

Full Length Research Paper

Comparative study: Medical Physiology teaching in hybrid problem based learning (PBL) vs. integrated system teacher centered teaching

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A new medical program that uses PBL approach was compared to an existing integrated system approach at two different schools in regards to the physiology mapping that includes content, timetable, assessment methods implemented and student performance. The objectives set by the APS forms a background for all medical school programs worldwide were used. Thorough analysis of all blocks and/or courses of the two learning system approaches were undertaken for major and minor objectives. Timetable and performance of the students in the two program approaches were compared and analyzed. The two groups were identical in terms of meeting the major objectives set by the APS. Although a lot of these objectives were set to be met by the students as self study assignment in the PBL approach rather than through lectures given by teachers in the integrated system approach. A lot of minor objectives are met in the integrated system approach compared to little minor objectives were met by the PBL approach. The performance in summative assessment was significantly better in integrated system approach compared to PBL approach, although this tends to be less with advancing years of study. The timetable was identical in both programs. Physiology objectives had not been compromised by the PBL system although they were moved from being delivered by teachers to being acquired through self and group study by the students. Better methods of assessment should be implemented in PBL system approach and students self study should monitored more carefully.

Key words: Integrated system, problem based learning (PBL), integrated system approach, physiology teaching.

INTRODUCTION

Medical curricula runs from traditional classical lecture format teaching to problem based student centered ones (Albanese and Mitchell, 1993; Bligh, 1995; Maudsley, 1999). Physiology is the major and one of most important

basic medical science taught usually during the basic science years at medical schools. Since the invention of integrated system and problem based learning (PBL) approaches of teaching, the physiological principles are being taught in a scattered manner within the systems or blocks. Physiology mapping of curriculum is a pivotal step in assessment of physiology teaching in the curriculum (António et al., 2006; Plaza, 2007). The PBL is a student centered system taught in the context of clinical problems.

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Medical educators found evidence that basic science knowledge learned in the context of a clinical problem is better understood and easily applied by medical students (Patel et al., 1988). The clinical problems should be carefully structured to include all essential physiological principles and objectives. Structuring a clinical problem is not an easy task, and it might end with not being a real one and needs a lot of preparation (Bizzocchi and Schell, 2009; Dolmans et al., 1997). Any missing objective of the clinical cases should be compensated for by lectures or tutorials that are why hybrid PBL system was adopted in certain PBL follower medical schools (Patel et al., 2004). The students today with the information revolution need to be given the opportunity for self directed learning to discover their areas of excellence. They have to be given the chance to play active role in decision making too. Nevertheless a lot of students face difficulty in understanding physiology concepts especially if they are not well prepared for.

King Fahad Medical City in Riyadh Saudi Arabia has a new medical school affiliated to King Saud Bin Abdelaziz University for health sciences, adopts hybrid PBL student centered method of teaching. University of Jordan, Faculty of Medicine in Amman Jordan, adopts the integrated system approach method which is teacher centered since seven years. The physiology curriculum of both systems is spread all through different blocks and courses. A comparison of the physiology curricula of both systems was studied. The aim of the project is to compare the teaching of medical physiology in Hybrid PBL student centered versus integrated system approach teacher centered method and infer methods to accomplish better learning.

The background for the comparison was the objectives of medical physiology set by the American Society of physiology (<http://www.theaps.org/education/medphysobj/medcor.htm>, 2006). Physiology curriculum mapping is concerned with the physiological principles and objectives (content), learning outcomes, learning resources, the timetable, and assessment. This project compared the content, learning resources, timetable and assessment methods between the two institutions.

METHODS

The undergraduate medical program at King Fahad medical city, Faculty of Medicine is a six year academic program. At the end of the program students earn MBBS degree. Students enroll at medical school right after high school. The program adopts hybrid PBL approach since it was founded in 2004.

The physiology curriculum in the PBL system is delivered through very few lectures which are just one resource of information, still other resources are: student seminars, brainstorming and review sessions for clinical problems, self study assignments, field visits, laboratory sessions and clinical skills sessions.

The assessment of the student in the blocks includes a continuous

assessment and end of block assessment. The continuous assessment includes a lot of formative assessments like a PBL session assessment by the facilitators, field visit report, laboratory and practical skills, seminar and portfolio, all of these accounts for 70% of the block grade. The end of the block assessment is a summative one consists of written MCQ and modified short answer questions, all of which holds 30% of the block grade.

The undergraduate medical program at the University of Jordan, Faculty of Medicine is also a six year academic program. And similar to the undergraduate program king Fahad medical city, Faculty of Medicine, students enrolls in this program after high school to earn an MD degree (equivalent to MBBS) in the end of the program years. The physiology curriculum in this integrated system approach is delivered through a sequence of lectures following the anatomy lectures of the system with few physiology practicals. University of Jordan, Faculty of Medicine is the oldest school of medicine in Jordan founded in 1972.

Analysis of the physiology curriculum in the integrated system approach is based on the content of the lectures taught to the students since this curriculum is lecture based.

Student assessment of all courses and blocks in the integrated system approach at the University of Jordan is only summative where 50% of the grade is held for the in-course exams and 50% for the final exam. All exams are MCQ type of assessment. There are no national exams for medical students in both countries.

RESULTS

Relevant courses and blocks where physiological principles might be introduced at both KFMC faculty of medicine and at the University of Jordan, faculty of medicine (Table 1).

Referring to the Physiology objectives set by the American Physiological Society revised August 2006 (<http://www.theaps.org/education/medphysobj/medcor.htm>, 2006); it was found that most of the major physiology objectives were met by the integrated system approach adopted by the Faculty of Medicine, University of Jordan and the Faculty of Medicine at King Fahad Medical City. Nevertheless at the KFMC PBL approach, a good deal of these objectives was not met by the clinical problems, seminars, practical skills or lectures but they were left for students as self study assignments that is self directed learning (SDL). Accomplishment of these self studies was very hard to test because of the time constraints, and leaving them to the assessment measures would be a late measure to be sure of being met (Abraham et al., 2005). In contrast, at the University of Jordan integrated system approach all these objectives were met by lectures delivered to the students in a timely sequential manner during the implementation of the blocks and /or courses. In terms of minor objectives, a lot of them were taken care through lectures at the UJ integrated system approach. In contrast very little attention had been taken to accomplish the minor objectives by any means at KFMC PBL system. The sequence of blocks and the timetable is similar for both systems of learning (PBL and integrated system) as seen earlier.

Table 1. Relevant courses and blocks where physiological principles might be introduced at both KFMC faculty of medicine and at the University of Jordan, faculty of medicine.

King Fahad Medical City- Faculty of Medicine (Hybrid PBL)	University of Jordan, Faculty of Medicine (integrated system)
Year 1	
Medical basic science	General biology
Normal human	General biology lab
	General physics for health sciences
Year 2	
Growth, development, and aging	Musculoskeletal system and integument
Musculoskeletal system and Integument	Gastrointestinal system
Hemopoietic system	Endocrine system and metabolism
Year 3	
Cardiovascular system	Cardiovascular system
Respiratory system	Respiratory system
Gastrointestinal system	Hematopoetic and lymphatic system
Urogenital system	Nervous system 1
Endocrine system and metabolism	Nervous system 2
Nervous system and special senses	Urogenital system
Year 4	
Reproductive system	Clinical years
Immune system	
Integrated multi-system	
Clinical years starts in the second semester	

In regards to the assessment of the students in the blocks, UJ students perform significantly better in written exam compared to KFMC students as seen in Figures 1 and 2.

Comparing the performance of the students in written exam, UJ FOM students showed significantly better performance in written exams. Nevertheless the performance of the KFMC, FOM students in written exams is improved as the students advanced in the years.

The results in Figure 3 show significant improvement of the performance of the students in written exams as they advance in the years of study $p < 0.05$. UJ, FOM students performed the same all through the basic science years, and still their performance in written exams is significantly better than the performance of the KFMC, FOM students in year 4.

DISCUSSION

Physiology in the undergraduate medical programs is always described as a difficult basic medical science subject. Teaching physiology is a challenge for all

physiology instructors. Physiology societies had agreed on the objectives to be met by medical physiology teaching to undergraduate medical students (<http://www.theaps.org/education/medphysobj/medcor.htm>, 2006). Incorporating clinical problems in physiology teaching was found to increase significantly deep learning and reducing use of the surface learning approach among undergraduate medical students (Abraham et al., 2006). Also teaching physiology in the context of clinical problem significantly improved critical thinking skills among medical students (Abraham et al., 2004). Flavoring physiology teaching in PBL approach with few didactic lectures (hybrid PBL approach) had been found to be more appropriate method of learning physiology, where 80% of the students found it very useful compared to 51% for PBL only and 34% for didactic lectures only (Ghosh and Dawka, 2000). It was found also that medical students felt more satisfied, with more positive attitude and perception in the PBL learning environment compared to the traditional system approach (Al Rukban et al., 2009; Kaufman and Mann, 1997; Kaufman and Mann, 1996). Because of all these factors and more, a good deal of medical schools adopted the new PBL approach of physiology teaching.

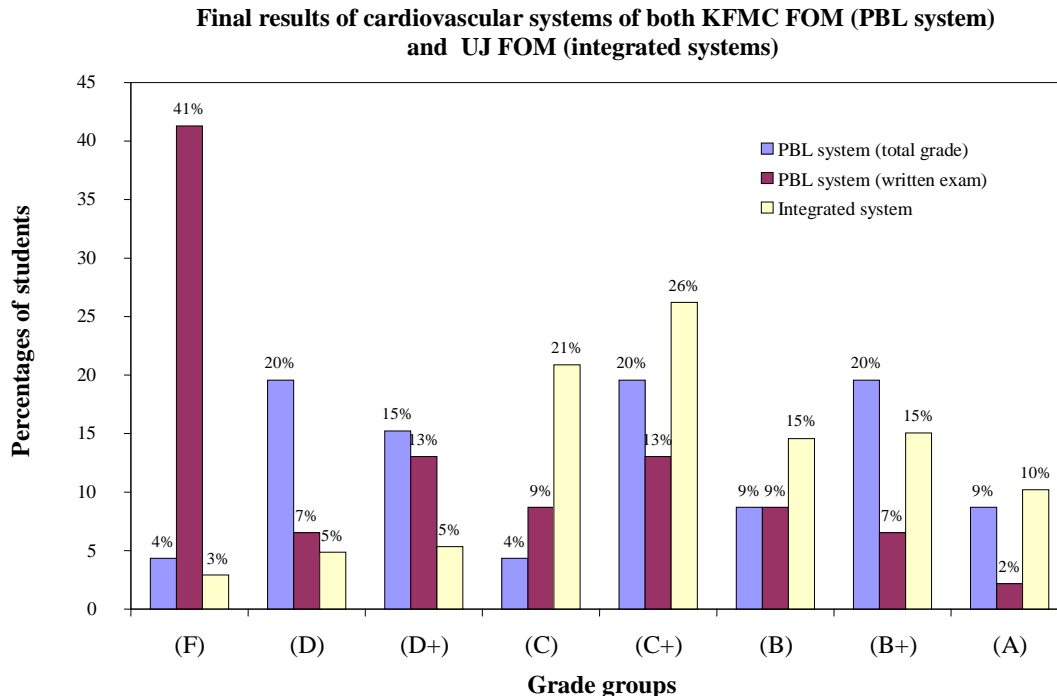


Figure 1. Final results for the cardiovascular system block of both the KFMC FOM students and UJ FOM students. Results are shown for the written exam and total grades for the KFMC students vs. the written exam of the UJ students. Results were statistically significant; $p < 0.05$.

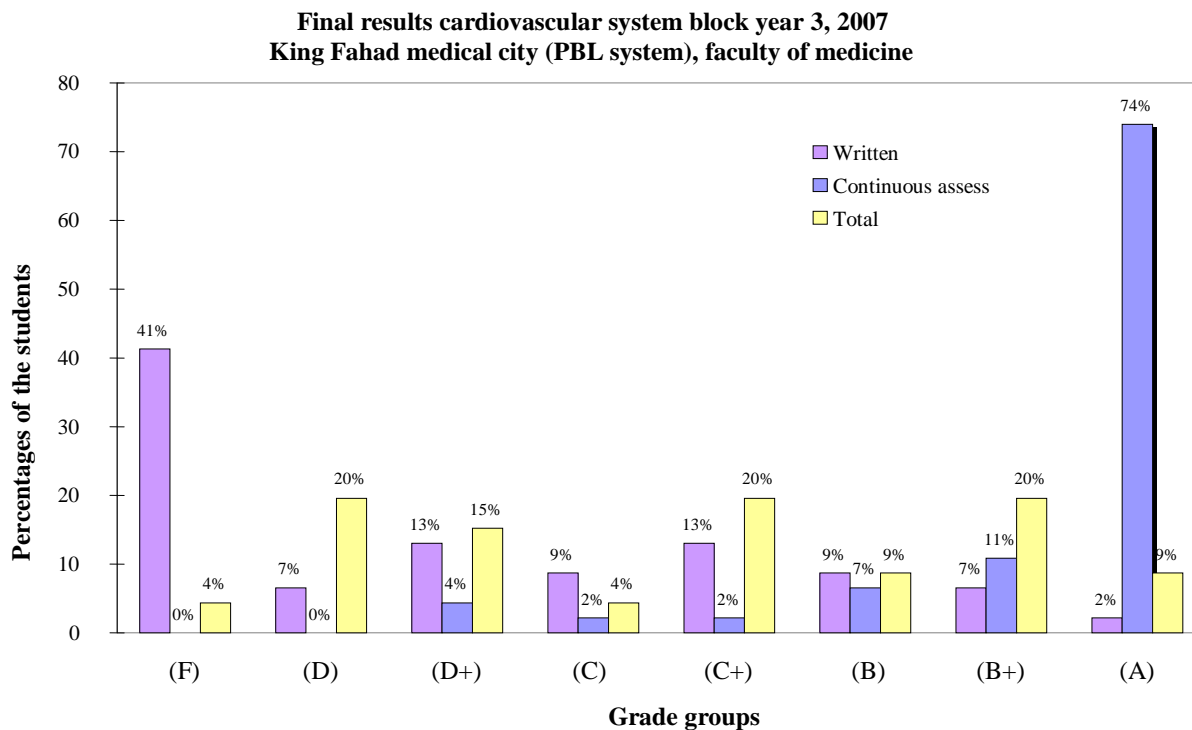


Figure 2. Final results for the cardiovascular system block; representative block in the third year of the curriculum in 2007 at KFMC, FOM. Results are shown for written exams alone, the continuous assessment results alone, and the results of total (written 30% and continuous assessment 70% respectively). Results were statistically significant; $p < 0.05$.

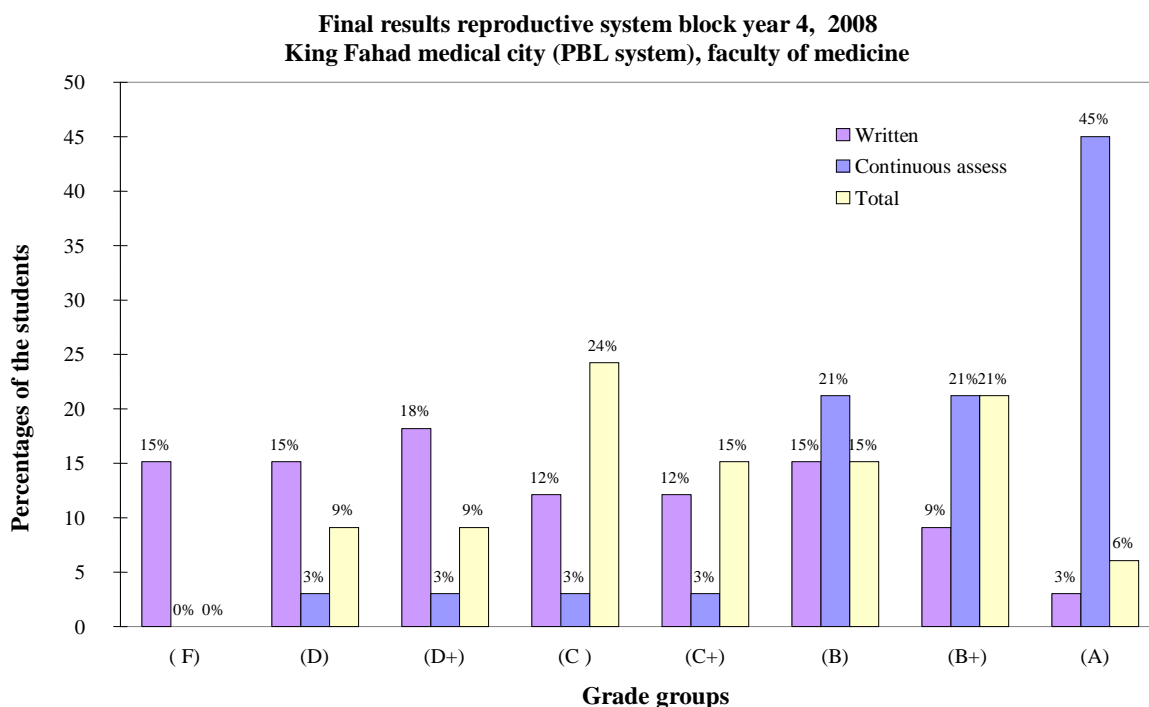


Figure 3. Final results for the reproductive block, representative block in year 4 of the curriculum in 2008. Class final results are shown for written exams alone, the continuous assessment results alone, and the results of total (written 30% and continuous assessment 70% respectively).

We found that the major physiology objectives were covered in both integrated system approach and PBL approach. We think that the minor objectives that were not covered in PBL in early years of study would be met by the students later during their clinical clerkship years as they come across them. The UJ integrated system approach is more like the discipline-based, traditional one since physiology lectures were delivered in a sequence manner after the anatomy of each system which defy the essence of integration.

In our study, the PBL students achieved significantly less in written exams than integrated system approach students in the basic medical sciences years. Other studies reported variable results from significantly better performance of the non-PBL students in the basic science part of Medical Council of Canada Qualifying Examination (MCC) Part I in Canada (Kaufman and Mann, 1999), in Dutch medical schools (Verhoeven et al., 1998), and in New Mexico (Mennin et al., 1993). Others found same achievement of students in step 1 and better performance in step 2 of the USMLE (Blake et al., 2000; Thomas et al., 2009). A more recent and thorough analysis of ten years experience at Columbia university, Missouri USA found significantly better performance of the PBL students in both USMLE step 1 and 2 and a better performance in residency clerkships compared to traditional teaching approach (Hoffman et al., 2006). This

better performance of the students seen recently could be explained through the more experience of the staff members gained in implementing the PBL approach, since this new innovative method of learning needs experienced staff as seen in Columbia university, Missouri USA (Blake et al., 2000; Hoffman et al., 2006).

The problem in the integrated system approach is the poor attendance of the students in the lectures. One study tackled this problem and found better attendance of the PBL students at all physiology activities including the few lectures given compared to the traditional student track (Anyaehe et al., 2007).

Conclusions

1. The physiology objectives are not compromised by the PBL approach compared to the integrated system approach for teaching medical students.
2. There is a need to improve the continuous assessment in PBL to be as much close to the students' performance in written exams, not just giving higher contribution of the written test out of the total grades.
3. Performance of students with the PBL approach in written exams is improved as they go along in their years of the medical school.
4. PBL is not without problems, here are some:

- 1) Finding enough tutors - 1 for each 8 to 10 students with the enlarging number of medical school students.
- 2) The range of topics which can be discussed is a limiting factor - quality control is difficult.
- 3) Heavy on library, computer resources, and support.
- 4) Objective evaluation of PBL is difficult.
- 5) Inherent conflict with lectures - waste of time.
- 6) Need the involvement of more clinician in the basic science years.

RECOMMENDATIONS

1. Real integration is found in PBL approach of learning, integrated system approach have some kind of integration but not optimum.
2. The study resources and infrastructure in the school is essential for success of the PBL program and enhance the performance of the students in knowledge based exams.
3. The evaluation methods in the PBL approach should be taken seriously and be improved to enhance the learning process.

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