

**EDITORIAL****PROBLEM BASED LEARNING IN THE  
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This article describes the main objectives of a medical school, how effective is problem based learning (PBL) in helping the student achieve the educational objectives of the faculty, the approach to PBL adopted by the Faculty of Medicine University of Gezira (FMUG).

**Introduction:**

PBL is an active learning stimulated by, and focused around a clinical, community or scientific problem. The starting point for learning is a problem. It is not only a method to solve a problem, but rather provides learning opportunities. In the normal approach the students have the knowledge required to solve the problem before they can start on it; in PBL the problem is presented first and the knowledge arises from work on the problem. PBL is essentially student centered and the role of the teacher is facilitatory. PBL is a teaching method that can be used along with other teaching methods rather than used as the sole educational strategy. PBL was first developed by Howard Barrows at MC Master medical school (1976) and soon adopted by many new medical schools all over the world. PBL has been adopted by the FMUG as a major educational strategy since the foundation of the faculty in 1978.

**PBL helps the student achieve the educational objectives of the faculty.**

The ultimate objective of a medical school is to graduate a doctor capable of managing medical/health problems of those who seek the services in a competent and humane manner. To achieve that objective the educational programme of a medical school should be able to develop in the graduate doctor the followings:

- acquisition of retrievable and usable knowledge, skills and attitudes
- ability to apply knowledge, skills and attitudes when needed.
- Acquisition of clinical reasoning skills
- Self directed learning

All medical schools have educational programmes which aim to graduate doctors with the above mentioned characteristics, however the educational strategies which they adopt to achieve those goals are not always effective.

**Acquisition of retrievable and usable knowledge, skills and attitudes**

All medical schools know the contents to be learnt in their own area of expertise but they pay little attention to the learning process itself. They place a heavy burden on medical students by teaching as much as possible biomedical sciences and clinical facts and they assume that all the knowledge taught will be retained, retrieved and used when needed in the future.

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Firstly; no medical school can teach all the knowledge, facts, concepts and skills that eventually may be needed even if they extend the studying time for an unacceptable long period e.g. 10 years. Even if they could much of the knowledge imparted will be forgotten and much of it will be out of date- if not wrong- in a few years and even before graduation. After graduation an enormous amount of information must be learned as the medical/ health sciences are ever increasing and progressing. Hence an effective programme should help the student acquire knowledge and skills relevant to major medical problems- core curriculum. It should also help the student acquire the essential skills of self directed learning to deal with problems in the future.

Secondly; those extensive detailed contents of basic sciences taught out of contexts will have no meaning to the student and hence he will not have the desire of learning them- lack of motivation.

Thirdly; knowledge and skills learnt in isolation and not related to a specific medical problem are not adequately retained and retrieved when needed.

A number of studies in cognitive psychology that have addressed retention, retrieval and appropriate use of information indicate that the retention of new information relates to how well it is integrated with the existing knowledge and to its organization in long term memory through use and re-use. Retrieval and use of the knowledge in the clinical context, require that the knowledge be learnt in a similar clinical context so that the cues (symptoms, signs, results of tests) that appear while working in a similar clinical situation will stimulate retrieval of the appropriate knowledge that has been previously acquired. In conventional teaching the student will organize knowledge around definitions and concepts, and hence when faced with a clinical problem in the future, no cues will help him in retrieval of the knowledge acquired.

In PBL acquisition of retrievable and usable knowledge and skills is very much enhanced.

- The amount of factual knowledge learnt is controlled by its relevance to what is needed for solution of the problem. This helps the faculty to choose- out of the extensive available information- the relevant contents. Since the medical school selects significant community problems, the curriculum will be community oriented.  
The PBL approach, through its identification of the core which is determined by the major health medical problems in the communities, contributes towards the reduction of information overload.
- Learning around a problem makes the learning meaningful and this motivates the student and improves, acquisition and retention of knowledge.
- New knowledge acquired is integrated with the old knowledge which is assessed during the PBL process in the first stormy session. Studies in psychology showed that it improves retention of knowledge.

### **Acquisition of clinical reasoning skills**

Clinical reasoning means the doctor's ability to apply his knowledge effectively in the evaluation and management of a medical problem. A doctor with a wealth of information is not useful- and even not safe – if he does not have the problem solving skills necessary to use that information accurately and efficiently. The doctor should have the skill of analyzing the clinical findings and the results of investigations and consequently evaluate the patient's problem and make decisions about appropriate management. Perhaps this is an area which is handled satisfactorily by the conventional medical schools especially in the clinical practices, however the graduates of those schools cannot use all knowledge studied in the basic sciences courses.

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In PBL the student acquires the skills of using, reusing and applying the acquired knowledge during the PBL process.

### **Self directed learning:**

The educational programme of a medical school should enable the student to acquire the essential skills of self directed learning. The graduate doctor should be able to extend and improve his competencies to keep pace with the rapidly advancing field of medical sciences. Skills of self directed learning enable the graduate to solve medical /health problems which he or she will face in the future. The programme should prepare the student for continuous education; both formal and informal. Conventional medical schools pay very little emphasis on this vital issue. In most of those schools the student is passive during teaching. Graduate of those schools experience a lot of difficulties in continuing their education and becoming life long learners.

In PBL the student takes more responsibility for his/ her learning and that prepares him or her for continuous learning in the future. The student develops the ability of self assessment and identification of how much he knows and what he needs to know to solve the problem, eventually he sets his learning objectives. Identification of learning issues by students enable them to set their own objectives, take decisions regarding relevant contents and look for appropriate resources.

### **PBL Process**

The process of the experienced physician in patients' management is a hypothetico- deductive reasoning through early generation of hypothesis or hypotheses formed by new cues in the first encounter and drawing from past experience. In practice the experienced physician adopts the standard clinical approach to solve the problem of his patient; perception, history, examination, provisional diagnosis and treatment. The process of PBL follows closely the standard clinical approach; patient information, presentation, hypothesis generation, inquiry design, clinical skills, data analysis, problem synthesis and therapeutic decisions.

Studies in psychology showed that when knowledge is acquired in a specific situation then its retrieval will be better if the learner faces the same situation. Therefore knowledge learned around a clinical problem will be easily retrieved if the doctor encounters a similar clinical problem.

It has been observed that the application of the basic principles of learning accelerates the learning process; acquisition of knowledge, generation of attitudes and development of skills. Application of the principles of learning improves the retention of knowledge and its retrieval.

All the principles of learning are applied in the PBL process; organization motivation interaction, reinforcement.

#### **1. Organization**

Unlike other learning activities PBL needs extensive organization, otherwise the activity will be a big failure and it will confuse the learner and waste his time. The learning objectives are clearly stated and there is a logical sequence of steps towards the solution of the problem. Resources of information (knowledge skills and attitudes) are identified and made readily available for students. The whole learning activity is organized in sessions; time allotted for each session, physical settings where the groups work and all educational materials are provided. The responsibilities of the students are clearly determined. A list of the main references in the library is provided.

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### **2. Motivation**

In PBL learning is meaningful. The problem provides excitement of discovery and hence the student has a strong reason and desire to learn because he or she wants to solve the problem. The students analyze the problem presented and then identify all the issues which they do not know as learning objectives and hence they have a strong desire to learn those objectives so as to solve the problem. The students understand the significance of what they are learning- to solve the problem. The students identify relevant information needed for the problem and this helps in the selection of materials out of the extensive jargon of information available. Moreover the learning environment motivates the students to learn, small groups improve the involvement in learning, a democratic environment in the small group make the students feel relaxed and improves their contribution.

### **3. Interaction**

Learning is an active process which is accelerated when the learner is involved. Learning is increased when physiological involvement is high. The PBL provides opportunities for a student- even if he or she is weak- to respond, react, suggest, defend opinions and make mistakes. The whole process is student centered and hence the participation of the student is improved. The small group environment should be democratic and autocratic so as to make the student at ease and willingly participate.

### **4. Re- enforcement**

In PBL the material learned is reviewed and summarized and discussed several times. The knowledge, skills and attitudes are used, reused and applied to solve the problem. This repetition of sharing the information in the PBL process help in retention of knowledge.

## **The approach of PBL in the FMUG**

The curriculum of the FMUG is offered in 5 calendar years, 10 semesters. The courses are presented in blocks. The curriculum is arbitrary divided in 3 phases;

- Phase I (semesters 1-3) include courses dealing mainly with basic sciences 70%
- Phase II (semesters 4-7) includes courses around body systems and their problems.
- Phases III (semesters 8-10) includes the clerkships courses which deal mainly with clinical sciences-70%.

The faculty adopts major effective strategies to enable students achieve the objectives of the curriculum; community orientation – community based education, integration of basic sciences with the clinical community and behavioral sciences, PBL, team work, early exposure to clinical problems and continuous staff development.

The design of the curriculum and the strategies greatly enhances the PBL process. The first course in the curriculum (introduction to medicine and the study of medicine) aims to introduce the student from DAY ONE to the major medical/health problems. The course also includes a short account about the instructional methods used in the faculty which help the student learn those major health problems during his stay in the faculty. The integration of sciences is essential for PBL and at the same time PBL is an important educational strategy for integrating the curriculum. The strategy of community orientation determines the choice of relevant problems. Since the PBL process involves teachers from different disciplines, the strategy of team work facilitates PBL.

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The courses (blocks) are arranged in a rigid sequence compulsory to all students- there are no options in the curriculum

The educational objectives of the curriculum are learned through many instructional methods; lectures, seminars, bed side teaching, laboratory work, field visits etc. Only a specific number of objectives are learned through PBL. Phase I includes few problems, phase II includes no problems and phase III includes the majority of the problems.

### **Criteria for selecting a problem**

In the FMUG the following criteria are used for selecting a problem

- patients problems that are most frequently seen in practice and most likely to be encountered in the future (e.g. chest pain, stridor, retention of urine, malnutrition etc)
- problems that have a high social or economic impact (e.g. AIDS)
- problems that will introduce the student to important concepts or areas of knowledge in basic sciences (e.g. brachial plexus injury in a course of anatomy, oedema in a course of physiology, diabetic keto acidosis in a course of endocrine and metabolism).

### **Concrete examples of problems**

Many examples of problems could be used in PBL; written, patient, simulation, role play, demonstration, video, reported case, diagrams and concepts. It is obvious that the patient- who is an actual real experience- is the best problem which satisfies all the criteria of PBL. Patients are used extensively in the bed side teaching in the clinical rounds. However, in the clinical round there is emphasis on the clinical and behavioral sciences (clinical skills, knowledge, clinical reasoning and attitudes) integrated with few basic sciences. There is also emphasis on the solution of the patient problem. PBL is not simply the opportunity to solve problems but rather learning opportunities where the student learns both clinical and basic sciences. Therefore, the model of PBL is not strictly applied in bed side teaching. In phase II a great deal of educational objectives are learned through PBL. In the community courses the real life situations are used as problems.

Almost all the problems used in PBL in the FMUG are written problems chosen according to the criteria mentioned above. The written problem is both feasible and practical. It is included in the course documents and is presented whenever the course is offered and that ensures consistency in the curriculum. The written problem guard the faculty objectives which are planned by teachers.

The curriculum of the FMUG includes 41 Problems presented as shown in table 1.

**Table I. The Clinical Problems (written) included in the Curriculum of the FMUG4 Problems in Phase I and 37 problem in phase II.**

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| Phase | Course                                 | Problem   | Phase | Course                              | Problem   |
|-------|--|---|-------|-------------------------------------|---|
| I.    | Man and his Environment                | 1.Oedema  | I.    | Nutrition & Biochemistry            | 2.Rickets<br>3.Protein malnutrition   |
| I.    | Introduction to Study of Diseases      | 4.Acute inflammation  | II.   | Blood and Blood Related Problems    | 5.Anaemia with pregnancy<br>6.Sickle cell anaemia<br>7.Haemophilia<br>13.Stridor<br>14.Epistaxis<br>15.chronic cough<br>16.chest pain<br>17.respiratory distress syndrome<br>18.haemoptesis         |
| II.   | Musculo-Skeletal System                | 8.Fracture and dislocation of shoulder joint- surgical neck of humerus<br>9.Fracture neck femur<br>10.Radial nerve injury<br>11.osteomyelitis<br>12.proximal myopathy   | II.   | Cardiopulmonary                     |   |
| II.   | Endocrine and Metabolism               | 19.Diabetic ketoacidosis<br>20.hypothyroidism<br>21. gout<br>22. sickle cell disease  | II.   | Problems of Gastro Intestinal Tract | 23. Dysphagia<br>24. Epigastric pain<br>25. Inguinal scrotal swelling<br>26. Bloody diarrhoeas<br>27. viral hepatitis<br>28. Liver cirrhosis<br>29. Obstructive jaundice<br>30. Portal hypertension |
| II.   | Genito-Urinary System and its Problems | 31. Absent testes<br>32.Oedema with pregnancy<br>33. Haematuria<br>34. Amenorrhoea<br>35. Infertility<br>36.Bleeding in early pregnancy<br>37.Renal colic, dysuria and frequency<br>38. Inability to pass urine | II.   | Central Nervous System              | 39.Hemiplegia<br>40. Paraplegia<br>41. Intra- cranial hemorrhage  |

**Implementation of the PBL Process:**

The FMUG organizes PBL by using the 7 jump approach

- Step 1: Clarifying what is not clear in the task
- Step 2: Defining the problem
- Step 3: Analyzing possible explanations
- Step 5: Formulating learning objectives
- Step 6: Looking for additional information between group sessions
- Step 7: Reporting back at the next tutorial group session.

The PBL process is planned in 5 sessions as shown in Table 2

**Table 2. Schedule of a PBL Activity**

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| SESSION NUMBER | SESSION   | Duration In Hours |
|----------------|---|-------------------|
| 1.             | <p><b>Stormy session: whole class.</b></p> <p>Present written problem, follow 7 jumps set learning objectives, guide students to resources and references, plan other sessions.</p> <p>(steps 1-5)</p>  | 2-3               |
| 2.             | <p><b>Small group work:</b></p> <p>Discuss problem, learning objectives and identify resources (steps 1- 5)</p>   | 1-2               |
| 3.             | <p><b>Collection of information:</b></p> <ul style="list-style-type: none"> <li>- students collect information from resources</li> <li>- formal learning activities relevant to problem e.g. lectures, clinical round, laboratory (step 6)</li> </ul>                       | Days              |
| 4.             | <p><b>Small group work:</b></p> <p>Share information obtained. Agree on presentation</p>  | 2-3               |
| 5.             | <p><b>Discussion of problem: whole class:</b></p> <ul style="list-style-type: none"> <li>- Use knowledge obtained in solution of the problem</li> <li>- Organize knowledge obtained and share knowledge with the teacher.</li> <li>- Fill gaps of understanding.</li> </ul> | 3 hours           |

**Session 1.**

Whole class- 200-250 students. During this long stormy session the first 5 steps are implemented. The written problem is presented fresh to the students who have not prepared themselves through previous study. The session starts by reading the problem. Then the students identify new terms and concepts which are clarified by other students or by finding them in their books or by the tutor e.g. syncope, heamoptesis. Then the students define the problem so as to limit their learning within the problem. Then the students work on the information provided in the task, analyze it and make logical explanation. They determine the underlying mechanisms and give explanations, knowledge gap could be provided by other students or the tutor, e.g. in a problem of a 60 years old man with chest pain and breathlessness. Explain the relationship between ischaemic heart disease, and pain and breathlessness- Describe the mechanism of how ischaemic heart disease causes pain and breathlessness. Then the students will encounter gaps in their understanding and identify them as learning issues.



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All the information in the written problem is analyzed as mentioned above. Eventually the students end with a number of learning issues or learning objectives which constitute all things which they need to solve the problem and which they do not know e.g. formation of an atheroma, anatomy of coronary artery, ECG, pathology of cardiac muscle infarction etc. Then the tutor compares the learning objectives set by the students to the learning objectives set by the faculty. Important missing objectives are added to those set by the students. Finally the students are provided with the pre-set faculty objectives.

Then the tutor plan the rest of the four sessions; dates, time and locations. Normally the class is divided into 8 ability small groups. Each small group (20-25) **SHOULD WORK ON THE WHOLE PROBLEM**. A student leader is appointed for each group.

### **Session 2: small group step (1-5)**

The students review the problem and the learning objectives. Then they identify the resources (library references, skills laboratory etc) Each group meets separately, all groups meet at the same time in close locations to help the course coordinator supervise them.

### **Session 3: whole class, groups, individual**

This is the time allotted for self directed learning when the students collect the information as determined by the learning objectives. This self learning should be carefully directed. Basic references and standard text books should be made known to students. Enough time should be allowed for this self directed learning. In self directed learning the students are guided by the learning objectives and the list of references. Students should **never** be left unguided. The worst approach which is adopted by some teachers is to tell the students "This is self learning... Go to the library and read!!" Such approach is really destructive to PBL and perhaps it is the main obstacle in PBL. The majority of the learning objectives are learned through self directed learning.

In the FMUG a number of formal learning activities pertinent to the problem are offered to the students during the days of collection of information. Those activities include lectures, clinical rounds and laboratory work. They are planned by the faculty and included in the course time table-compulsory activities. The lectures and laboratory work are whole class activities and the clinical rounds are small group activities. Those learning activities include objectives which are considered by the faculty too difficult to be learned by self learning. They also include clinical skills and laboratory work- both of them need instruction. For example: a problem of chest pain is followed by a lecture on ECG, a laboratory work on the physiology of the conducting system of the heart, a clinical round on examination of the cardiovascular system; both normal and abnormal. Unlike other medical schools adopting PBL, the selection of resources and their utilization is controlled by the faculty and not the students. This approach – we believe – is more effective and feasible. It ensures that all the students have adequate teaching and instruction about the basic and difficult objectives. It is true that some of the learning objectives cannot be learned by the students alone and a formal instruction and teaching must be provided to meet all the faculty objectives.

### **Session 4: small group work (step7)**

Each small group meets separately, however all the groups meet at the same time in locations close to each other so that the course tutor can observe the students, check the attendance and solve problems arising during the work. The students share the information they have collected, use and re-use the



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knowledge to solve the problem. They review the sources and references of the information. Finally they organize all the information in a short presentation.

### **Session 5 (step 7) whole class**

This is a long busy session supervised by the course tutor. At the start the students read the problem and then they summarize all the previous steps. Then each group present the information they have obtained, the tutor directs the session so that repetition by the group is avoided. The most important thing in this session is the ability of the students- guided by the tutor- to use and apply the knowledge obtained to solve the problem.

The second issue is the evaluation of the knowledge presented; the tutor must comment on the relevance and quality of the knowledge presented and make appropriate corrections and modifications. He should help the students to organize the information and generalize their learning on other context or settings. The information obtained is then synthesized to explain the phenomena in the written problem. During this process the students organize prior and new learning around the problem. This helps retrieval of what has been learned when a similar problem is encountered in the future. The final important step in PBL is to generalize the learning to other situations in which such knowledge will be applicable e.g. an understanding of the mechanism of breathlessness in the problem of chest pain is broadened to general understanding of breathlessness in other situations. By the end of this session the tutor must be sure that **All** the students achieved the objectives. In the FMUG the whole problem process is organized in 5 sessions only. All the sessions and the other learning activities are compulsory. The next problem is NEVER presented to students before the previous one is completed; the students always work on ONE problem.

### **Role of the tutor in PBL**

Facilitating PBL is supplied by a tutor who is a **subject matter expert**, never by an educationalist without medical understanding or knowledge. The tutor is an academic staff member in the faculty. He is responsible of the implementation of the problem; organization, planning of sessions, arrangement of resources and keeping of attendance. He tutors the first and the fifth session and he supervises the whole class in the small groups work and in the other activities. The small groups work is facilitated by a group of tutors, one tutor for each group. These tutors are also **subject matter experts** chosen from the registrars and teaching assistants. They are usually given some training in PBL training. Selected tutors must show interest in PBL and demonstrate ability to organize PBL. Generally the tutor guides the students and not directs them, facilitates and not lectures. He asks questions to clarify certain areas and should maintain a democratic environment to allow for free discussion. The tutor makes constructive comments on the group work and not on individual students. He does not dominate but he guards the faculty objectives.

There is a common misunderstanding among teachers that the role of the teacher in PBL is limited and that the students are responsible for all the learning process. It is true that the actual process is student centered, however the teacher is responsible for the organization and facilitation. The teacher is expected to do extensive preparations and is expected to be available physically in all the sessions. He should read a lot about the problem and be ready to respond to any enquiries. Unless the PBL is carefully organized the students learning will be inadequate and poor. Lack of proper organization is the single most important factor which affects the PBL process adversely.

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The FMUG adopts an important strategy- staff development. Most of the currently enrolled teachers had training in PBL and new teachers will follow. The success of PBL strategy depends on the abilities of teachers in PBL

### **Writing a written problem**

The design of a good written problem must ensure that students cover a pre- defined area of knowledge or learn important concepts, ideas, techniques and skills. The problem should lead students to a topic or field of learning and so meet the faculty learning objectives.

**First step:** the choice of the problem conforms to the criteria of selecting a problem; relevant to a significant medical problem and can include a set of faculty learning objectives. The choice also depends on the phase of the curriculum and the course. The pre- requisites of the course should be reviewed carefully so that faculty learning objectives are not repeated and the students can build on prior knowledge and hence activate that knowledge. The criteria of selecting a problem help the faculty identify the learning objectives to be learned through PBL, determine the relevant basic sciences and ensure that the curriculum is community oriented.

**Second step:** identify the faculty learning objectives to be learned through the problem

**Third step:** prepare the written problem in such a way that there is integration between the basic, clinical, community and behavioral sciences.

**Fourth step:** formulate cues to guide the student and stimulate discussion and encourage students to elaborate and search for explanations.

**Fifth step:** write a realistic case as near as possible to real life situations encountered in the practice. The case should encompass the learning objectives, the cues. The written problem must include the patient's symptoms, signs, family background and socioeconomic status. Provide enough information- history, examination, laboratory data- so that the student can work with sufficient data. Avoid closed problems. Avoid window screen problems- of one or two lines e.g. a patient presenting with breathlessness!

**Sixth step:** provide the references. Write clearly the up- to- date references. Always include text books in the references and do not include too many references which will confuse the student- 3-4 references.