HOW TO TEACH STUDENTS IN THE INFORMATION ERA?

K. C. Chu
Hong Kong Institute of Vocational Education (Tsing Yi), Hong Kong

Index: Problem-based Learning. Student-centered teaching

Abstract: Problem-based learning (PBL) is a way to help students to think and make use of suitable information to solve their problem. However, direct import of the typical PBL model may not be appropriate to local student. This study focuses on the advantages and disadvantages of previous PBL model used and studying the effect of modified PBL model in a Higher Diploma engineering course in the HKIVE(TY). This modified PBL model uses a variety of teaching and learning modes to facilitate students to solve the real world cases. Promising results gathered from summative test and student interview show that this local context PBL model is suitable to all students.

INTRODUCTION

In the past, people were badly lack of information to support their learning and working. Nowadays, we experience too much information through different media especially through Internet. Usually, we can obtain a lot of related materials through search engineer from Internet. Then, another problems will be arised when we are facing such huge amount of information. How can we select suitable information to read in so limited amount of time? How can we digest the information? How can we make use of the information to solve our problem?

On the other hand, Students in Hong Kong are familiar and comfortable with didactic teacher-centered approaches. Some methods should be used to channel tertiary students out of the didactic teaching/learning model commonly found in secondary schools. One of the most effective ways for preparing independent life-long learners is when it is problem-based (Boud, 1985). Problem-based learning is one of the methods to improve the quality of student learning (Gibbs, 1992). PBL was found to maximize learning outcomes (Lai & Chu, 1997). There have been many studies of the effectiveness of PBL in increasing knowledge retention and fostering deep learning (Schmidt, 1989; Tans, 1986; Boshuizen, 1990). PBL is also known to enhance abilities of students to integrate basic science knowledge into the solutions of clinical problems (Patel, 1991). With regard to effective outcomes, PBL enhances intrinsic interest in subject matter. Barrows and Tamblyn (1980) advocates that this student-centered approach increases motivation because students are given chances to generate learning issues and thus have ownership to their own learning.

The philosophy of problem-based learning (PBL) is that deep understanding and learning can come only from active processing of new information. Problem-based learning, perfectly in keeping with contemporary constructivist views of education, is an instructional method that uses real world cases or problems as vehicles for students to acquire critical thinking and problem-solving skills (Lai & Chu, 1997; Chu & Lai, 1997). Original form of Problem-based learning (PBL) was created in Western countries and first used to teach medical students to find possible solution through real life cases. PBL is one of the student-centered teaching approaches that are proved to be effective to foster deep learning and improving problem solving skill. Traditionally, PBL works well in small classes and this method emphasizes on the learning process in which students actively engage in collecting information and solving a problem. Students are not working alone as they can build their

own understanding under the guidance of instructor, but the instructor does not do the building for them.

There is growing number of research on the implementation of PBL in Hong Kong for different disciplines such as education (Biggs & Tang, 1997), engineering (Lai & Chu, 1997), and hotel & management (Tse, 1997). Although PBL is used by teachers in many different teaching and learning contexts, successful implementation of PBL may not involve direct transportation of the original form of PBL. Almost all local PBL models (Biggs & Tang, 1997; Lai & Chu, 1997; Tse, 1997) used were specifically designed to suit the individual teaching or learning context. Tang et al, in their study of PBL within the Hong Kong Polytechnic University, pointed out that consideration should be given to the actual teaching and learning context (Tang et al, 1997). There is a growing need to develop a context-based model which would preserve the philosophy and retain the key elements of PBL but allowed for modification and adaptation in response to each local teaching and learning context.

ORIGINAL FORM OF PBL

Original form of PBL was introduced in the then Hong Kong Technical College (Tsing Yi) two years before (Lai & Chu, 1997). The students discussed the case or problem as a group, clarifying terms and concepts not readily understood by making use of knowledge of the group members. Based upon their common consensus, the group then proceeds to generate hypotheses necessary to analyze the problem. Then they begin to define 'learning issues', which are more or less what they do not know and need to find out in order to solve the case. These learning issues serve as guide for studying the literature or searching for other sources. Learning resources are considered, and here the instructor and students decide on where they can find the relevant information. At the next session, students inform each other about their findings, and teach the rest of the class what they have learned about their assigned issue. Attempts are made to integrate the new information, and to relate it to previous knowledge. If the learning process raises new questions or leaves some issues still poorly understood, these too are listed and the cycle is repeated until a satisfactory evaluation and clarification of the case can be made. This second meeting aims at checking whether a deeper understanding of the problem has been reached. In all these processes the instructor attempts not to inform but to guide, support and encourage the students' initiatives.

The two Engineering classes used in this previous study was taught by the same teacher, with the Experimental (PBL) class (N=41) taught in the problem-based way, and the Control class (N=21) taught in the usual expository way. The final summative test consisted of questions testing the higher-order cognitive abilities. Results (Fig. 1) show that experimental students with a bias towards a deep approach to learning achieving considerably better than the deep-biased students in the control class ($t=2.20$, $p<0.05$). However, for surface biased students, the average test scores of both experimental and control classes are quite similar.

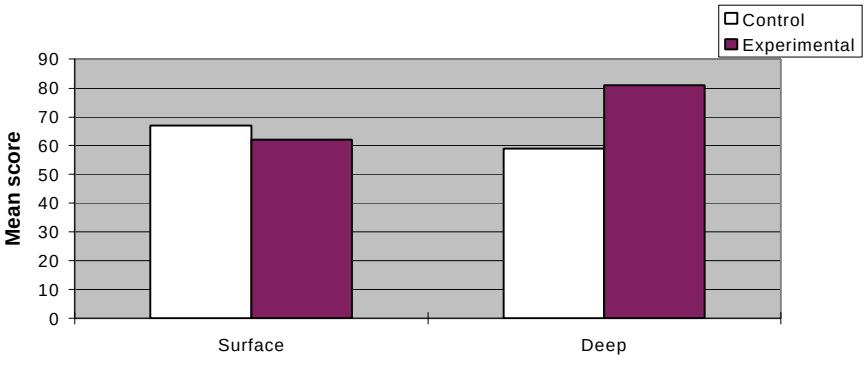

Fig. 1 Summative test means by treatment and approach to learning

The interviews clarified how this worked. Deep and surface students perceived the impact of problem-based learning teaching strategy for different assessment tasks in quite different ways. Deep learners of the liked problem-based learning for it can enhance understanding of the subject matter by individual and group work, hence, enable them to answer question easily. Quite a different response emerged from the surface learners when they had gone through the assessment tasks. The surface learners expressed their preference to low-order skill questions. Deep and surface learners also differed in the ways they studied for the test in this study. Most deep learners spent only a short period of time to prepare the test because they found they had already understood the materials after undergoing the problem-based learning process. Surface learners, on the other hand, had to spend more time to study before the test. They found a lot more difficult than the deep learners to prepare the test because they, without any lecture notes to study, could not understand the materials.

MODIFIED FORM OF PBL

The subjects are year one engineering students studying in the Hong Kong Institution of Vocational Education (Tsing Yi). A subject is randomly chosen for two engineering classes. These two large classes, with 74 students each, have the same entry qualification. The modified PBL model is designed to suit the course requirements and standards set by external engineering professional bodies. The modified PBL model uses a variety of teaching and learning modes which include lectures, tutorials, group discussion, and presentation to facilitate students to solve a main problem. For the experimental class, 4 students form a group. Members of each group are the same throughout this period of study (approximately 15 weeks) and all activities are group based. Students can tutor each other and solve problems collaboratively in the lecture as well as the tutorial.

A summative test is given to both experimental and control classes at the end of this study. The questions of this summative test are related to basic knowledge given in the mass lecture as well as the project work. Based on the numerical result of this test, learning outcomes between these two classes in this PBL program can be studied. This final summative test also consists of questions assessing the higher-order cognitive abilities. At the end of the study, eight students from the experimental group are randomly selected and interviewed. The aim of this interview is to probe in an open-end way how this modified PBL model may affect their learning and their views towards this new teaching approach. The interview is conducted in Cantonese and is audiotaped. Results (Fig. 2) show that the experimental class was superior to the control class in the test score, students with

both deep and surface biased approach to learning achieving considerably better than the control class.

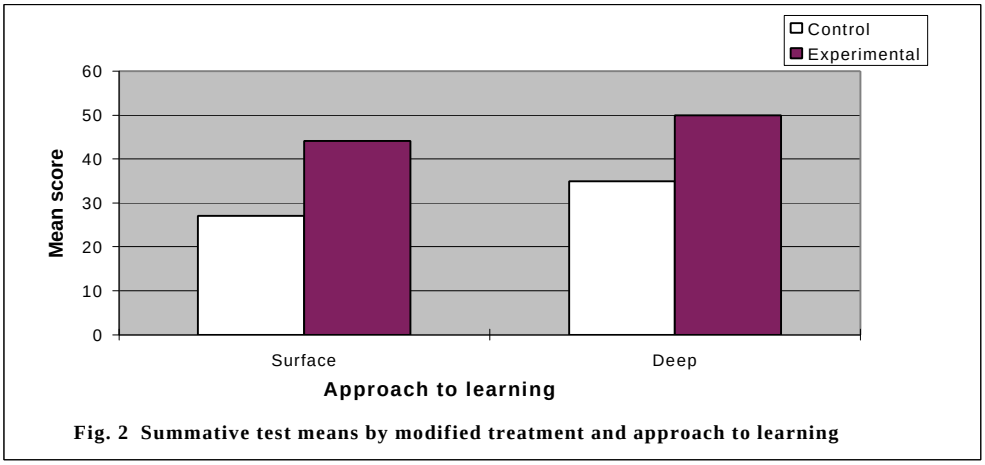

Fig. 2 Summative test means by modified treatment and approach to learning

It shows much difference for questions assessing students' higher-order cognitive abilities. The t-test for the average scores yields t=2.837 (surface) and t=2.577 (deep). In both cases, $p<0.05$, establishing a statistically significant of improvement of students' problem-solving skill in the experimental classes.

Positive feedback also obtained from student interview. Most students from experimental classes enjoyed the chance to discuss together during the completion process of the main problem. Actually, students could teach each other and remember the discussion process for a longer period of time. They were encouraged to work harder by peer pressure within a group. After the discussion in this exercise, students could be trained to think and learn independently. Even a surface student, who was not so active in the discussion, could learn difficult concept through the discussion process.

Supporting sessions such as lecture and tutorial were also essential to the success of this modified PBL model. These two teaching activities provided an environment for students to learn basic concept rather than start everything from zero by students' own effort. Problems given in the lecture and tutorial helped student think actively and understand the topic more so that they could eventually apply the theory to practical design with this PBL model.

Positive changes in learning style were found among students in the experimental class. Deep students had reported better time management and deeper thinking. Surface students had confidence to ask more questions and learned to transfer knowledge into practice.

CONCLUSION

As suggested by Tang et al, (1997), a direct importation of the typical model of problem-based learning is inappropriate. This can be reflected from the student interview that some students cannot solve problems by their own in the beginning. They would like to have some guidance of project work to lead them to acquire problem-solving skills. The quantitative results support the previous findings (Lai & Chu, 1997; Glasgow, 1997; Hadgraft, 1998) that problem based learning increases the problem solving skill of the students in the class. Positive changes were reported by deep students in the interview. In contrast with Lai & Chu (1997), the present study also shows an increase in the problem solving skills of surface bias students who are usually labeled as role learners and adopt passive learning approach (Griffith, 1992).

This hybrid PBL model provides an environment for students to actively solve real life case problems through the support of interactive lecture, quiz, and tutorial to learn basic concept and problem solving skills. Though the discussion process, students had different viewpoint to be expressed. Students can learn from different ideas generated to solve the same problem. This also creates more interest for students in learning. Both deep and surface students are encouraged to think and benefit from this active learning process.

This study concentrates on the full time engineering student. It is also worthwhile to study on the application of this hybrid PBL model to part time students or students of other non-engineering courses to find out any constraint that will be encountered. Finally, in order to improve cooperation between students within a group, it is better to introduce more elements such as cooperative learning into the process so as to help students better throughout the problem solving process.

REFERENCES

Barrows, H.S. & Tamblyn, R.M. (1980). *Problem-based Learning. An Approach to Medical Education*. Springer, New York.

Biggs, J.B. & Tang, K.C.C. (1997). Assessment by Portfolio: Constructing learning and design teaching. Paper presented to HERDSA Annual Conference, Adelaide, July.

Boshuizen, H.P. (1990). Curriculum style and the integration of biomedical and clinical knowledge. Paper presented to 2nd International Symposium on Problem-based Learning, Indonesia.

Boud, D. (1985). *Problem-based learning in education for the professions*. Higher Education and Development Society of Australasia.

Chu,K.C., & Lai, Patrick (1997). 'Which assessment question best suit problem-based learning?', The Hong Kong Educational Research Association 14th Annual Conference, Hong Kong.

Gibbs, G. (1992). *Improving the Quality of Student Learning*. Bristol: Technical and Educational Services Ltd.

Glasgow, N.A. (1997). New Curriculum for New Times - a Guide to Student-centered, Problem-based Learning. London: Corwin Press.

Griffith, P. (1992). Problem-based Learning in Automotive Engineering Design. In G. Gibbs (eds). Improving the Quality of Student Learning. Bristol, Technical and Educational Services Ltd.

Hadgraft, R.G. (1998). 'Problem-based Learning: a vital step towards a new work environment', International Journal of Engineering Education, 14(1), 14-23.

Lai, P. & Chu, K.C. (1997). 'Who benefits from Problem-based learning?', *Zeitschrift fuer Hochschuldidaktik, Special Issue Problem-based learning: Theory Practice and Research, 21* (1), 148-160.

Patel, V. L. (1991). 'Effects of Conventional and Problem-based Medical Curricula on Problem Solving', *Academic Medicine, 66*, 380-389.

Schmidt, H. G. (1989). 'Explanatory Models in the Processing of Science Text: The role of Prior Knowledge Activation through Small-group Discussion', *Journal of Educational Psychology, 81*, 610-619.

Tang, C. and 12 others (1997). Developing a context-based PBL model. In J. Conway, R. Fisher, L. Sheridan-Burns and G. Ryan (eds). *Research and Development in PBL, Vol.4: Integrity, innovation, integration.* Newcastle: Australian Problem Based Learning Network.

Tans, R.W. (1986). 'Directing the learning process by means of problems: a field experiment', *Tijdschrift voor Onderwijsresearch, 11,* 35-46.

Tse, P. (1997) Problem-based learning in Hotel and Management: Implementation and Evaluation. In J. Conway, R. Fisher, L. Sheridan-Burns and G. Ryan (eds). *Research and Development in PBL, Vol.4: Integrity, innovation, integration.* Newcastle: Australian Problem Based Learning Network.