

Developing Critical Skills Through the Use of Problem-Based Learning: a review of a pilot scheme in Microeconomics

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Introduction

Problem-based learning [PBL] is an increasingly popular approach to teaching and learning. Supporters of this approach generally declare that they promote greater understanding of the concepts, develop skills, foster active participation and motivate classes. Proponents of PBL also argue that it brings benefits not only for assignments or for courses, but for part or all of a disciplinary curriculum as well as for lifelong learning (see, for example, Albanese and Mitchell (1993), Vernon and Blake (1993), Maudsley (1999)).

However, there is no agreement in the literature about the actual effectiveness of PBL. Concerns have been raised difficulties in its implementation and the philosophy that underpins it. For example, Benbow and McMahon (2001) wonder how problems of group dynamics can be resolved when it is not uncommon for some students to dominate and others to withdraw. Fenwick (1998) claims that PBL treats uncertainty and plurality as obstacles because it fundamentally conceives of life as problem-governed. A recent research project coordinated by Newman (2004) evaluated the use of a PBL curriculum in nursing education. The results of the research do not provide support for the many claims made for the advantages of PBL and, rather, they show that in some contexts it may lead to worse outcomes for some students. Overall, the research concludes that it is far from clear what the ingredients necessary for successful PBL are.

In this paper we reflect on our experience in using PBL for the first time in the year I module Introduction to Microeconomics. After briefly explaining how we organised the module, we use structured feedback from students, unstructured feedback from the teaching team members and some statistical evidence to analyse our experience. We highlight our problems with the implementation of the approach, the coordination of a large teaching team and the monitoring of group work. We also raise questions about the effectiveness of the standard PBL approach that does not take into consideration local issues.

The Module

'Introduction to Microeconomics' is an autumn semester module that is core for all economics degrees. The module is taught on the two university campuses in

Holloway Road (North London) and in Moorgate (City of London) by a teaching team of eight lecturers. A total of 137 students took the module (43 on the North campus and 94 on the City campus) with the students divided into eleven seminar groups.

The module's aims and objectives are not only to introduce students to the basic principles of microeconomic theory but also to provide them with basic IT skills such as the use of software packages such as Word, Excel, Powerpoint and Internet Explorer. Four hours of weekly contact time were timetabled: two hours for the lecture, one hour for seminar activities and one for a workshop in the computer lab.

Implementing PBL

In the academic year 2004/5 a common undergraduate programme was introduced across the university. This gave us the opportunity to review the design and structure of the Introduction to Microeconomics module. In doing this we drew upon the work of Frank Forsythe (2002) and designed a programme in which the weekly two-hour lecture was complemented with seminar and workshop activities built on group work. The PBL environment was organised as follows.

Group Work

From the first week of the semester in each seminar the students were organised into small self selecting groups of 3-5 people. However, we also allowed for students to work independently if they wished to do so. It was intended that group composition should remain unchanged for the duration. Each group was asked to nominate a 'leader' who would coordinate the activities of the group and liaise with the seminar tutor.

The PBL Tasks

The students were asked to engage with three PBL tasks set by the teaching team. The sequence of tasks were designed to cover the whole syllabus and contained a mixture of problem solving and independent activities based on a close interaction between theory and real world cases. The development of IT skills was embedded into the tasks which required students to produce solutions and analysis through the use of Excel, present results with Powerpoint, write reports by using Word and search information on the Internet. The intent of each task was to progress students from basic skills of knowledge and comprehension to higher order skills of analysis and synthesis. Thus, the early stages of each task contained simple problems aimed at developing basic understanding while in the later stages more involved and articulated problems were designed to induce students in analysis and evaluation.

Task n.1 was framed within the context of the petrol market and required students to investigate theoretical and practical issues concerning the demand and supply of petrol, the price elasticity of demand and the effects of government intervention. Task n.2 used data concerning a fictitious company to develop in students an

understanding of the theory of the firm and the production and pricing decisions under alternative forms of market structure. Task n.3 addressed the issues of market imperfections and externalities by requiring students to investigate the private and social returns to education and the use of market oriented policies in dealing with environmental problems.

Hence, each task started with a set of problem solving exercises that sought closed progressing to into more open-ended activities that required the use of data and statistics to analyse and evaluate real world issues. Our intention was to facilitate students developing problem-solving skills and critical skills through the interaction between closed and open-ended activities. The more 'traditional' PBL approach of including only open-ended question/activities was rejected on the basis that we believed that our students required a higher level of structure, including lectures, to support them develop their skills.

The Process

As mentioned, students were required to attend a two-hour lecture followed by a two-hour seminar. The lectures were used to deliver basic knowledge content in a rather traditional format. On the other hand, the seminar hours were used for the proper PBL activities where students were working in groups under the supervision of the lecturer.

The first hour of the seminar would take place in the classroom while the second hour would take place in the computer lab. In week 1 the students were asked to organise themselves in groups of no more than five people and to deal with generic problems concerning introductory issues such as scarcity and the production possibility frontier. From week 2 to week 4 the students were asked to deal with task n. 1. Each group would work independently under the supervision of a seminar tutor. In week 5 each group was asked to give a short presentation concerning some of the questions in the task and to submit a preliminary account of their work to the seminar tutor. The seminar tutor would provide feedback by the following week. In week 5 each group was also asked to start dealing with task n. 2 to be completed by week 7. In week 8 each group was asked to give a short presentation and to hand in their work in progress in order to receive some feedback from the seminar tutor. By the end of week 8 the students were also asked to submit their coursework. From week 8 until week 11 the students would deal with task n. 3.

Assessment

Students were assessed through coursework (40% of the overall mark) and a two-hour long 'seen' exam (60% of the overall mark). Students were asked to submit the solutions to tasks 1 and 2 as part of their coursework. The end of semester exam paper was divided into two sections. The first included four questions that required students to engage in analysis. Given that they were able to access the exam paper in advance of the actual exam date (it was agreed to circulate the exam paper one

week before the exam), it was felt in keeping with our hopes for the PSB approach that the exam paper needed to test students' ability to engage in analysis and synthesis rather than in simple knowledge replication. The second section of the exam paper included two questions based on articles drawn from the *Financial Times* and *The Economist*, and pertinent to issues investigated in the third seminar task, of which students were asked to answer only one.

The Role of Tutors

Seminar tutors were briefed at the beginning of the semester about their role and responsibility within the PBL sessions. Tutors were asked to facilitate the students' self-directed study by providing opportunities for reflection and analysis rather than suggesting possible solutions or answers. Tutors were also warned about the 'fine' line that separates an 'interventionist' attitude aimed at helping the students in difficulty and the 'doing nothing' attitude perceived as a possible consequence of the PBL approach. During the duration, the module leader attempted to monitor the direction taken by the various seminar groups by asking tutors to report on their activities.

Embedding IT in the Curriculum

As noted earlier, it was decided to embed the use of IT within the PBL tasks. Students were asked to input data, carry out calculations, plot graphs, in Excel, produce reports in Word, prepare presentations in Powerpoint and search for microeconomic data and statistics on the Internet. The students were not introduced formally to these IT packages but rather it was felt that the PBL approach naturally lent itself to the development of the IT skills outlined above.

An Evaluation of the PBL Experience

A critical reflection of the PBL experience is based on feedback from students collected via an end of semester questionnaire and unstructured interviews and feedback from the tutors. The analysis will look at 'operational' issues concerning the organisation and running of the approach as well as 'learning' issues related to the approach effectiveness in developing deeper learning and critical skills.

Operational Issues

The success of PBL depends on a good organisation and communication among the interested parties. "Staff and students must be aware of what is expected of them and they must be equipped to carry out their designated roles" (Forsythe, 2002, p. 15). We prepared a module handbook with all the necessary information about the PBL approach containing details about the tasks, the assessment, the presentations and the group work. Meetings with staff were held at the beginning of the semester and it was explained why PBL was introduced, the potential benefits and problems that were expected, the importance of facilitating student self-directed study rather

than inhibiting the process and how PBL sessions would operate. Despite this level of organisation, problems have been encountered and mistakes have been made.

Communicating the PBL Approach

The module booklet explained the PBL approach and presented the three tasks that the students were asked to complete. In the initial lectures and then in the seminars tutors presented the PBL approach and organised the students in groups. However, interestingly, about 52% of the students claim that the PBL approach was not explained at the beginning of the semester and only about 45% were clear about what was expected from them. Moreover, when asked whether the tasks were clear and whether they knew what they were supposed to do, only 34% of the students responded affirmatively. Thus, the feedback from the students seems to reveal a lack of effective communication about the set-up of the PBL approach.

It is also interesting to notice that there was a large and significant discrepancy between the feedback provided by young students (18-21 years old) and more mature students (22-35 years old). The former perceive that the PBL approach and its requirements were not communicated to them effectively, while the majority of the latter (two-thirds) confirm the opposite.

The Teaching Team

Coordination and communication has not always been easy, particularly across the two campuses. To some extent this can explain the students' confusion about the PBL approach and what was expected from them. While all staff were briefed before the start of teaching, it was clear throughout the semester that not everybody was following the set rules. This is reflected in the comments of one of the full-time lecturer who pointed out that not all seminar tutors were supportive and fully committed to the PBL approach.

The students' heterogeneous experience is emphasised in some of the feedback comments such as "Our tutor cleared up understanding problems from the lecture", "Group work is a failure especially when the tutor is so poor in coordinating it", "There is no need for a tutor, it is a waste of two hours a week" and "No use for a tutor as they do not do anything". About 64% of the students agreed that the tutors were helpful and supportive. However, this percentage increases to about 81% if, in particular, one tutor who received poor feedback is excluded from the statistics (17 students are removed from the dataset). The exclusion of this tutor improves all the statistics concerning the perception of PBL among students and it can be regarded as a confirmation of the importance of a well trained and coordinated group of staff for the successful implementation of PBL.

The Logistic of two Campuses

The difficulty in coordinating the teaching team is due to various factors such as all staff being new to the approach and the intense workload that makes

communication more difficult. However, logistic factors also played an important role. The physical distance between the two campuses made it difficult for the module leader to get a direct contact with the teaching team and with the students and to get a sense of how the approach was implemented and perceived by students. In turn, this made it more difficult to intervene quickly and suggest solutions in case of problems. While we do not see any major reason why PBL should not be effectively introduced even if the module is split over two campuses, it is clear from our experience that this 'physical' constraint adds additional challenges and coordination problems that need to be carefully considered.

Working in Groups

Groupwork is a feature of PBL and various suggestions are given on how to organise and regulate it. We decided to allow students to form their own groups for no more than 5 people or to work independently if they wished to do so. We also established that the members of a group would share the same mark and that any issue concerning the work ethic within each group would be raised by the group leader and dealt with by the seminar tutor.

The experience has been mixed. While some groups worked very well and produced some good work, other groups struggled. The following is a list of issues that we identified throughout the semester:

- **Free-riding:** some students failed to properly engage with the other group-members and tended to either miss group meetings or to put very little effort. In turn this led to a more or less continuous reshaping of groups;
- **Share of Work:** many groups acted strategically and distributed the work among group-members rather than all working on the whole tasks. This led to situation where each group member engaged only partially with the tasks resulting in a selective learning process;
- **Allocation of Marks:** some students complained about the fairness of allocating the same mark to all group members when instances of the free-riding problems emerged within some groups. Despite the attempt by the seminar tutors to minimise the problem, some students felt that their effort was not fully rewarded.

When questioned about the effectiveness of group work, the students responded in various ways. About 45% of the students agreed that group work was a good experience. This percentage is higher among the students who had a good seminar tutor (55%) and mature students (67%). However, the majority of students (48.2%) believed that group work should not be replaced by an individual assessment. Again this percentage increases among the students who had a good seminar tutor (57%) and mature students (56%).

The contrasting experiences are reflected in some of the feedback collected at the end of the year such as "Group work is too much hassle... cannot rely on other

members to do work”; “PBL is a positive experience when it does not have to be done in group, although is a good idea to share information”; or “Group work encourages cooperation”.

Learning Issues

PBL is promoted as a student-centred method of learning that leads to greater understanding and achievement of competencies, rather than retention of knowledge for its own sake. Relative to conventional lecture-based methods, in the literature it is argued that PBL (see Gibbs (1992), Boossche et al. (2000)):

- fosters a deeper approach to learning;
- promotes more versatile studying methods;
- develops greater knowledge retention and recall skills
- students tend to exhibit stronger knowledge application skills.

However, recently this literature has been criticised on the grounds that “... less has been written about the circumstances in which PBL is or is not successful” (Pawson, 2004, p. 5). In particular, a recent “... project looking at the evidence on its effectiveness suggests that it is far from clear what the ingredients necessary for successful Problem Based Learning are” (Newman, 2004, p. 1). In the next subsections we attempt to contribute to this debate by evaluating the impact of PBL on our students’ learning and critical skills development.

The Development of Critical Skills

It is difficult to measure the effectiveness of PBL in developing high order skills of analysis, synthesis and evaluation. Various factors combine to develop such skills and it is difficult to isolate and measure the actual relevance of the PBL approach. We attempt to measure the impact of PBL by using three methods: the marks achieved by students in the final exam, the feedback received from students and a comparison of the marks achieved in the “Introduction to Microeconomics” module and the other modules in year I. The results of this latter method are not yet available and are not presented in this paper. The idea is that if PBL has indeed fostered high order skills, these should *ceteris paribus* [other things being equal] be reflected in higher marks in the second semester modules. Obviously, this approach can be questioned on many grounds but we consider it worth exploring and such an analysis will be presented in an updated version of this paper. We designed the exam paper specifically to test the students’ development of skills of analysis and evaluation. Both the problem-based and the case-study questions were geared towards the ‘measurement’ of the students’ level of learning. A deeper level of learning would therefore be reflected by the award of higher marks. Table I summarises the distribution of the exam grades in the two campuses:

Table 1: Exam mark distribution

Grade	North Campus		City Campus	
	N. Students	%	N. Students	%
A	1	2.94%	5	8.62%
B	1	2.94%	7	12.07%
C	10	29.41%	10	17.24%
D	4	11.76%	6	10.34%
E	6	17.65%	8	13.79%
R	12	35.29%	22	37.93%

Note: the students included in this table are only those who completed the module by submitting both the coursework and completing the exam.

The evidence shows that a small number of students managed to achieve either grades A or B while, on the other hand, about one third of the students failed the exam and revealed no clear learning of the subject. In general, the distribution is skewed towards the lower marks to denote a limited level of understanding. On the basis of this evidence it is difficult to conclude that PBL has been conducive to deep learning. However, this conclusion needs to be taken with some care. The poor performance in the exam can be a reflection of various factors among which must be included the fact that PBL was not introduced and implemented properly for all students (see the discussion above).

Students' feedback can provide us with some information about their perception of their level of learning. About 48% of the students agreed that PBL allowed them to gain a deeper understanding of microeconomics, although the percentage was as low as 33% among younger students. On the other hand, this percentage increases to about 66% for those students who either had a good seminar tutor or were classified as mature students. Consistent with most of the existing literature (see for example Forsythe, 2000), about 64% of the students thought that PBL had been a frustrating experience. Again, it is notable that the percentage is much lower (44%) among mature and much higher (73%) among younger students.

PBL is supposed to foster independent learning but only 43% of the students agreed that this was the case. Again, the percentage is higher (about 55%) when the poor tutor group is excluded from the data and among mature students. Some written feedback from students points out their perception about the effectiveness of the PBL approach: "It enables a deeper understanding of economic situations"; or "Helps to deal with research in own time", or "PBL gives you a sense of belonging and the opportunity to research, to be resourceful and share opinions"; or "It has helped me to strengthen my knowledge of microeconomics - I believe it is much more effective than a traditional lecture".

When queried about the most appropriate teaching methods, about 70% of the students expressed a preference for a more traditional lecture/seminar approach. This result is robust across gender, age and seminar tutors and is reinforced by the fact that less than 10% of the students would like to have no lecture at all and only seminar activities during the week. If the PBL approach has to be introduced, the majority of students (52%) suggest that it should be introduced later in the semester. Overall, this evidence seems to suggest that a good number of students appreciate the potential of PBL but would prefer a more gradual implementation throughout the semester and the curriculum.

Students' Background

Recently the learning philosophy behind PBL has been criticised. Pawson (2004, p. 3) contends that "PBL inevitably reifies problem solutions, emphasising the instrumental, the doing, ahead of the thinking, reflection and accommodation". Beringer (2004) also claims that "...some students dislike the messiness of the real-world problems of PBL, preferring the security that comes from the structure lent by more traditional learning situations." We believe that this is an important factor to take into consideration before introducing PBL. In order to be successful, this approach requires students to have some well developed skills. From an organisational point of view, the participants need to be focused, dedicated, well structured and organised in their approach to information collection and elaboration. From an academic point of view, there is a need to have developed an ability to approach problems in a structured and rational way. In general, we believe that PBL is well suited to students who have a well formed and stable educational background. Students who do not fit these criteria will tend to find it more difficult to cope with barrier-less platform that PBL manifests with and will find it more difficult to make sense of the information provided and to construct a rational and informative answer to the given task.

Most of the students on our module can be shown to have a relatively weak educational background and this has made it more difficult for them to fully appreciate and deal with the challenges offered by PBL. While we do not have substantial impartial evidence to support this claim we believe that this is a factor that is worth taking into consideration when implementing PBL and that it deserves future research.

The Development of IT Skills

The PBL tasks required students to engage in the use of Excel, Word, Powerpoint and Internet Explorer. None of this software was formally introduced to the students and it was expected that they would gradually acquire a deeper knowledge by dealing with the set tasks. Throughout the semester the students with a weak IT background found it difficult to cope with the simultaneous demand of learning a new software and applying microeconomic analysis to the solutions of the problems. To some extent, this dual 'burden' led students to be distracted from their main

objective and to focus mainly on the development of their technical skills rather than on the appreciation of the economic problems and their solution. In turn, this has affected the students' ability to acquire a thorough understanding of microeconomic theory.

From the end of semester feedback it emerges that most of the students (77%) support the inclusion of some Excel, Word and Powerpoint lectures at the beginning of the semester. with the majority agreeing (80%) that they could use Excel more confidently and that the module helped them to develop their IT skills. Embedding IT into the PBL tasks has also helped the majority of students (70%) appreciate the importance of using spreadsheets such as Excel in conducting economic analysis.

Summary and Conclusions

In this paper we have reflected on our experience of introducing the PBL approach in the first year module Introduction to Microeconomics. The analysis has attempted to identify mistakes in its implementation and wider issues concerning the effectiveness of the PBL for a first year module. Some of the points that we raise have already been highlighted in the existing literature while others add to the more recent debate calling for a critical appraisal of the PBL approach. Our findings can be summarised as follows:

- While we adopted a 'partial PBL environment', we implemented it from the start of semester. This proved to be too demanding for the students and we will consider introducing it later in the semester.
- As emphasised in the literature, group work is demanding for both students and staff. We organised the group work in a loose way in the hope that a combination of sense or responsibility on the students' part and tutor coordination would create a productive working environment. This has not always been the case and we will need to reconsider our approach.
- The coordination of a large teaching team spread over two campuses is a challenging task. Next year, procedures for better communication between the teaching team will be put in place and visits across the two campuses will be organised.
- From our experience we find little evidence that the PBL approach has helped students develop deeper learning. However, this conclusion needs to be taken with care. The problems experienced throughout the semester and the methodology used can lead to inaccurate conclusions.
- We believe that a pre-requisite for a successful implementation of the PBL approach is a student body with a successful education background. Students who have experienced difficulties in their earlier education are likely to find it difficult to cope with the requirements of organisation and structure that characterise the PBL approach.

Our aim is to update the implementation of the PBL approach in this module by taking into consideration the points raised above. We will also attempt to collect unbiased data that will allow us to test some of the conjectures postulated in this paper.

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Biographical note

Dr John Sedgwick has been at the University since 1987, taking the North London route. He has published widely on the economics and history of film, including two books. He was made a Leverhulme Research Fellow in 2000 for research into the decline of cinemagoing in the US in the postwar era, and recently was awarded a Menzies Bi-Centennial Research Fellowship to research the diffusion patterns of Hollywood movies in the Australian market during the 1930s.

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