Introducing Problem-Based Learning to Teacher Education Programmes

K. S. So, K. H. Yeung, Albert T. K. Lo and Ken Volk

The Hong Kong Institute of Education

Abstract

One of the principles adopted in the Review of the Education System in Hong Kong is to give more room and flexibility for students to be masters of their own learning. This is particularly important in teacher education programmes which aim to prepare student teachers who, in turn, will influence the learning approach of their students. Problem-based learning (PBL) is generally a student-centred learning approach in which students are encouraged to participate in the learning process. Three groups of students studying the Technical Teacher Certificate Course formed the subjects of this research project. An authentic contextual problem was presented to the students, with the lecturers acting as facilitators during the whole of the learning process. Student feedback indicating their attitudes was solicited after the first cycle of implementing PBL. The first week of the PBL process was most crucial. It is important that students fully understand both what PBL is as well the roles of lecturers and students in the learning process. The second phase of the project was administered with reference to the comments from staff and students made after the completion of the first cycle. Follow-up interviews were conducted to report on the needs of the students in the learning process. It is anticipated that this study can foster more student involvement in the learning process and that deep learning can be encouraged and supported.

Introduction

'Student-focused' has been one of the principles adopted by the Education Commission (EC) in formulating the proposals for Education Reform in Hong Kong. The EC believes that learning should be focused upon students' personal development and that school reform should aim to give more room and flexibility for students to be masters of their own learning (Education Commission, 2000). There has been increasing concern about the ability of our students to cope with the rapidly changing needs demanded from the community. Imparting knowledge is no longer the principal function of education. The role of education should be to foster imagination, creativity, intellectual development, problem-solving ability, and critical thinking skills in our students (HKIEd, 1999a, p.42). The education system must change to meet the challenges resulting from economic, technological, social and cultural changes in the community.

The aims of school education include helping students to think logically, independently and creatively; to make rational decisions; to solve problems independently and in co-operation with others; and to cope with stress and change (EMB, 1993). This is echoed in the formulation of the aims of education in the recent review of the academic system in Hong Kong. The overall aims of education in Hong Kong for the 21st century should be:

> To enable every person to attain all-round development according to his/her own attributes in the domains of ethics, intellect, physique, social skills and aesthetics, so that he/she is capable of life-long learning, critical and exploratory thinking, innovating and adapting to change; filled with self-confidence and a team spirit; willing to put

> forward continuing effort for the prosperity, progress, freedom and democracy of his/her society, and contribute to the future well-being of the nation and the world at large. (Education Commission, 2000, p.5)

Quality Learning and Teaching

In order to allow more room and flexibility for students to be masters of their own learning, students' needs and interests should be given due consideration, as should the learning and teaching approaches used. The constructivist view of learning places emphasis on the learner in the creation of knowledge.

> If students are to learn desired outcomes in a reasonably effective manner, then the teacher's fundamental task is to get students to engage in learning activities that are likely to result in their achieving those outcomes…It is helpful to remember that what the student does is actually more important in determining what is learned than what the teacher does. (Shuell, 1986, p.429).

In other words, it is the learner who constructs knowledge, not the teacher who imparts it (Biggs, 1991). How would the learners learn to construct knowledge? How should the teachers promote appropriate learning approaches to foster this construction of knowledge? Biggs (1991) and Biggs and Telfer (1987) assert that in order to encourage deep learning the teaching and learning activities should contain one or more of the following:

- an appropriate motivational context;
- a high degree of learner activity;
- interaction with others, both peers and teachers;
- a well-structured knowledge-base.

In developing new teacher education programmes, the Hong Kong Institute of Education (HKIEd) firmly believes that lecturing staff should model approaches which are relevant to students' own learning contexts, and that lecturers will facilitate learning by engaging students in learning activities which encourage dialogue and collaboration, reflection, critical thinking and independence (HKIEd, 1999b, p.29). This reciprocal-teaching paradigm (Palincsar, & Brown, 1984; Moore, 1991) is perceived as important in nurturing an environment for quality learning and teaching. In particular, the project described in this paper aims to study the feasibility of introducing PBL in the teacher education programmes at the HKIEd.

Problem-based Learning

Problem-based learning (PBL) is known to have originated from the medical education curricula in North America some 30 years ago. Since then, it has received considerable attention and development in other disciplines such as law, engineering, architecture, education, business, etc. In Hong Kong, PBL was first introduced to the Department of Physiology at the University of Hong Kong in 1992/93 and subsequently to the Faculty of Medicine as recommended by the research team undertaking the studies of PBL in teaching physiology and pathology (Kwan, Chan, Nichols, Sheng, & Wong, 1997). The philosophy behind this learning approach fits well with the present trend in education to allow the learners to be masters of their own learning. In essence, there are five defining characteristics of PBL (Bridges, & Hallinger, 1998):

- The starting point for learning is a problem.

- The problem is one that students are apt to encounter in their future work.
- Subject matter is organised around problems rather than the disciplines.
- Students assume a major responsibility for their own instruction and learning.
- Most learning occurs within the context of small groups rather than lectures.

The PBL introduced in this project was generally a student-centred learning approach in which team spirit was emphasised. The lecturer acted as a facilitator during the learning process. The problems were real world issues which enabled students to contextualise their understanding within a simulated policy decision making framework.

Methodology

Subjects

The subjects of this study were students studying the one-year full-time Technical Teachers Certificate (TTC) Course at the HKIEd. Average class size numbered around 10 students each year during each of the three cycles in the study. These students were graduates in engineering or design fields with most at Diploma or Higher Diploma level. Some also had degree qualifications. They also had industrial experiences before enrolling on the Course.

Methods

PBL was introduced as the teaching and learning approach in the module 'Current Issues in Prevocational/Technology Education'. This was new to most students as it differed considerably from the traditional lectures and seminar approach they were more accustomed to. Past experience in introducing PBL in traditional courses revealed that students always found it difficult to follow at the initial stage (So, & Yu, 1996). It is therefore important to provide a thorough description of the PBL approach and the roles of lecturer and students at the early stage of the learning process. These include introducing to students the concept of PBL, the week by week processes, the assessment scheme and the possible problems encountered.

There were four components in the overall assessment:

Attendance	10%
Participation	30% (mean of peer, self and lecturer scores)
Five-minute papers	20%
Report	40% (lecturer assessed)

The assessment of participation was based on the student's contribution to class discussions, demonstration of research efforts, and performance in report presentation. The rationale for such weightings was to enable students to have more involvement in both the learning as well as the assessment of the module.

During the learning process students were required to complete a five-minute reflection paper (Whittle, & Marsh, 1994, p.12) (see Figure I) after each PBL session. The purposes of the five-minute reflection papers were to stimulate students' thinking and reflections on their learning and to compare their initial expectations with the outcomes they obtained through research and group discussions.

Figure 1: Five minute reflection papers

Name: **Class:** **Date:**

Five-minute Reflection Paper: Week 1

What is the central problem ?

What are the sub-problems derived from the central problem ?

What thoughts do you have about the sub-problems before you start to do your research ?

Write down what you think you might find out through your research activities this week ?

What area(s) are you going to look into this week ? What possible resources will you use ?

Name: **Class:** **Date:**

Five-minute Reflection Paper: Week 2

Do the evidences you collected during the past week support your original thoughts ?

Write down what you think you might find out through your research activities this week ?

What area(s) are you going to look into this week? What possible resources will you use ?

What further thoughts do you have about the sub-problems before you start to do your research this week ?

Name: **Class:** **Date:**

Five-minute Reflection Paper: Week 3

Try to summarise the ideas about the problem you have researched into. How has your thinking changed over the weeks ?

At the end of the process, each student was required to complete a questionnaire relating to the overall evaluation of their learning through PBL. Consequently, the following procedures were administered in this study:

- Introduction of students to the rationale of using PBL in the Course, the concept of PBL, the week by week processes and the assessment scheme.
- Arranging of students into groups of 4-6.
- Posing of the central problem to the groups.
- Discussion and identification of the central problem, exploration and creation of internal ideas about the problem, splitting of the central problem into sub-problems and distribution of the tasks among team members to conduct the investigation of a particular sub-problem.
- Completion of a five-minute reflection paper after each session.
- Conducting of a literature survey and search for appropriate solutions to the sub-problem,

both individually or in a group ,and reporting of the finding during the PBL session.

These sessions were repeated with lecturers acting as facilitators during the development to facilitate the discussion and problem solving process. The groups were to present their solutions to the central problem to the whole class. Finally, students were required to complete an evaluation questionnaire to inform the refinements in the next cycle of implementation.

Findings and Discussion

First Cycle

Central Problem

The central problem for the first cycle was related to the design of a new Graphical CommunicationLaboratory. Students were presented with the following problem:

> The subject 'Technical Drawing' will be replaced by another subject called 'Graphical Communication' in the Year 2000. This will result in a corresponding change in the laboratory layout as well as the facilities in the laboratory. You are the panel chair of Technical Drawing in a secondary school. Your task is to design the new Graphical Communication Laboratory, taking into account the trend for curriculum development and the possible problems encountered during the transition period. (Technical Teachers Certificate Course, 1997/1998, HKIEd).

This problem is a major problem faced by practicing technical teachers and by graduates of the TTC Course who will be instrumental in implementing the new technical curriculum in the year 2000.

Sub-problems

During the learning process, students discussed and managed to derive the following sub-problems to facilitate their problem-solving process:

- reasons for change
- room layout / modification
- budget
- timing
- safety
- construction tender
- examination
- facilities/equipment
- upgrading the computer
- software selection
- teachers' knowledge
- curriculum trend
- management of laboratory

Learning Process

In order to solve the sub-problems, students identified the needs to understand the roles of the inspectors and school teachers, studied the criteria in choosing the curriculum, explored the constraints in room modifications, market demands and methods of assessments, etc. It was observed that students were active in searching for information from a variety of sources, such as visits to schools and the Education Department to interview teachers and inspectors, searching for equipment catalogues and prices, and conducting Internet and library searches.

Feedback

Feedback from the first cycle was obtained through the evaluation questionnaires and interviews administered at the end of the learning process. Some of the feedback is summarised in the following extracts of quotations from students:

> … understand the feeling and anxieties of technical teachers teaching Technical Drawing
>
> … learning took place through the use of Internet, discussions and management of information
>
> …understand the 'conflict' between inspectors and school teachers
>
> …my concept on Graphical Communication had been extended
>
> …visit to inspectorate was practical and useful
>
> …group discussions helped broaden my perspective on the issue
>
> …through teamwork, I learned to develop my technique in exploration
>
> …my presentation skill was improved
>
> …I found the approach very difficult to follow in the beginning
>
> …I learned to look at problems from difference perspectives
>
> …These learning activities facilitated my participation in the learning process
>
> …I thought this was an effective learning approach
>
> …I liked the process of research

The results from the evaluation questionnaire are presented in Figure 2. The students opined that they learned more or less the same as they did in a conventional lecture based course. However, they were very satisfied that the PBL approach helped them to develop communication skills effectively. In addition, they agreed that PBL encouraged them to employ a deeper approach to learning than the conventional approach. When asked about the role of lecturer in the learning process, students generally expressed that the lecturer should perform the role of 'counsellor' to provide guidance to students in tackling the problem, or 'observer' to observe how students approached the solving of the problem. They found it most difficult to search for relevant information, and to make sense of it, due to the fact that they were not provided with much background information.

Figure 2: Evaluation Questionnaire (modified from Cawley, 1989; Ireland, 1985) The evaluation questionnaire was designed on a 5 point Likert scale - 5 meaning 'very much' and 1 meaning 'not at all'

	97/98 (1st cycle)	98/99 (2nd cycle)	99/00 3rd cycle)
Did you find the learning approach interesting?	3.8	3.4	3.8
Have you enjoyed the learning process?	3.9	2.8	3.7
Did you find that focusing the course on real problems made the course seem more relevant to your interests?	4.0	3.8	4.0
Did working in groups mean that you learned from each other?	4.2	3.8	4.0
Have you understood the technical materials of the course better than if it had been lectured in the conventional way, i.e. didactically?	3.8	3.5	3.7
Do you think you have learned as much technical materials as you would on a conventional lecture course?	3.1	3.3	3.3
Considering the material you have learned, do you think you have learned it more thoroughly than you would on a conventional course?	3.9	3.8	3.7
Has this course taken more or less time than other conventional lecture courses? (In your assessment of the time taken by other courses, you should include the time you will spend on revising for the examinations.)	4.1	3.6	3.8
Has this course helped you to develop communication skills effectively?	4.7	3.6	3.7
Has this course encouraged you more than the conventional lecture course, to use a deep approach to learning?	4.0	3.9	4.1
Is the level of difficulty of the problems appropriately set?	3.3	3.1	4.0
Would you like more problem -based learning (PBL) introduced into other modules within the curriculum ?	3.4	3.5	3.8
Are you satisfied with the assessment methods used?	3.7	3.1	3.4
Have you received sufficient direction during the learning process?	3.3	3.0	3.4

Second Cycle

Central Problem

Based on the feedback obtained from the first cycle, some background information was provided to students in the next year before they embarked on the problem-solving process. Lecturers involved were advised to give more guidance to students when it was deemed necessary and the scope of the central problem was widened to cover more areas. This was reflected in the following central problem for the second cycle.

> In the year 2000, a new curriculum of Graphical Communication will be implemented in prevocational and secondary technical schools in Hong Kong to replace the current Technical Drawing curriculum. Based on your previous working and teaching experiences, you are asked to:
>
> - Identify problems in terms of management, implementation, modes of teaching and learning, …etc. which will be faced by the school management team, subject panel and his team, and students themselves.
>
> - Propose strategies to resolve some of these issues.

(Technical Teachers Certificate Course, 1998/1999, HKIEd)

Sub-problems

Since this central problem covered a very wide area, the students had correspondingly derived many sub-problems. These included, among others, the aims and objectives of the new curriculum, the adaptability of the school management team, the teaching and learning methods, the impact of curriculum change on society, budgetary constraints, and implementation problems.

Learning Process

The learning process was similar to the first cycle in which students underwent the problem identification process, evaluated the constraints of the problem, and sought advice from relevant parties concerned. They also undertook visits, surveys, interviews, Internet and library searches and had discussions among members. It was observed that they were rather frustrated when faced with such a huge problem and many sub-problems. The enthusiasm was low, especially during the first two weeks. The whole exercise was extended by one week to a total of four weeks to allow the teams more time to gather and analyse the information.

Feedback

The results of the evaluation questionnaires in the second cycle suggested that the students did not seem to enjoy the learning process (2.8 in a 5-point Likert scale with 5 being 'very much' and 1 being 'not at all'). The response in the first cycle was 3.9 for the same question. An analysis of the week-by-week process through discussions with the teams and reading the 5-minute reflection papers revealed that they spent considerable time in deriving sub-problems. They expressed during the interviews that the process of deriving sub-problem from the central problem caused a lot of confusion. The following are examples of some of their comments on the learning approach.

> … through PBL, I learned to analyse problems from different perspectives
>
> … explored the main concept through different channels
>
> … found it difficult to follow at the beginning
>
> … There were too many sub-problems derived from the central problem … helped strengthen the learning of subject knowledge
>
> … the workload of this kind of PBL was heavy
>
> … time was limited, so it is impossible to look into every details
>
> … this learning approach was constructive and worth implementing
>
> … facilitated co-operation and sharing of experiences among colleagues
>
> … established linkages with the professional community
>
> … was aware of the importance of teacher retraining in this curriculum change
>
> … good to have the chances to meet difference groups of people during the learning process

The general comment from the students indicated that the central problem was too difficult for them. In fact, one of the biggest challenges in using PBL is to create ill-defined problem scenarios that are relevant and appropriate. If the problems presented are too clearly defined, students may lose the opportunity to engage in problem-finding or the problem may lose some of the flavour of reality (Bridges, & Hallinger, 1995). The implementation of the second cycle

suggested that the design of the central problem must be well balanced and thought through. This is also the difficulty faced by many PBL programmes.

Third Cycle

Central Problem

In this last cycle, the central problem was carefully designed to focus mainly on the learning and teaching aspects of the new technical curriculum.

> The current prevocational and secondary technical curriculum is undergoing extensive reviews. Some outdated subjects will be removed while new technology / business subjects will be introduced in the year 2000. Consequent to this move, the need to review the teaching approaches with reference to the teaching resources available is apparent. You are the panel chair of technical subjects in a prevocational or technical school. Your brief is to review the impact of such change on the learning and teaching quality of technology / business subjects and to make recommendations on the teaching approaches appropriate to the new technical curriculum. (Technical Teachers Certificate Course 1999 / 2000, HKIEd)

Sub-problems

The sub-problems were more focused in this round. They basically centred around issues relating to curriculum, pedagogy and resources and the impacts of the curriculum changes upon teachers and students. The sub-problems derived by the students included the following.

- Demands for teacher retraining as a result of the curriculum change;
- Need for replacing the old equipment and facilities;
- Comparison of traditional and new teaching approaches;
- Impacts of new teaching approaches on practicing teachers and students;
- Issues relating to curriculum, pedagogy and resources …;
- Changes in subject knowledge and teaching aids;
- Any change in the aims of technology education;
- Limitations of the current teaching approaches.

Learning Process

Students managed to present their solutions to the problem in three weeks. Their learning approaches were similar to the previous two groups. There was not much frustration demonstrated during the process. This might be attributed to the clear focus of the central problem. Some students expressed that they initially viewed the problem in a rather abstract way. This perception had, however, gradually becoming more concrete as they gathered more information about the curriculum change.

Feedback

Most students believed that the level of difficulties of the problem was appropriate (4.0 in a 5-point scale). They enjoyed the learning process (3.7 as compared to 2.8 in the second cycle), and they generally supported the introduction of PBL into other modules within the TTC curriculum. Some of their comments are summarised below.

…Learned to analyse problem

…Very time consuming to gather relevant information

…This was a new but useful learning approach

…It facilitated active learning

…A student-centred learning approach

…Difficulty in the distribution of labour

…The approach was suitable for technical subjects

…Should preferably be less demanding in the early stage

…Not just suitable for school education but also a good approach for life-long education

…Solved the problem from difference perspectives

…Lacked of prior knowledge, difficult to follow

With reference to the experiences gained from the first two cycles such as allocating sufficient time to tackle the problem, ensuring the appropriateness of the level of difficulty of the central problem, and defining the roles of lecturer and students, the implementation of this third cycle received encouraging comments from students. At the interviews, some students expressed that the PBL approach was a very good learning method if the problem was designed in accordance with students' ability. It would also facilitate students to be more proactive in the problem-solving process.

Conclusions

The three cycles of introducing PBL into the teaching of a module in the Technical Teachers Certificate Course has been a rewarding experience for the research team. There were times when students were rather frustrated. The lecturer, seemingly, could have saved time and set the group on the right track by telling them what to do. However, most groups found themselves back on track by their own self-assessment and problem- solving (Bridges, & Hallinger, 1995, p.57). Our findings support Bridges and Hallinger because our attempts to shortcut the learning process through such interventions often ended up leading students on indirect routes that were less productive than if we let them work through problems on their own.

This study reinforces our belief that getting students to be involved and to take charge of their own learning is fundamental to ensuring quality learning and teaching. The HKIEd has recommended PBL as one of the methods of teaching and learning in all the new programmes. It is anticipated that this initiative would allow more room and flexibility for student teachers, that they would be capable of critical and reflective thinking, life-long learning, innovating and adapting to change, and filled with self-confidence and a team spirit (Education Commission, 2000). More importantly, these student teachers will in turn influence their students in promoting such spirit when they enter the teaching profession.

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