
Title	The effectiveness of problem-based learning (PBL) on academic self-confidence and generic skills of graduate students in health-related fitness and wellness in Singapore
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Source	<i>III International Conference of Physical Education and Sports Science (III ICPESS 2010) on "Youth in Physical Education and Sport", Singapore, 25 - 28 May 2010</i>
Organised by	Physical Education & Sports Science Academic Group, National Institute of Education (Singapore)

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THE EFFECTIVENESS OF PROBLEM-BASED LEARNING (PBL) ON ACADEMIC SELF-CONFIDENCE AND GENERIC SKILLS OF GRADUATE STUDENTS IN HEALTH-RELATED FITNESS AND WELLNESS IN SINGAPORE

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This study examined the effectiveness of Problem-based Learning (PBL) approach on enhancing graduate in-service physical education teachers' academic self-confidence, leadership and initiation, academic affect, and information processing competence. A pre-test/post-test with quasi-experimental design was used. 27 graduate in-service physical education teachers from the National Institute of Education, Nanyang Technological University, Singapore, in a health-related and wellness module participated in this study. The intervention comprised teaching participants using a PBL approach for 12 teaching weeks. Measuring scales of high validity and reliability were developed for this study to measure participants' self-concept, leadership, academic affect and their information processing competence. Averaged post-test scores in most of generic skill aspects (8 out of 11) were significantly higher than pre-test scores. Students had in general more positive attitudes toward the module and themselves at post-test than they had at pre-test. The results strongly support that teaching using a PBL approach is beneficial to both students' generic skill development and academic affect to teaching and learning.

1 Introduction

Problem-based learning (PBL) was first developed in the middle of the 20th century in the medical school at McMaster University as an approach to instruction. PBL, serving as an alternative educational methodology for the traditional-style approach, has become increasing prominent. It was applied not only in medicine, but also in elementary schools, middle schools, high schools, universities, and many other professional and academic disciplines including coaching, physical education and sports science in higher education (Chin *et al.*, 2004; Jones, 2006; Martin *et al.*, 2008; Torp & Sage, 2002).

PBL starts from an ill-defined, challenging problem that has many possible solutions. Students must identify the problem situation, find and use information which is relevant to the problem and their learning needs, and develop their own solution. During the PBL process, students assume the main responsibility to their learning. Through providing students with content instruction and feedback, the teacher primarily serves as a tutor or “cognitive coach” rather than an expert dispensing knowledge (Savery, 2006; Torp & Sage, 2002).

Compared with traditional teaching approach, the advantages of PBL could be understood from three perspectives. First, students in PBL are accountable for each step in their own learning, from defining the question to presenting their solution. The responsibility in this process is beneficial to developing students’ creativity, self-regulation skills, problem-solving skills, reasoning skills, critical thinking, knowledge acquisition, and ability of knowledge translating (Ward & Lee, 2004).

Second, unlike traditional approaches, PBL emphasises the importance of learning in a real and meaningful context (Pedersen & Liu, 2002). When students are involved in PBL, they must search for relevant and useful information according to the problem situation, and apply it to find a solution, arguing for the reasonability and implication of the solution. In this way, PBL helps students to understand the relation between information and the problem, and encourages students to use information flexibly. Third, PBL is not only an integrated approach that incorporates content knowledge and higher order thinking skills from different subjects, but it is also an efficient teaching method that encompasses different learning styles as reported by Hubball *et al.*, (2004) by using PBL to enhance team and player development of youth soccer players.

A challenge to physical education in the 21st century is to develop scholarship that is integrative, that incorporates the interconnectedness of the humanities, social sciences, and sports science into the study of physical activity and sports (Chin, 2001). PBL is an alternative instructional approach which encourages students to engage active participation through solving sports, health and physical activity problems in real teaching and life situation. Students would not rely on lectures only and they would need to be involved with independent and active learning. Fewer directions are provided, which places more emphasis on students taking responsibility for their own learning, both individually and as members of groups. Case studies would require students to make connections between their school and life experiences, what they have learnt from books, journals, magazines, newspapers and practical experiences in the Human Performance Laboratory to their teaching of sports and physical activity in school. It is the aim of this study to identify the extent to which PBL is effective in enhancing graduate in-service physical education teachers’ academic self-confidence, leadership, academic affect, and their competence in information processing.

2 Methods

Participants. The subjects for this study consisted of 26 graduate students in physical education in a module entitled Physical Activity and Lifestyle Behaviour. They are all in-service physical education teachers, except two majoring in exercise science, at the National Institute of Education, Nanyang Technological University, Singapore.

Research Design. The design is a pre-test/post-test with quasi-experimental design. At the start of the semester, the participants were pre-tested. Then after a 12-week intervention (3 hours each week contact time giving 36 hours of intervention but total semester duration is 39 hours as there is a one-week break within the 12 week period) using PBL, the participants were post-tested.

Rather than receiving lectures, the PBL classes were then presented with conceptual questions, issues and situations at the beginning of each unit and lab session, and then students utilised various resources and methods to research and solve the problems. The problems were “real-life” issues that required students to explore for the possible answers. An example of the problems was a case involving a girl who suffered from obesity, had low self-image and was harassed by other students on her body weight. Students were engaged in active learning in formulating, analysing and solving the problems in small groups. Students also experienced working in the Human Performance Laboratory during the module. For the assessment of the module, the students needed to conduct a PBL case study with a 15-min oral presentation on selected learning objectives and submit an individual case assignment on a critical analysis of physical activity patterns of school children in a real school setting.

Instrument. The measurement instrument comprised a questionnaire which has a background section on participants’ gender and group, followed by four sections. Section A focuses attention on participants’ self-rating on three psychological aspects, namely, academic aspiration, self-confidence, and leadership in relation to learning the module. Each of these psychological aspects is measured by a 4-item Likert-type scale. An example item for the Academic Aspiration scale is, “I aspire to working hard to make progress in Health and Fitness”. The response scale for the items in Section A, comprises a 6-point Likert-type response scale, ranging from 1 (Strongly Disagree) to 6 (Strongly Agree). The scales are scored such that higher values represented more positive attitudes (better aspiration, stronger self confidence and more leadership) in learning the module than do lower values.

Section B of the questionnaire focuses attention on participants’ attitudes toward the subject matter in the Health and Fitness module, namely the perceived importance of subject matters in Health and Fitness, affect towards studying the module, and autonomy in studying the module. Each of these areas is measured by a 4-item Likert-type scale. An example item for the Importance scale is, “It is important to me to be good at Health and Fitness”. The response scale for items in Section B comprises a 6-point Likert-type response scale, ranging from 1 (Strongly Disagree) to 6 (Strongly Agree). The scales are scored such that higher values represented more positive attitudes toward the Health and Fitness module than do lower values.

Section C focuses attention on perceived competence in problem solving in relation to learning. The five competences are Competence to Search for Information; Competence in Judgment and Selection of Information; Competence in Interpretation and Understanding of Information; Competence in Integration of Information; and Competence in Application of Knowledge to New Situations. Each of these competences is measured by a 4-item Likert-type scale. The response scale for all Likert-type items in Section C comprises a 6-point Likert-type response scale, ranging from 1 (Seldom) to 6 (Often). The higher the scale score, the higher the self rated competence.

Section D of the Questionnaire focuses attention on the evaluation of the Health and Fitness Module. It is made up of 10 7-point semantic differential items. An example item is, “I look forward to Health and Fitness class” versus “I don’t particularly look forward to Health and Fitness class”.

Analysis showed that all scales had very good reliability (internal consistency), with Cronbach’s Coefficient Alpha at least 0.8 for all of them. Details of scales used in the questionnaire and their reliabilities are presented in Table 1.

Table 1. Scales in the Questionnaire Used in the Study.

Scale	Number of Items	Cronbach’s Alpha
Section A: Psychological Constructs		
Level of Academic Aspiration	4	0.85
Self-confidence	4	0.81
Leadership and Initiative	4	0.84
Section B: Attitudes toward module		
Perceived Importance of Health and Fitness	4	0.87
Affect	4	0.88
Autonomy	4	0.80
Section C: Self-Perceived Competence		
Competence to Search for Information	4	0.77
Competence in Judgment and Selection of Information	4	0.70
Competence in Interpretation and Understanding of Information	4	0.79
Competence in Integration of Information	4	0.83
Competence in Application of Knowledge to New Situations	4	0.86
Section D: Module Evaluation (Semantic Differential Scale)	10	0.80

3 Results

3.1. Pre-Post Difference

Pairwise t-tests on students’ scores on the Likert-type scales between the beginning (Pre) and end (Post) of the semester were used to check pre-post lecture differences and results are presented in Table 2 and displayed graphically in Figure 1.

Table 2. Pairwise t-tests at Pre and Post Lecture and Effect Sizes.

	Pre mean	Pre SD	Post mean	Post SD	Post-Pre	t	df	Sig.	Effect Size
Section A: Psychological Constructs									
Level of Academic Aspiration	5.15	0.70	5.22	0.42	0.07	0.501	26	0.621	0.1
Self-confidence	4.83	0.57	5.05	0.57	0.22	1.667	26	0.108	0.4
Leadership and Initiative	4.18	0.90	4.71	0.69	0.53	3.842	26	0.001**	0.7
Section B: Attitudes toward Module									
Perceived Importance of Health and Fitness	5.13	0.73	5.44	0.50	0.31	2.732	26	0.011*	0.5
Affect	4.99	0.70	5.15	0.66	0.16	1.496	26	0.147	0.2
Autonomy	4.43	0.65	4.99	0.59	0.56	4.399	26	0.000**	0.9
Section C: Competence in:									
Search for Information	4.50	0.68	5.19	0.52	0.69	4.474	26	0.000**	1.1
Judgment & Selection of Information	4.47	0.63	4.98	0.63	0.51	3.947	26	0.001**	0.8
Interpretation & Understanding of Information	4.61	0.63	5.11	0.61	0.50	4.298	26	0.000**	0.8
Integration of Information	4.40	0.71	5.06	0.61	0.66	4.332	26	0.000**	1.0
Application of Knowledge to New Situations	4.62	0.60	5.11	0.57	0.49	3.932	26	0.001**	0.8

Note: 1=strongly disagree, 6=strongly agree; * $p < .05$; ** $p < .001$.

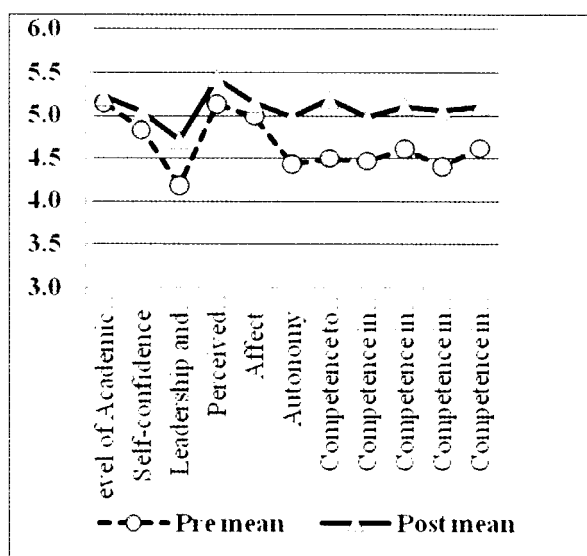


Figure 1. Difference between Pre-test and Post-test Mean Values.

It can be seen from Table 1 that all participants have much higher mean values than 3.5 (the mid-point in a 6-point scale) at both pre test and post test in the 11 scales in

Sections A to C concerning participants' psychological constructs in learning Health and Fitness, their attitudes toward the module, and their self-perceived level of competence in problem solving in the module. It means, in general, participants have rather positive attitudes and self-rated levels of competence (e.g. Competence in Integration of Information) even at the onset.

With three exceptions, there is significant increase in their attitudes and self-perceived level of competence after the instruction using PBL. Eight of the 11 scales were shown to have statistically increased in mean values from pre to post lecture. These 8 scales were: Leadership and Initiative; Perceived Importance of Health and Fitness; Autonomy; Competence to Search for Information; Competence in Judgment and Selection of Information; Competence in Interpretation and Understanding of Information; Competence in Integration of Information; and Competence in Application of Knowledge to New Situations. The 3 scales where the changes from pre test to post test were not significant were: Level of Academic Aspiration; Self-confidence; Affect toward the Module.

Notably, all scales had significantly increased mean values from pre to post instruction in the perceived competencies in problem solving including competence to search for information, in making judgments and selection of information, interpreting and understanding information, integrating information, and in applying knowledge to new situations. These competencies are important 21st century skills. It can also be seen from Table 2 that the changes in perceived competencies had very large Effect Sizes ranging from 0.8 to 1.1.

These findings imply that after learning with the PBL approach introduced in this study, participants experienced more leadership and initiatives, perceived greater importance of health and fitness, experience more autonomy, and perceived stronger problem solving competence. On the other hand, there has been little change in participants' level of academic aspiration, self-confidence, and affect from pre test to post test. These three areas are more robust values and attitudes held by participants, and are less affected by the 12-week experience in PBL.

3.2. Attitudes toward the Module and Themselves

It can be seen from Table 3 that students' attitudes became more positive post than at pre PBL instruction, although most of the differences did not reach statistical significance, probably because of the small sample size. Pre PBL instruction ratings were moderately correlated with post PBL ratings, with Pearson Product Moment correlation coefficient ranging from 0.2 to 0.6. With the caveat that there is no statistical significance except for one item, both Table 3 and Figure 2 suggest that after 12 weeks of PBL instruction, participants were more looking forward to Health and Fitness class; had higher expectations to learn a great deal from Health and Fitness; even more sure that they took the module for personal interest; re-confirmed their expectation that Health and Fitness was to be great fun; were significantly more inclined to be the team leader at the module

sessions; had enhanced confidence in themselves to perform well at the Health and Fitness module; were less inclined to depend on the tutor to give guidance in everything they did; were more confident that if they used the right strategies, they would succeed; and that success at Health and Fitness was independent of their other studies.

Table 3. Comparison of Inclination Pre and Post PBL Instruction.

Items of the Semantic Differential Scale: Smaller mean values are closer to these Items	Pre Mean	Pre SE	Post Mean	Post SE	t	sig	Corr
I look forward to Health and Fitness class	2.30	1.17	2.22	1.37	-0.348	0.731	0.630
I expect to learn a great deal from Health and Fitness	2.00	1.00	1.81	1.11	-0.708	0.485	0.173
I take Health and Fitness because I am personally interested in it	2.00	1.04	1.85	1.20	-0.700	0.490	0.525
I expect Health and Fitness to be great fun	2.19	1.08	2.07	1.36	-0.500	0.621	0.570
I would like to be the team leader at the module sessions	4.00	1.39	3.30	1.33	-2.267	0.032*	0.293
I have full confidence in myself to perform well at Health and Fitness	2.48	1.01	2.19	1.04	-1.494	0.147	0.496
I would like the tutor to give me guidance in everything I do	3.74	1.29	4.04	1.32	1.053	0.302	0.369
If I try hard enough, I shall definitely succeed	2.11	1.05	1.96	1.26	-0.642	0.527	0.470
If I use the right strategies, I shall definitely succeed	2.11	1.09	1.89	1.22	-0.811	0.425	0.242
Success at Health and Fitness has nothing to do with my other studies	4.96	1.81	4.48	1.91	-1.133	0.267	0.295

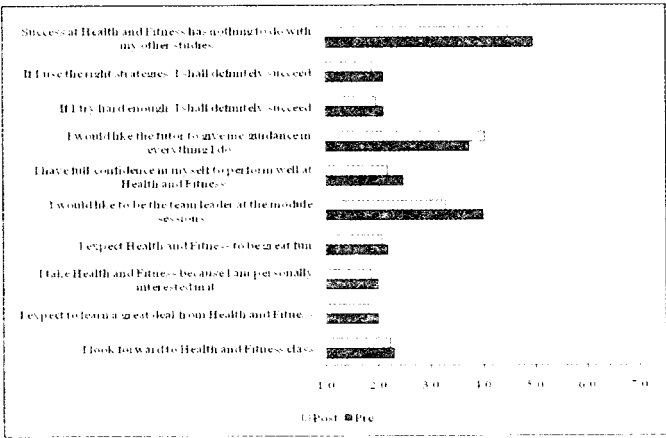


Figure 2. Comparison of Inclination Pre and Post PBL Instruction.

4 Discussion

The goals of this PBL teaching in health-related fitness and wellness are to engage students in active learning situations, activate prior sports experiences and exercise science knowledge, motivate students to pursue knowledge and gain problem solving and critical thinking skills, and to stimulate discussions through case studies, learning issues and laboratory experiences. The key concepts and the linkage of the obesity, weight management, physical activity and nutrition with critical analysis were presented in units so that the students would find the problems relevant and entertaining. To facilitate their self directed learning, schedules are developed with the goal of providing unstructured time to learn and the students are explicitly and implicitly expected to be responsible for their learning. From the feedback of the students, they are spending a large amount of time accessing appropriate resources independently and spending much time and effort as required to learn the issues raised in their small group discussions and case studies through collaborative investigation.

Traditional lecture type format in teaching of health-related fitness and wellness usually fails to provide students with opportunity to integrate and apply knowledge to analysis the complex issues related to obesity prevention and weight management in a holistic approach. The inter-linkage of various factors such as the involvements of scientific physiological principles, characteristics of sports, psychological and nutritional aspects will need to be considered. The adoption of PBL shifts the responsibility for learning from the lecturer to the student. It has the potential to enhance the understanding of the interdisciplinary connection and promote lifelong learning as a physical education teacher.

Through this PBL experience, students actively explore an open-ended problem with more than one solution and participate in the discussion in a meaningful, problem solving context by working as a part of a group. High motivation comes from the ownership of the role of students' active involvement as they are free to make choices and decisions in how they approach learning, enhancing students' self-regulation skills, and makes learning more relevant to meet their learning needs.

To work on their information processing competence, each unit presents students with the opportunity to improve their core skills in team work, decision-making, planning and goal-setting, communication, time management, data collection and reflective analysis through the resolution of authentic, "ill-structured" problems in "real world" situations.

In this study, effect of the problem-based learning approach on participants' self-confidence, leadership, academic affect, and competence in information processing was tested using a pre-test/post-test experimental design. Pre-test and post-test scores in these domains were compared statistically. In conclusion, the results strongly support that teaching using PBL is beneficial to both students' generic skill development and academic affect to teaching and learning. PBL appears to be an effective learning and teaching strategy of health-related fitness and wellness for graduate in-service physical

education teachers in higher education. Physical education and sport and exercise science programmes including games teaching, sports psychology, sports nutrition, and sports biomechanics should also consider the use of PBL styles at all levels to encourage development of life-long learning skills.

Acknowledgement

The authors would like to acknowledge the institutional support via Visiting Professorship Scheme for Prof. Ming-Kai Chin provided by the National Institute of Education, Singapore.

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