The Problems of Problem-based Learning

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University education – what is it you want your students to learn?

(1) What you want them to learn?
(2) What they want to learn?

(3) Or do you want them to develop a set of skills that enable them to find information, use information to solve problems, and be capable of communication and team work?
The bottle theory of education. At graduation the student is filled with knowledge and is ready to go out into the world . . .
Is Problem-based learning the answer?

• Why was it invented?
• How does it work?
• Does it work?
• What are the problems?
Problem-based learning – History

**Background:**
(a) Information is not all you need to solve a problem
(b) The amount of information is increasing exponentially – no one person can keep up with it all

Problem-based learning started in medical education.
Problem-based learning – History

**Background:**
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- 1913 Sir William Osler (concerning the education of medical students) – “too great a reliance on lectures and on students’ capability of memorising a growing number of items of knowledge”
Problem-based learning – History

- **1950s** – integrated systems teaching in the medical school – Case Western Reserve University (USA)
- **1960s** – Problem-based learning introduced in McMaster University (Canada)
- **1970s** – many medical schools in N America and worldwide adopted problem-based learning, including Maastricht (Netherlands)
- **1990s** – in the UK the medical schools in Manchester, Liverpool and Glasgow adopt problem-based learning
The effectiveness of problem-based learning? Does it increase performance at:

- adapting to and participating in change?
- dealing with problems and making reasoned decisions in unfamiliar situations?
- reasoning critically and creatively
- adopting a more holistic approach
- practicing empathy, appreciating another person’s point of view
- collaborating productively; working in teams
- identifying one’s own strengths and weaknesses (and undertaking appropriate remediation)

compared with “traditional” teaching strategies
Problem-based learning – How to do it

• The tutor* presents a problem (on paper, video, audiotape) to the group. The students are expected to organise their thoughts about it.

*Also called the facilitator
Examples of problems

**Title:** Water, water, everywhere

**Synopsis:** Shipwrecked boaters run out of drinking water and wonder about drinking sea water

**Topics uncovered:** Seawater composition, physiology of water balance, homeostatic control, hormones, kidneys
Examples of problems

**Title:** Faecal coliforms in the Antarctic

**Synopsis:** Disposal of untreated sewage from Antarctic research station: what are the environmental and medical consequences?

**Topics uncovered:** What experiments might be done to find out, bacteriology, environmental concerns
Problem-based learning – format (1)

• The tutor presents a problem (on paper, video, audiotape) to the group. The students are expected to organise their thoughts about it.

• *E.g.* identify the broad nature of the problem and endeavour to understand it (including any unfamiliar words).
Problem-based learning – format (2)

The group ‘brainstorms’ ideas and possible solutions, probes existing knowledge, clarifies or restates the problem.

They realise they need more information and that there are things they don’t understand.

(The facilitator may help them to focus on the important things.)
Problem-based Learning – format (3)

• The group divides the task(s) of finding information among themselves.
• This information to be brought back to the group a few days later and explained.

• [Skills developed: finding information, explaining, communication]
Problem-based learning – format (4)

- New knowledge and understanding applied to the problem which may now be refined and redefined.
- They may decide they still need more information and the facilitator may provide further data and guidance.
Problem-based Learning – format (5)

• It may now be possible for the group to produce a solution to the problem.
• More than one solution may result.
• The group reflects on how they tackled the problem, what they learned individually, and how they functioned as a group.

[Reflection on the learning process]
Characteristics of problem-based learning

• It uses stimulus material to trigger discussion
• It presents the problem as a real-life situation
• It guides students’ critical thinking
• It requires that students work in a group
• It encourages students to identify their own learning needs
• It encourages evaluation of the learning process
The Joys of Problem-based Learning

PBL does provide a more challenging, motivating and enjoyable approach to education.

This may be a sufficient *raison d'être* - providing the cost of implementation is not too great.

Norman & Schmidt: *Medical Education* 34, 721 (2000)
The problems of problem-based learning – Students

Students are familiar with traditional methods and may feel threatened if the system is changed.

• No fixed curriculum
• No textbook
• Have to work harder/remain active
The problems of problem-based learning – Self

The *teacher* has authority and ownership of knowledge = personal power. Prefers students to be passive.

The *facilitator* does not necessarily know the answer = loss of control.

PBL encourages open-minded, reflective, critical, active learning.
The problems of problem-based learning – *Staff*

Can all the staff be persuaded to take this route?
PBL appears to devalue academic expertise.
Students will not achieve the “gold standard” of knowledge.
The Problems of Problem-based Learning – Institution

We tend to be happy with our departmental structures. Our subject areas are circumscribed. Although we admit that there is an exponentially increasing amount of knowledge, and too much for students to learn, no one is prepared to teach less!
The Problems of Problem-based Learning – Assessment

Assessment is needed for checking the progress of students. Students need to check their own progress. We need to assess whether the course is satisfactory.

Should we use traditional methods of assessment for a non-traditional way of teaching?
The big problem with problem-based learning . . .

• . . . it’s expensive in time and effort – so does it work?
• Are the graduates from a PBL programme any better than those from a traditional programme?
• By what criteria?
  . . . or are they simply “no worse”?
Problem-based learning

Some examples of problems
Examples of problems

**Title**: Mass fainting

**Synopsis**: What caused 400 people at a rock concert to faint?

**Topics uncovered**: What is fainting? Effects of fasting, effects of hyperventilation, induced cerebral vasoconstriction
Examples of problems

Title: Out of control

Synopsis: The population of lesser snow geese in the U.S. is growing exponentially. What factors contribute to this population explosion? Impact on the ecosystem?

Topics uncovered: Population dynamics, growth curves, ecosystems, relationships in communities
Problem-based learning in disciplines other than Medicine

Geography
Engineering
Nursing and Health Care
Cell Biology
Law
High school Biology
Conclusion

You may be left with the feeling that problem-based learning is a splendid thing . . . but you can see many personal and institutional reasons why it would not work.

But you don’t have to go “all the way” to 100% PBL.
Problem-based learning

Is active learning – students work in groups

Students have to understand/formulate the problem

Students have to make decisions about how to solve the problem and what information is needed

Students have to find information, digest it and present to the group
The learning pyramid

- Lecture 5%
- Reading 10%
- Audio Visual 20%
- Demonstration 30%
- Discussion Group 50%
- Practice By Doing 75%
- Teaching Others 90%

(Average Learning Retention Rates)

(National Training Laboratories, Bethel, Maine)
Contribution of problem-based learning to students’ intellectual development

(1) Motivation
(2) Developing reasoning powers
(3) Structuring knowledge
(4) Developing self-learning skills