Proponents vacillate between the idea that students should find their own solutions and the idea that group work is the only legitimate venue for learning. The possible solutions at the time the “problem” is presented. This clinical vignette approach, stripped as it usually is of ambiguity and anomaly, may have a role in undergraduate teaching as a way of illustrating important points, but it is not in any way a realistic practice tool for clinical problem solving. The tension between case authenticity and the structure necessary in education has not been resolved by PBL and never will be, because clinical problem solving is the wrong task for students at this level.

Clinical Problem Solving Is Not the Appropriate Task for Preclinical Medical Students

PBL began with the idea that clinical problem solving is a skill that can be specifically developed through practice. Early proponents directly challenged the assumption that information is required before problem solving can begin.9 However, clinical problem solving is a complex cognitive task involving hypothesis generation from ambiguous cues. It requires reasoning that is based partly on fuzzy categorical knowledge, is partly probabilistic, and is partly based on appreciating the urgency and risk–benefit relationship in possible actions.29 In short, for clinical problem solving to be a meaningful experience, it requires knowledge and experience in the area of the problem.3,30 Students in the first two years of medical school have no realistic basis for formulating or solving clinical problems. If the “problems” are complex, ill structured, open ended, and realistic, as PBL proponents have advocated,26 the issues that preclinical medical students are capable of raising on their own are trivial, and it is likely that the student’s approach will lead to confusion, wasted time, and misguided study. As more structure is introduced to the problem-solving process, as seems to be the trend,16 the “problems” become a contrivance to cue study of a particular content domain. In such cases, students are usually just learning the definitions of the possible solutions at the time the “problem” is presented. This clinical vignette approach, stripped as it usually is of ambiguity and anomaly, may have a role in undergraduate teaching as a way of illustrating important points, but it is not in any way a realistic practice tool for clinical problem solving. The tension between case authenticity and the structure necessary in education has not been resolved by PBL and never will be, because clinical problem solving is the wrong task for students at this level.

Medicine Should Not Be Self-Taught at the Undergraduate Level

The PBL-method emphasizes self-directed learning, and this orientation has been justified by invoking educational constructivism and adult learning theory. Educational constructivism posits that “students actively construct or reconstruct their knowledge networks . . . creating meaning and building personal interpretations of the world based on individual experiences and interactions.”15 This relativistic proposition about knowledge is interpreted as support for student centeredness in the acquisition of knowledge. Adult learning theory, as popularized by Knowles et al,31 adds the notion that adults are primarily motivated to learn from an internal need to know and resist being told what they have to know by an outside authority or a subject-centered syllabus. Taken together, these ideas seem to indicate that medical students (as young adults) are best left to build their own knowledge structures around questions they generate themselves during active engagement in real-world experiences. Although there are significant reservations about the concept of the adult learner and its appropriateness in medical education,32 PBL proponents often further justify self-directed learning in this setting with the idea that this is the type of learning students will have to carry into their professional lives.

Although developing self-directed, lifelong learners seems a desirable outcome, it does not follow that the method to achieve this is to rely on self-teaching during formal education. This confusion of means and ends with respect to self-directed learning has been strongly criticized by Philip Candy (summarized by Miflin33). Candy advocates constraint on the degree of self-direction during introduction to complex bodies of knowledge. Cobb14 echoes this point, lamenting that “the theoretical commitment to analyze the generation of knowledge as a process of construction is frequently transformed into the prescription that teachers should not tell students anything because they have to construct their own understandings.”

True self-directed learning implies a maturity in relation to the subject matter (a maturity not necessarily correlated to chronological age). Candy concludes that this involves (1) study skills (time management, critical thinking, research skills), (2) sufficient familiarity with the subject matter to formulate pertinent questions, and (3) a sense of learning competence (i.e., knowing when an answer is sufficient to a specific situation). The last two of these tasks are not within the competence of a medical student with respect to the field of medicine. Familiarity with a subject area allows identification of gaps in personal knowledge in relation to a particular question and allows focused, self-directed study to fill in the gaps. Preclinical medical students have no overall conceptual framework allowing identification of such gaps. The lack of knowledge and experience also
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dooms to failure the self-assessment implied in having “a sense of learning competence.”35 As Eva concludes, “one can never know that one is incompetent without external guidance, thereby further reducing the validity of the rhetoric around nurturing learners to be self-directed.” We as adult learners recognize that we have maturity with relation to some fields of knowledge and don’t have it in others. In areas where we don’t have basic or sophisticated knowledge, it is appropriate to seek guidance from an authority.

The Facilitator Role Is a Misuse of Faculty

Proponents of PBL acknowledge that recruitment of faculty tutors is “always a challenge,”31 but they don’t seem to appreciate why that is. Among the many reasons faculty might have for resisting PBL, perhaps foremost is a perception of a devaluation of their potential unique contribution to the education of students.33,36 The faculty at a medical school consists of individuals who have achieved hard-won expertise, often to the point of contributing new knowledge in their field of interest. Such individuals are not receptive to the idea that management of small groups is “a critical skill for medical faculty,”37 and they resist attending training programs (perhaps a week in duration)31 so that they can become part of a cadre of “facilitators” alongside educationalists1 who have no knowledge of medicine or basic science. To take this aspect of PBL to its logical extreme, a medical school devoted exclusively to PBL could dispense with its faculty altogether and hire a team of psychologists to expertly monitor the small-group process.

The idea of reducing the expert faculty to the lowest common denominator as small-group facilitators would perhaps not be so absurd if the method of PBL were indeed the best way to achieve important educational goals—but it is not. Proponents of PBL repeatedly argue that group activities can cause cognitive effects deemed positive according to those having sophisticated understanding of the subject matter seems at least a prerequisite for making it possible.

PBL Promotes Manufacturing Cases, and Contrived Cases Are Potentially Destructive to Learning

There is a tendency in PBL to manufacture cases, a tendency that is driven by two features of the method. First, PBL has from the very beginning used cases as vehicles for content delivery. When attempting to deliver comprehensive knowledge of a subject via cases, one is faced with the choice of either using an inordinate number of authentic cases to cover the scope, or creating relatively few “perfect” cases. In the literature dedicated to the construction of effective case problems in PBL, the bias seems to be for creating ideal cases.44 A commonly referenced method is to build a case around a “topic tree” reflecting the educational objectives of the exercise.45 The second feature of PBL that drives case construction is the necessity of compensating for the lack of expertise in tutors.18 The “causal model” of PBL25 suggests that two major factors determining group functioning and student achievement are the quality of the problems and the quality of the tutor’s performance. What is lacking in one (tutor expertise) can apparently be made up by the other (highly structured cases).

PBL proponents either do not appreciate or choose to ignore the potential destructiveness of manufactured cases in teaching. Fabricated cases can seriously mislead students in their struggle to understand medicine. Cases manufactured around a topic tree are little more than lectures in disguise. Unlike lectures, however, where students know that the organization and ideas are tentative abstractions by the instructor, the abstraction in the manufactured case is presented as an actual instance, a fact to be accounted for in students’ models of reality. One tends to underestimate the learning that goes on at the intuitive, unconscious level and the harm that a falsity can do at that level. I agree with Ertmer and Newby,46 who state that “understanding is ‘indexed’ by experience . . . [and thus] . . . authenticity of the experience becomes crucial to the individual’s ability to use ideas.” These considerations seem to be lost on proponents of PBL, and the fact that “optimizing the authenticity of the problems” is only recently being recognized as important15 is disturbing.

New Assumptions for Case Study in the Preclinical Medical School Curriculum

The problems with PBL are fundamental and deep, but the attraction of case study in medical education is persistent and legitimate. There is a need to develop approaches to case study with different assumptions than those of PBL, approaches that focus the case experience on important educational goals with tasks appropriate to the students’ capabilities and a role for faculty that utilizes their strengths. The suggested new assumptions follow.

The goal of case study in the preclinical medical school curriculum is education, not training. Although education and training proceed simultaneously throughout medical school and residency, they are distinct, and
education should be the primary focus for preclinical medical students. The goal of education is development of ideas rather than skills. In the present context, the implication is that case study should be structured so that students become conversant in the language and concepts of medicine, which would then enable meaningful participation in discussions of clinical cases and informed interaction with the medical literature.

Case study should be viewed as support for a structured curriculum rather than as a vehicle for content delivery. Letting go of content responsibility allows case study to do what it does best (energize students and help integrate and make relevant the subject matter taught in other courses) without compromising the authenticity of the case material or the level of discussion.

The structure of case study should respect but not overestimate the capability of students. Students at this level are expert learners, not expert clinicians. Trying to imitate what expert clinicians do with a pretense of solving problems in a near vacuum of knowledge and experience will not short circuit the arduous task of actually becoming experts. As expert learners, however, students are capable of marshaling considerable resources and processing complex ideas if they are appropriately directed. Rather than self-teaching, the case study approach should promote independent study directed toward issues that would constitute a realistic discussion in medicine.

The structure of case study should position faculty to contribute from the strength of their expertise. The appropriate role of the faculty is to provide a model of excellent problem solving so that through study of that which is modeled, students gain a sense of the ultimate target of their education and training. Thus, faculty should be brought into the discussion precisely where their unique perspective and experience bears on the problem at hand. Case study is an excellent venue for faculty expertise to shine without seeming esoteric to students.

Small-group format is not an end in itself, and the benefits of small groups do not justify their costs. Many of the problems of PBL relate to its commitment to small-group interaction. The challenge for alternative methods of case study, once small groups are abandoned, is to find other means of assuring student participation in the process and of promoting elaboration of ideas.

Reading and Analysis of Published Cases from the Medical Literature as an Alternative to PBL

As an example of the options that open up when the methodological assumptions of PBL are left behind, I will describe a preclinical case study experience we have developed at SUNY Upstate Medical University. This case study course is discussed in detail elsewhere. My approach here will be to briefly summarize the main features of the course and then discuss how they align with the new assumptions about case study that I have detailed above. Obviously, the design of this course represents only one possible solution to reaping the benefits of case study without the drawbacks of PBL.

The course consists essentially of reading and analyzing published cases and supplemental materials from the medical literature, followed by class discussion of the readings with faculty experts in the relevant areas. Most of the case reports are from the New England Journal of Medicine (clinical problem-solving exercises, and case records of the Massachusetts General Hospital). These case reports are read in their entirety. Thus, there is no diagnostic or therapeutic problem solving involved in the exercise; the reasoning and ultimate resolution are part of the reading itself. Instead, the task is to analyze the reading and use it as a scaffold to direct whatever background study the student finds necessary to understand what happens in the case and what is discussed by the authors. Students work independently (or in study groups they form voluntarily on their own without faculty supervision), gathering and synthesizing information. After the phase of independent study, students are tested on their understanding of the case, and then the case is discussed in large-group sessions attended by the entire class of approximately 150 students. In these sessions, students hear the perspective of someone with experience with the problems raised by the case and have an opportunity to ask questions about issues they were unable to completely resolve on their own. The faculty involved with the case also identify issues meriting further study because of their complexity or recent developments affecting the subject. In some instances, the faculty assign additional readings from the medical literature to address these more complex issues. Students study these additional readings independently as well and discuss them in class sessions led by appropriate clinical or basic science faculty. The final student assignment for each case is to create a summary hypothesis explaining the phenomena of the case in terms of underlying disease mechanisms.

How does this course design conform to the principles elaborated above? First, the emphasis is clearly on education as opposed to training. The approach is to immerse students in a sophisticated discussion that engages them with the best of the observations and ideas of those who preceded them in defining the knowledge base of the medical profession. There is no pretense that students will emerge from this experience able to handle patient problems. The goal is that students become conversant in medicine so that they are able to participate more meaningfully in their further education and training. The preclinical case study experience is viewed as a beginning, not as an end.

Second, as a supplemental experience without responsibility for specific content, the course serves as a vehicle for motivating students and integrating curriculum without compromising the authenticity of the case material. The main issues raised by the individual cases are aligned somewhat with subjects being taught concurrently in the more traditional, discipline-based curriculum, but the cases are not assigned with the objective of “covering” specific material. The cases are selected on the basis of quality of presentation and intrinsic interest, and they change yearly to keep pace with advances in medicine. The discipline-based courses maintain their internal comprehensive and coherent structure without regard to the cases chosen in a given year. In the process of studying the published cases, it becomes obvious to the students that knowledge acquired in other courses is necessary for
understanding the cases. Because there is no specific content agenda for the case experience, no large initial investment in manufacturing cases is necessary. There is a constant supply of new, varied, and authentic case material available in the literature.

Third, the structure of the course encourages independent, self-structured study without succumbing to the error of interpreting self-directed learning as self-teaching. Students read the cases and gather background information independently and have to apply and refine their critical-thinking skills in attempting to understand the readings, but rather than being confined to the small worlds of their own devices or those of their peers and facilitators, they are guided rapidly into the larger world of current, state-of-the-art discussion of medical issues, both by the authors of the papers and by the expert faculty. This leads directly to the fourth point.

The course puts faculty in a position to make a difference based on their experience and expertise. Faculty can provide a perspective for dealing with complex areas, point out areas of controversy, direct students to new developments, and model high-level clinical reasoning and application of basic science to clinical problems.

Fifth, and finally, the course allows case study experiences to be incorporated into the curriculum in the face of limited resources. By giving up small-group interaction as a goal in itself, the costs and logistics are, in fact, the same as any traditional course, because the large-group sessions require only a single faculty expert leading the discussion. Interestingly, we have found that most students join independent study groups outside of class time to discuss the cases and assignments. We presume that these student interactions are at least perceived by students as effective, because there is no requirement and no reward promoting participation in such groups.

The case-reading course has been a success at our institution. Students have rated the experience as excellent in institutional surveys and feel that they learn more in this course than in any other. The case has progressively grown over the past five years, in large measure because of strong student advocacy. Admittedly, the success of the course is largely in terms of student satisfaction, a goal that even PBL can convincingly claim to have achieved. However, our course has achieved this goal at a much smaller cost and additionally offers at least the possibility of a higher-level discourse. Whether students actually attain a more sophisticated knowledge as a result of this experience will require further study.

Leaving the Empty Glass Behind
I have argued that PBL has practical and philosophical limitations that are not offset by compelling educational advantages. Contrary to the conclusion of Distlehorst et al at SIUSM, it seems that, for PBL, the glass is mostly empty. The small-group experience is inherently variable and sometimes dysfunctional. Relegation to the role of facilitators is a misuse of the faculty. Clinical problem solving is the wrong task for preclinical medical students. Self-directed learning interpreted as self-teaching is not appropriate in undergraduate medical education. The more appropriate concept of independent, self-structured learning is not compatible with a format of forced group learning with peers. Manufacturing cases has a danger of misleading students. In all, one must conclude that the peripheral methodological features of PBL undermine the potential value of case study.

I suggest a revised model involving a shift in the goals and structure of case study to promote a more sophisticated and authentic discussion of medicine. I have briefly described one possible approach based on this revised model. The simplicity of our approach—reading published cases in the medical literature and having class discussions of the cases with experts in the relevant areas—lends itself to easy incorporation as a supplement to any structured curriculum. Immersing students in an expert-guided, high-level discussion facilitates acquisition of the language and state-of-the-art ideas of medicine and provides a model of the ultimate target of study for students.

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