Medical education: revolution, devolution and evolution in curriculum philosophy and design

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ABSTRACT

- Contemporary medical education must train skilled and compassionate health care professionals who are rigorous in their approach to patient care and their pursuit of knowledge and solutions.
- Problem-based learning has been widely introduced, but there is no evidence that it leads to better outcomes than more traditional programs, and fundamental gaps in conceptual knowledge may result.
- Recently, emphasis has been placed on a solid grounding in underlying concepts combined with a systems-based approach, and ability to transfer information and solve problems.
- Integrating traditional scientific and clinical disciplines with progressive and continuous assessment, may be a better means of achieving the combined aims of clinically relevant curriculum design, vertical integration of medical knowledge, and facilitation of the continuum of training.
- Being adaptable and flexible, cognisant of costs, and driven by evidence are key features of delivering medical education and contemporary medical practice.
- Educational research should lead to continuous improvement, but innovation without evaluation and attention to costs may create as many, or more, problems as are solved.

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Changes in the delivery of medical education in Australia and elsewhere have been driven by two imperatives. The first relates to the combined effects of the explosion of knowledge in medical science and the changing nature of contemporary medical practice. Consequently, students must understand the key principles that underlie the scientific basis of medicine and be able to apply them, rather than attempt to memorise ever-increasing volumes of facts. The second imperative is the prerequisite for graduates to be able to identify and solve new problems by, where necessary, acquiring additional knowledge and critically evaluating new information. Accordingly, the education process must develop independent and motivated learners who can identify their limitations and gaps in knowledge, and know how to fill them. The best way to achieve this is to provide contextual, student-centred learning opportunities.

With far less evidence than the standards of evidence-based medicine demand, problem-based learning (PBL) was widely introduced, in a revolutionary manner, as the predominant mode of learning in medical programs, particularly in the preclinical years. The purposes of PBL are to develop reasoning skills, enable learning within a relevant context, promote integration and retention of knowledge, and promote self-directed learning. PBL devolves the responsibility for learning, and determining what to learn, to students. Despite graduate satisfaction with well implemented PBL programs, there is no evidence, apart from higher ratings of self-confidence,[1] that graduates of such programs are significantly different[1,2] or better able to maintain competence than graduates of more traditional programs.[3] Moreover, tutor quality and consistency — key determinants of the success of a PBL group — are issues that have become more challenging as demand for tutors increases alongside escalating student cohort sizes.[4]

PBL is not an end in itself, and it exists in many variants of the originally described form.[5] Similar outcomes to those of PBL can be achieved, and the goals of PBL complemented, with a range of other pedagogic methodologies. Arguably, self-directed learning should be established as routine, rather than the exclusive routine for learning during undergraduate medical education.[5] Case-based learning (CBL), which provides more focused learning, offers more efficient use of student and faculty time and is preferred over PBL by students.[6,7] CBL has greater utility for developing problem-solving skills, which is particularly applicable in clinical contexts,[8] and can be delivered in an interactive manner online.[9] Structured tutorials stimulate student participation, effectively develop basic science and clinical knowledge, and enhance depth of learning, as well as the ability to evaluate information.[10] Medical graduates must function in a team-based, collaborative work environment; have sound knowledge and clinical skills; and have a capacity for lifelong learning.[11] PBL may have a role in the process of developing some generic transferable skills, but there is no compelling case for it to be the primary method of learning.[12]

The original "McMaster PBL" curriculum (developed at McMaster University in Canada) attempted to integrate both basic and clinical science into biomedical problems. A second iteration of the curriculum focused on priority health problems and common medical problems, on the basis that an understanding of the management of common conditions includes areas of knowledge that are essential for clinical competence. A third iteration, the COMPASS (concept-oriented, multidisciplinary, problem-based, practice for transfer, simulations in clerkship, streaming) model, was adopted in 2005; it placed an emphasis on underscoring the underlying concepts in the curriculum with logical sequencing of both the concepts and the body systems.[13] This model of learning represents an evolutionary change in approach.

A return to the fundamental notion that definable core knowledge of the scientific basis of medicine is required for clinical practice is welcome. The structure of the human body (macroscopic and microscopic), together with its functions at systems, cellular and molecular levels, must be grasped to properly understand the processes of disease, as well as the origins of symptoms and signs that result from disruption of normal function. This information must be appropriately synthesised to enable selection of appropriate investigations and interpretation of results. It is also necessary to understand not only the principles of pharmacology, but also how to independently evaluate evidence to facilitate rational and safe prescription of medications.

In many modern curricula that use PBL, optimal acquisition of medical knowledge and clinical skills by students appears to be problematic. For example, many students find that learning anatomy is a suboptimal experience with equivocal outcomes. Students on surgical rotations feel that their limited knowledge of anatomy compromises their understanding of the symptoms and signs of surgical conditions, and the knowledge of anatomy held by qualifying doctors has been criticised for being below an acceptable level.[14-16] Some in the medical profession are concerned that patient safety in clinical practice might be compromised,[17] but it is not immediately clear how to remedy this situation. A way forward is to merge the traditional departments of anatomy with those of relevant specialty services, agree on the core knowledge to be assimilated, and deliver an anatomy course that is functionally and clinically relevant as well as vertically integrated into the curriculum. For this approach to be maximally effective, assessment of knowledge of anatomy must be ongoing. More detailed anatomy training would be required for graduates aiming to enter areas of medicine where such knowledge is critical to practice, and this would potentially enable postgraduates to assist with undergraduate anatomy teaching. This approach addresses the combined aims of clinically relevant curriculum design, vertical integration of medical knowledge and facilitation of the continuum of training.[17]

Optimal methods of course delivery and teaching are debatable. Recent trends away from dissection-based learning to solely prosection-based learning may, without well structured demonstrations, result in a passive and incomplete learning experience. Students have indicated that dissection deepens their understanding of anatomical structures, provides them with a three-dimensional perspective of structures, and helps them recall what they learnt.[18] Dissection is also, by its nature, self-directed and action-based learning — a reason for its retention in the instruction of anatomy. Prosections, plastinated specimens, radiographs, three-dimensional computer-generated images[19] and virtual training tools can all be used to facilitate clinical context-based student-directed learning.[20,21] Electronic resources have the advantage of accessibility, interactivity and low-maintenance costs.

Another concern regarding a predominantly PBL approach to medical education is that students taught in this way do not seem to have a grasp of basic physiology and medical biochemistry. These areas are fundamental prerequisites for understanding the functional consequences of disease, and therefore the origin of symptoms and signs that are evident on clinical examination, as well as the results of tests that are undertaken by clinical chemistry, cardiac and respiratory laboratories. Although an active learning approach produces the best outcomes, there is no evidence that these are better achieved by PBL per se. The challenge is for students to not just acquire knowledge, but to apply it to solve clinical problems. This is best achieved when students are able to transfer conceptual information learnt in one area to another. The explicit development of models and themes that can be applied to physiology learning in general promotes this kind of transfer. A common set of principles, arguably as few as seven (control systems, membrane transport, conservation of mass, mass and heat flow, elastic properties of tissues, cell-to-cell communication, and molecular interaction), can be applied to a variety of physiological systems.[22] The more problems that students solve using this approach, with appropriate feedback, the more readily they will be able to apply learnt concepts to solve novel problems — a defining characteristic of meaningful learning.[2] For this approach to be most effective, it must be reflected in the construction of the resource materials, and be applied consistently (both horizontally and vertically) by teachers.

Similarly, a core set of principles in pathology and pharmacology can be applied to a broad range of problems. Expertise in these disciplines exists in most clinical teams. Vertical integration of pathology and pharmacology can be achieved if every clinical case provides an opportunity to learn about the mechanisms and, where relevant, pharmacotherapy of disease — an approach that is facilitated by continuous assessment. New technologies such as virtual microscopy,[23] integrated with computer-assisted interactive learning[21,24] and human patient simulations,[25] can be combined with interactive lectures, PBL and CBL in the form of clinicopathophysiological case conferences.

The optimal approach to training health care professionals remains to be determined. Contemporary medical education must train skilled and compassionate health care professionals who are rigorous in their approach to patient care and their pursuit of knowledge and solutions. Being adaptable and flexible, cognisant of costs, and driven by evidence are key features of the practice of medicine and the delivery of medical education. Good educational research ought to lead to continuous improvement. Innovation without evaluation and attention to costs may create as many, if not more, problems than are solved.

Competing interests

None identified.

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