

Exploring PBL: An Action Research Project Among Pre-Service Teachers

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Abstract

An action research project was designed to explore problem-based learning as an instructional approach in a pre-service physics education methods course. The main aim of this research is to immerse pre-service teachers in authentic learning experiences that would encourage them to adopt problem-based learning in teaching and learning. Data collection methods included feedback elicited from pre-service teachers' reflective journals, field notes, and pre-service teacher-generated documents during teaching practice. The paper describes how pre-service teachers' knowledge, understanding and classroom practice change as a result of their action research experiences. Implications for physics education are also addressed.

1. Introduction

In training and equipping pre service teachers for a challenging and demanding profession, Sultan Idris Education University (SIEU) is bullish in coming up with innovations that is effective, applicable and viable. Any graduate teacher today needs to be self-directed, critical thinkers, good problem solvers, able to integrate knowledge and skills and possess lifelong learning skills. SIEU aspires to produce not only graduates with the aforementioned qualities, but are also equipped to brave an ever-demanding and challenging career ahead. SIEU believes that a problem-based approach specifically designed for teacher training will enable teachers to cope with the complexities of the teaching profession.

Research studies clearly provide evidence of the effectiveness of Problem Based Learning (PBL) in retaining factual knowledge (Norman & Schmidt, 1992), ability to relate theory to practice and improved ability to remember and re-use

knowledge (Breton, 1999; Darvill, 2003). PBL has also proved to be the most effective methodology employed to date, to promote students' research and collaborative team work skills (Murray-Harvey & Slee, 2000). It also captures many of the key principles of a constructivist learning (Savery & Duffy, 2001).

This paper reports a pioneer project (Problem Based Learning Project in Science – PBLPiS) at SIEU in the form of an action research on how, 37 pre-service teachers' knowledge, understanding and classroom practice change as a result of their action research experience in implementing PBL as a new approach to learning. The action research project offered these pre-service teachers a framework to develop and practice their critical thinking and problem-solving skills while implementing PBL in schools during teaching practice. The overall research study aims to improve classroom practice, understanding of that practice, to contribute to the knowledge base of teaching and learning, and to immerse pre-service teacher trainees in authentic learning experiences that would encourage them to adopt problem-based learning in teaching and learning. Data collection methods included feedback elicited from pre-service teachers, reflective journals, field notes, and pre-service teacher-generated documents over a 12-week period. This study focused on an exploration of PBL in the context of pre-service Physics teachers' experiences. Answers to the following research questions were sought:

- a. Which aspects of the PBL sessions did the pre-service teachers enjoy most?
- b. What challenges did the pre-service teachers faced in conducting PBL?
- c. To what extent were the learning outcomes achievable?

Methodology

Conceptualization and Design

SIEU had its beginning as a teacher training college officially founded on 29 November 1922 in Tanjong Malim town at the southern tip of Perak State, Malaysia. The objective was to train teachers for primary schools who were also empowered to teach handicrafts and agriculture to rural children. SIEU evolved from this humble beginning. Change came in 1987 when it became an institute, midway in the process of becoming a public university. The change is of form and substance. The aim is now to generate educationists of caliber who are capable of meeting the challenges of

education in the new millennium. With that in view, all eight faculties in the university offer courses that are pinned to the basic philosophies of active learning approaches involving innovative learning processes such as PBL.

Several programmes to introduce and incorporate PBL were designed for SIEU pre-service and in-service teachers pursuing a career in Physics, Chemistry, Biology and Mathematics education. These programmes were initiated as a pilot run by incorporating into several existing courses. Results of the pilot run garnered very encouraging and positive feedback from faculty members and pre-service/in-service teachers. Recently PBLPiS was introduced among pre service teachers during their teaching practice to look into its applicability in bridging theory and practice.

One of the rationale behind PBL as an approach to learning adopted in this action research project, is the focus of learning around problem scenarios rather than discrete subjects. Through the PBL process, pre service teachers do not only learn how to problem-solve but are able to apply these abilities to other kinds of problem scenarios and situations in their professional practice, engaging with and reflecting upon related theories, current research and classroom practice.

SIEU is the only higher education institution that is solely responsible for the training of secondary school teachers in Malaysia. Graduates of SIEU, who have being inculcated with these invaluable experiences, would be able to apply this approach with school students throughout the country. This is significant considering the multiplier effect needed for developing the human capital of the nation. This is coherent with the pillars warranted in Malaysia's National Education Development Plan (2006-2010) in an effort to bridge the gap between the urban and rural and ensure democratization of education.

Subjects

The study was conducted in the final semester (during teaching practice) of a diploma level course among 37 pre-service Physics teachers. The subjects of this study were pre-service teachers enrolled in a one year full time Post Degree Diploma in Teaching program specializing in Physics Education at SIEU. These pre-service teachers were graduates in various fields related to physics with an industrial or teaching experience before enrolling into the programme. These pre-service teachers had undertaken a course on Learner Centered Teaching that includes a topic on PBL. Besides, they were also exposed to PBL in some of the courses undertaken during the two semesters prior to teaching practice.

The pre-service teachers had initially undergone and participated as students in a PBL environment. They also had to complete an assignment on crafting problem scenarios for topics from the Form Four Physics curriculum specifications. The crafted problems were presented to the class. Comments and feedback given by peers and the course lecturer (who is also the principal researcher) were considered to ensure the feasibility of implementing it during teaching practice.

Procedure

PBL when introduced as an instructional approach to the group of pre-service teachers was a new experience as it differed considerably from their lecture based undergraduate studies. Experiences by previous researchers (So, & Yu, 1996) have found difficulties in the initial stage for students to understand and shift from traditional to PBL approaches. Hence, it is important that the pre-service teachers involved in this study are introduced to the concept of PBL, provided with a first hand experience of the PBL process, and completed an assignment on crafting a problem based on a chosen topic in the Form Four Physics curriculum specifications. In order to facilitate the problem crafting process, a template for crafting a problem scenario was used. A thinking tool, called Facts, Ideas, Learning Issues, and Action Plan (FILIA) was also introduced as a guide in identifying questions to investigate while trying to find solutions to the problems. It also serves to ascertain whether the learning outcomes specified in the Physics curriculum specifications were achievable. Working in groups, nine problem scenarios were crafted, presented and subjected to comments and feedback from peers and the principal researcher. Finally, only five Physics problem scenarios were selected and implemented amongst Form Four school students during teaching practice.

The study was conducted throughout teaching practice – a period of twelve weeks. The subjects in this study were assigned one, two or three scenarios to conduct with their students. The number of scenarios depended upon whether they are doing their teaching practice alone, in groups of two or three in their respective schools within the state of Perak in Malaysia. The students generated FILIA and deliverables from PBL sessions conducted were collected and later analyzed. At the end of this project, the subjects were requested to submit a report regarding their PBL experiences, rewrite the problem scenarios indicating changes made to improve it, and include a reflection. Table 1 below shows the problem scenarios assigned to the nineteen groups of pre-service teachers in their respective schools during teaching practice.

Table 1: Problem Scenarios and Related Scientific Concept Assigned to Pre-Service Teachers During Teaching Practice

TITLE OF PROBLEM SCENARIOS	RELATED SCIENTIFIC CONCEPT
Floating Drown	Buoyant Force
Yik Mun’s Hot Pau	Specific Latent Heat
Flying Without Wings	Impulsive Force
Space Junk	Gravitational Field
Safety First	Safety Features in Vehicles

Findings and Discussions

Aspects of PBL teachers enjoy most

Analyses of interview transcripts were in accordance to the research question posed. The first research question is ‘Which aspects of the PBL sessions did the pre-service teachers enjoy most?’. Excerpts of responses to this question are tabulated in Table 2.

Table 2 Aspects of PBL teachers enjoy most

Excerpts	Respondent
...development of process skills like problem solving, teamwork and creative or critical thinking is achieved... make their group discussion, going to their self searching and study to answer their learning issues...	001
.....they were exited to being a part... my students will enjoy a lesson which is differ from normal	002
lesson become smooth and fabulous (e.g teaching and learning become easier).....can made the project, as team work , can present by their own style and active learner	003
...membolehkan pelajar berfikir secara kritis dan analitika (think critically and analytically). ...menggalakkan motivasi sendiri...(encourage self motivation)	004

Kelas cikgu seronok (<i>teacher's class is interesting</i>).	005
Belajar secara santai dan sempoi. (<i>Learning was relax and enjoyable</i>)	006
I really enjoy and love the moment at the discussion stage when students co-operate with each other in their own groups to find ideas and learning issues from problem scenario given. ...they can share and exchange ideas ... two way communications	007
...mereka lebih enjoy dan mampu mempersembahkan hasil kerja dengan jayanya.... (<i>they really enjoyed and manage to present their work successfully</i>) kerjasama di antara pelajar dan cara mereka mengeluarkan pendapat masing-masing (<i>cooperation between students and different ways of presenting ideas</i>)	008

The responses in Table 2 suggest that PBL is an appealing approach to students. Most of the respondents reported students enjoying the session. Some of the words used to describe this feeling includes 'enjoy', 'interesting', 'relax and enjoyable', 'excited', and 'self motivating'. Other aspects mentioned are the discussion in teams and sharing and exchanging ideas. Students involved feel that they have the freedom to express their thoughts and ideas and they do not feel threatened by the teacher's presence.

From the perspective of the pre-service teachers, PBL offers them a new approach to teaching Physics concepts. They also feel that they have the flexibility to use a range of instructional methods, thus increasing the chances that all students learning styles will be supported. For example, giving different roles to each member in the team allows students to work individually and collaboratively as part of the team. The role as facilitators of knowledge appeals these pre-service teachers since it increases communication and interactiveness between teacher and student. This is suggested in the following excerpt:

"... when I'm facilitating my students, there is two way communications between me and my students, they ask questions and I guide them find the solution to the problem scenario" (007)

It is no doubt that PBL is an appealing approach to students and pre-service teachers, however the effectiveness of this newly introduced approach must be measured in terms of achieving the learning outcomes stated for the topics taught. Analysis of the second and third research questions suggest that excitement and enthusiasm shown towards this new approach will not necessarily lead to successful achievement of all the learning outcomes developed.

Challenges in conducting PBL

The second question posed was ‘What are the challenges pre-service teachers faced when conducting PBL?’ A list of challenges were recorded from the pre-service teachers:

1. Crowded classroom
2. Obtaining students’ co-operation and understanding
3. Lack of experience in facilitation
4. Lack of confidence in implementation
5. Not enough time
6. Lab not well furnish with hardware
7. Understanding and analysing problem scenarios
8. Generating learning issues that matches learning outcomes

One of the biggest challenges faced by Malaysian teachers is the large classroom size. Classroom sizes in Malaysia range between 25 – 35 students. This would translate into approximately 5 to 7 groups doing PBL. Given a short teaching time (40 – 80 minutes) for each classroom meeting, teachers acting as facilitators would definitely face problems trying to facilitate each of these groups, which would have different learning issues at hand. This is evident in one pre-service teacher’s excerpt:

“...lack of experience facilitating... (2) limitation of knowledge on PBL (not 100% confident so I was not conducting PBL successfully)... and (3) time constrains (cannot complete in my 11th week of teaching” (002)

Having good facilitating skills can be a motivating element for teachers adopting this new approach. But mastery in this aspect could only come with accumulation of considerable experience and investment of time. Ma, A.K.F., et al., (2007), commenting on this issue, suggest that while pre-service teachers could master new teaching concepts and ideas relatively easy, the prospect of having to master a new teaching approach could be daunting for some of the teacher trainers, their professional training being obtained in a traditional way in the past.

One aspect that needs to be looked at more seriously is the nature of the problem scenarios. Some pre-service teachers report that students have difficulty understanding the problem scenario given. A good example is the following excerpt:

“...when I give them problem scenario about Space Junk. Most of them can't relate the problem scenario with the topic of Understanding Gravity...” (006)

“... their lack of understanding the text or scenario given is a challenge that needs to be overcome”. (007)

This difficulty would explain why pre-service teachers reported students' having problems in generating learning issues that match the learning outcomes. Thus, careful consideration should be given to the design of the problem and ensuring that problems crafted be driven by the learning outcomes for the topic concerned.

PBL is a fairly new approach in teacher education in Malaysia. Students here are accustomed to the conventional teaching approach where the teacher delivers information and procedures are systematically prescribed during problem solving. When faced with ill-structured problems, as in PBL, students often find difficulty in identifying critical learning issues, relating their prior knowledge to the current problem and generating hypothesis based on logical arguments.

Achievement of learning outcomes

There were mixed responses to the third research question ‘To what extent were the learning outcomes achievable?’. Two of the eight teachers interviewed reported that there are groups that fail to relate the problem scenario given to the physics concepts concerned. Another two of the teachers reported that they could achieve all the learning outcomes for the topics. The rest of the respondents reported between 25 – 70% success in achieving the learning outcomes.

The issues raised in answering the second research question explain fairly clearly why learning outcomes could not be fully achieved. Apart from trying to understand the problems students are still tied to their traditional role as receivers of information and are tightly bound to the normal classroom textbook. This is evident from the following excerpt:

“... their answers are limited to general things only and too short. When I asked them to give further answer they can't because they get the answer from reference books or other related sources” (006)

“Soalan yang dikemukakan oleh pelajar tidak cukup untuk menjawab permasalahan yang sedia ada. objektif PBL” *Questions posed by the students are not adequate in designing a solution that would meet the learning outcomes state for the PBL scenario.* 008)

...pelajar tidak mampu membentuk soalan bersifat higher order thinking atau soalan yang kreatif. *Students are not able to create higher order thinking questions or which are creative* (005)

It is quite apparent that the learning curve for these students who were previously taught by the ‘chalk and talk’ approach is steep. This is intensified by the fact that teachers have a heavy teaching load. These students should be provided with opportunities to further develop process skills through various training and workshops before undertaking PBL.

Conclusions

As novices to the process and implementation of PBL, this new approach presents SIEU with a number of challenges. Some of the lessons learnt from the PBLPiS are: (1) PBL is an interesting approach to teaching and learning but students must be made to understand the real nature of PBL and its learning process (2) challenges face by the teachers indicate that special considerations should be made in terms of equipping students with the necessary generic skills to facilitate team work, information search, thinking skills and informed decision making. Teachers should be well trained in facilitation and should have the capability in handling group dynamics (3) more effort should be focused to designing good problem scenarios that will help aid students generation of learning issues and to finally achieve the stated learning outcomes.

Research findings indicated the importance of explaining the purpose and process of PBL, role of both teachers and students, and valuing this method of

learning. The research has highlighted a number of areas where improvements can be made to the PBL experiences. These improvements will be adopted in the development and delivery of future teacher training curriculum.

Findings from this study indicated the needs of these pre-service teachers in the learning process. It can be anticipated that the PBLPiS project can foster greater involvement among pre-service teachers in the learning process and that deep learning can be encouraged and supported if these teachers are better equipped with the necessary skills.

Peer support, leading workshops, sharing strategies on best practices, and continuing education are some of the steps to be taken in sustaining the project. Areas that will be explored aggressively is the use of virtual technologies for facilitation and students' feedback in overcoming constraints in time and facilities.

SIEU has initiated efforts for the past three years in promoting PBL as one of the active learning methods in quality learning and teaching in all programmes. These efforts would more importantly, make it possible for pre-service teachers to in turn promote similar environment when they enter the teaching profession.

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