Part I
What is Problem-based Learning?

Introduction

Is it possible to provide a prescription of what is and is not problem-based learning? We suggested in Chapter 1 that it is possible to do so at the most basic level. Problem-based learning is an approach to structuring the curriculum which involves confronting students with problems from practice which provide a stimulus for learning. However, there are many possible forms that a curriculum and process for teaching and learning might take and still be compatible with this definition.

Charles Engel sets problem-based learning in the context of an approach to learning rather than a teaching technique. The traditional curriculum suffers from overloading students with an excessive emphasis on memorization. Engel sees problem-based learning as a means of developing learning for capability rather than learning for the sake of acquiring knowledge. He is sympathetic to Barrows’ (1986) analysis which associates problem-based learning with a particular strategy based upon small groups with a supportive tutor. This method is, he argues, consistent with adult learning principles and takes account of the need for courses not only to ‘teach’ well, but also to lay the foundations for a lifetime of continuing education, formal and informal. Engel outlines some of the options, but also emphasizes a particular variant which he helped to develop as one of the pioneers of the University of Newcastle medical curriculum.

An effective curriculum is not just a matter of having a collection of well-designed subjects. There is a need for a clear conceptual map of the domain of learning, a curriculum structure, a means for students to progress through the material and a way of checking to see if both the students and the course are achieving what is intended.

Bob Ross pursues the idea of a framework for the curriculum in more detail and describes a broader framework for problem-based learning. In his view, the tutorial-centred model is self-fulfilling and needs to accommodate a great variety of activities. He is not wedded to a particular model, having been involved in a variety of innovative course designs in different discipline areas at Griffith University. He offers a clarification of terms, referring to problem-oriented, problem-based and problem-solving curricula as a way of distinguishing levels of specification and approach to the role of problems. Ross makes the important point that problem-based learning is one of few approaches to study which makes active use of students’ existing knowledge.

Why does problem-based learning generate so much strong feeling, both for and against the approach? Don Margetson, from his philosophical background, sees this as closely connected with a conception of knowledge in problem-based learning which is profoundly different to that found in subject-centred learning. The knowledge which is valued in problem-based learning is that which can be used in context, rather than that which justifies the structure of particular disciplines.

The emphasis of problem-based approaches is on learning processes of enquiry which proceed by asking what needs to be known to address and improve a particular situation. This is quite different from some of the garbled versions of discovery learning which imply that students are supposed to invent knowledge which is already known. The knowledge which students use needs to be identified and applied in the context of the presented situation. Margetson stresses that students will be ill-served if they are given only the products of enquiry without learning how they were derived or how to pursue enquiry. Critical reflection is central to effective action and an enquiry-oriented approach is a useful means of promoting this vital skill.

Reference

Chapter 2

Not Just a Method But a Way of Learning

Charles E Engel

'Pedants sneer at an education which is useful. But if education is not useful, what is it?' Whitehead (1950) wrote in the Foreword to his book The Aims of Education and Other Essays. In 1978 the Royal Society of Arts devoted three Cantor Lectures to Education for Capability. This initiated a movement in educational circles in Britain that culminated in 1987 in a programme designated 'Higher Education for Capability'. While higher education has a long tradition of fostering scholarship and of valuing knowledge for its own sake, the primary responsibility of Higher Education for Capability is to assist students in their development of the capability to benefit from and cope with modern life, and to contribute productively to their society. Higher education is thus seen as responsible for producing capable agriculturalists (Bawden and Valentine, 1984), anthropologists, doctors (Neufeld, 1984), engineers (Cowan, 1984) and lawyers (Duncan, 1984). The same is also true for any profession.

However, in order to be capable of benefiting from and coping with modern life and of contributing to society, students need to acquire much more than a store of knowledge in the subjects that relate to their future profession. Those who embark on higher education now will still be in active professional practice well towards the middle of the next century. They will practise during a period of accelerating and massive change. Change, as it relates to their profession, will make self-directed learning throughout their life a sine qua non. However, to adapt to change and to participate in change within their profes-

sion will perhaps be the least demanding of their tasks. They will have to adapt to numerous economical, political, scientific and technological changes and, as members of their profession, to participate in advancing, moderating or retarding changes as they affect their own society and, increasingly more frequently, as they affect the whole of our world. Adapting to, and participating in, change and self-directed learning are composite competences. Each will require the development of a number of component competences, such as the skills of communication, critical reasoning, a logical and analytical approach to problems, reasoned decision making, and self-evaluation.

How, then, are institutions of higher education to meet their challenge of creating capable citizens for the next century (Engel, 1985)? As long ago as 1913, Sir William Osler argued cogently against too great a reliance on courses of lectures and on students' capacity to memorize a growing number of items of knowledge. More recently, Dornhorst (1981) warned with even greater urgency against information overload. Medicine is perhaps one of the most conservative professions where education of its next generation is concerned, but it has also provided some of the fiercest critics of present-day higher education, for example Maddison (1978) and Bok (1984). Bishop (1983) summarized his view of contemporary medical education by saying 'What emerges are physicians without enquiring minds, physicians who bring to the bedside not curiosity and a desire to understand, but a set of reflexes that allows them to earn a handsome living'. Can the liberal arts, the natural and physical sciences, or any of the other professions lay claim to a more positive education for their educational practices? However, medicine has also been among the pioneers in the application of problem-based learning as a means towards rectifying the existing situation in undergraduate medical education (Spaulding, 1969) and postgraduate medical education (Jack and Engel, 1976).

Where problem-based learning has been adopted as the mainstay of the curriculum, its application is expected to fulfill two quite distinct purposes. One aim is to use problem-based learning as a method that will assist students towards achieving a specific set of objectives, that is to become capable in a set of competences (Table 2.1) that will be important to them throughout their professional life, irrespective of the precise branch of the profession in which they come to practise.
The second aim is to use problem-based learning as the method of choice, because it is particularly suitable to support the conditions that influence effective adult learning (Table 2.2).

Barrows (1986) has analysed the various educational practices that use the appellation ‘problem-based learning’. Only one method of problem-based learning can be expected to contribute optimally to the achievement of the generalizable competences cited above. This is also the only problem-based approach that will consistently support effective adult learning. Tables 2.3 and 2.4 present a condensed illustration of the ‘pure’ form of problem-based learning (Barrows and Tamblyn, 1980) and may serve to support Barrows’ contention.

Table 2.1 Examples of generalizable competences

- Adapting to and participating in change.
- Dealing with problems, making reasoned decisions in unfamiliar situations.
- Reasoning critically and creatively.
- Adopting a more universal or holistic approach.
- Practising empathy, appreciating the other person’s point of view.
- Collaborating productively in groups or teams.
- Identifying own strengths and weaknesses and undertaking appropriate remediation, eg through continuing, self-directed learning.

Imagine a group of some seven first-year students sitting around a table with their tutor. This two-hour session (Table 2.3) is scheduled for early in the week so that a follow-up session (Table 2.4) can take place before the end of the week. The group has elected a scribe who will record the main items of the group’s discussion on a flipchart, chalkboard or white board. In some institutions the group will also elect a chair. The tutor is not necessarily an expert in the topic to be

Table 2.2 Examples of conditions for effective adult learning

- Active learning through posing own questions and seeking the respective answers.
- Integrated learning, learning in a variety of subjects or disciplines concurrently through learning in the context in which the learning is to be applied in real-life situations.
- Cumulative learning to achieve growing familiarity through a sequence of learning experiences that are relevant to the student’s goals, experiences that become progressively less straightforward but more complex, as well as less non-threatening but progressively more challenging.
- Learning for understanding, rather than for recall of isolated facts, through appropriate opportunities to reflect on their educational experiences, and through frequent feedback, linked with opportunities to practise the application of what has been learned.

The process

The tutor starts the session with the presentation of a problem that a new graduate might be faced with. He or she may show a short videotape, play a brief audio recording or distribute a written account.

The students are expected to organize their thoughts about the problem and to attempt to identify the broad nature of the problem and the factors or aspects involved in the problem.

After a period of brainstorming in relation to underlying causes, mechanisms and solutions the students are encouraged to examine each of their suggestions more critically.

Throughout the discussion the students will quite naturally pose questions on aspects that they do not understand or need to know more about. These questions will also be recorded by the scribe.

The goals

The students are stimulated to attempt to tackle a realistic problem in the field in which they wish to become competent.

The students practise observation and succinct presentation of what has been observed. The students are challenged to begin by applying their existing knowledge and experience.

The students are given constant practice in a logical, analytical, scientific approach to unfamiliar situations.

This facilitates the progressive development of a mental process for the storage, retrieval and application of knowledge.

The outcomes

Learning in the context in which it is to be applied is remembered longer and can be retrieved more easily for application in the context in which it is to be used. Relevance to the goals of the learner provides an incentive to learning.

Learning is cumulative, leading to increasing familiarity. Stimulation of existing knowledge facilitates anchoring of the new knowledge.

The students are consistently encouraged to identify what they do not yet understand or know and to regard this as a challenge to further learning (not as a disgrace).

Adults find it easier to learn if they can ask their own questions and seek answers to their own questions.
Table 2.3  Cont.

The process
Before the end of the session the tutor will help the students to concentrate on questions that are particularly important at this stage of their studies. The students decide which of these questions they will all want to follow up and which questions they will leave to individuals who will subsequently teach their fellow students.

The goals
Students are helped to recognize that nothing is ever learned completely, and that learning in a variety of subjects/topics is concurrent in order to be applied in an interrelated fashion. Also that when a great deal has to be learned, the task needs to be shared with other students.

The outcomes
Integration of learning assists integrated application. Cooperation is fostered instead of competition with colleagues.

Table 2.4  The second session

The process
The tutor starts the session by encouraging the students to reflect on what they have learned towards answering the questions that are still on the flipchart or board. They will start by exploring each others’ answers to the questions which all the students had decided to follow up. The next step is to invite individual students to pass on to their peers the insights they have gained from their study of questions which they alone had agreed to tackle.

The goals
The students practise exchanging information on the usefulness of various sources of information. They practise sharing new learning by presenting it to their peers and by questioning each other.

The outcomes
They learn how to obtain information from various sources, including consultation of experts. They learn how to convey information and how to question others critically but without causing offence. Active use of what has been learned and feedback on how well new learning has been assimilated help to embed new information in long-term memory. Students learn how to compare their performance with that of their peers and to identify their own strengths and weaknesses.

The process
New knowledge and understanding is applied to the original problem. The students consider whether their earlier conjectures or hypotheses can be reordered or refined, and what further information about the problem will assist in its further exploration. Throughout both sessions the tutor can provide further data about the problem when the students have advanced cogent reasons for access to such information. A definitive resolution of the problem may not be necessary, particularly early in the course.

The goals
The students practise the application of new knowledge to the original or a similar problem.

The outcomes
They practise transfer of knowledge through application in a realistic context.

Perhaps, once every two weeks, at the very end of a second session, the tutor will call ‘time out’ and stimulate the group to reflect on how their studies are progressing, what they have learned, how their learning fits together, how they, as individuals, are progressing and how they have functioned as a group.

Students are encouraged to reflect on what they have learned, how they have learned and how they have contributed to the group’s work.

Reflection on recent experiences is an effective method of learning: wisdom through reflection.

explored by the students at this early stage in the course and will thus be spared the temptation to lecture or to give ready answers the students. The tutor’s role is to guide and help the students through each of the successive and iterative stages of their discussion and decision
making. The tutor will also prevent or remediate difficulties that arise in the dynamics of the group's interaction.

Problem-based learning is thus particularly suited to assist students towards mastery in a range of generalizable competences and to support effective adult learning in the cognitive and affective aspects of a course in higher education. However, the full potential of problem-based learning as an educational approach is dependent upon the design of the curriculum. The quality of the educational environment (Clarke et al., 1984) is equally important if the curriculum is to be implemented by the academic staff as it was designed, and if it is to be perceived and used by the students in the spirit in which it was planned (Engel, 1989). Table 2.5 includes perhaps the four most important aspects to be built into a problem-based curriculum.

Table 2.5 Important components of a problem-based curriculum

- **Cumulative learning**
  No subject or topic should be studied in finite depth at any one time, rather it should be reintroduced repeatedly and with increasing sophistication whenever it contributes legitimately to reasoned decision making in a problematic situation.

- **Integrated learning**
  Subjects should not be presented separately but rather be available for study as they relate to a problem.

- **Progression in learning**
  As the students mature so the various aspects of the curriculum (eg working in groups, relationship between theory and practice) must change and progress.

- **Consistency in learning**
  The aims of problem-based learning must be seen to be supported in every facet of the curriculum and in the way it is implemented (eg students must be treated throughout as responsible adults. It should never be perceived as merely the sugar on a bitter pill; summative assessment should be used sparingly and should test for application, not merely recall of knowledge (Feletti et al., 1983); adequate human and material resources must be available to support individual, self-directed study).

What are the consequences?

First, it is not possible for separate, subject-centred groups of academics to plan, organize, implement and evaluate a problem-based curriculum. For example, a medical curriculum will need to be faculty-centred, a mechanical engineering curriculum will need to be department-centred. Subject-centred groups will thus need to relinquish some of their power. This loss of power will need to be replaced or appropriately compensated, and budgetary reorganization will be required where financial resources were previously linked to subject-based teaching.

A central education committee will need to ensure that the overall curriculum, with its progression through the years of the course and its philosophy, is implemented through sub-committees that are not staffed on the basis of subject representation (Clarke, 1984). Evans (1970) described the overall administrative pattern as matrix management, a well-established system in industry.

Second, each subject needs to develop a 'discipline map' that provides a hierarchical overview of the principles and concepts which the subject experts expect students to learn. When this content has been justified in terms of the curriculum objectives, to the satisfaction of the education committee, it can be transformed into a 'road map' that shows when the principles and concepts are studied, repeatedly, in relation to the agreed progression of problems.

The third and perhaps most difficult task is to devise an overall curricular structure that allows students to progress towards mastery in each of the generalizable competences. The curriculum must help students to do so in the context of progress towards mastery in the specific objectives that delineate the responsibilities to be assumed on graduation. The curriculum must also accommodate the concomitant and relevant study of basic subjects which enable students to make reasoned decisions in dealing with the problems that are presented to them.

Fourth, and last, the academic staff need time to become informed about the need for change, the nature of the change and its consequences (Mennin and Kaufman, 1989). They will need opportunities to contribute to the new curriculum, whether for the entire intake of students (Richards and Fülöp, 1987) or for a parallel track with a limited number of students in the first instance (Kaufman, 1985; Kantrowitz et al., 1987). They will also need opportunities to practise skills that are specific to planning, implementing and evaluating problem-based learning, but especially the skills required for the tutorial process (Barrows, 1988). How better to let problem-based learning be seen to be practised than to place these academics in situations where they are required to deal with problems of planning, implementing or assessment, where they can identify for themselves what they need to learn and are then able to apply their new insights and skills?
One other task remains. As responsible academics we are bound to encounter the questions: Have we planned, implemented and assessed in ways that teachers and students find acceptable? Have the objectives been achieved effectively and efficiently – with an affordable expenditure of time, effort and resources? The new curriculum needs to be evaluated so that it can be improved and refined. It also needs to prove itself, if the heterodox of today is to become the orthodoxy of tomorrow (Schmidt et al, 1987).

Problem-based learning is not a mere method to be taken up and discarded as just another passing fashion. As an essential means for higher education into the next century it is an exacting taskmaster. The reward rests in the intellectual stimulus provided by the high motivation and enthusiasm of our students and graduates (Rolfe, 1984; Boyd et al, 1984; Barbeau et al, 1990).

References


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