

## Pilot Study on Problem Oriented and Student Centered Teaching of Physiology in A Large Class Setting

Yared Wondimkun\*

**Abstract:** *Recent developments in undergraduate medical education have shifted the focus from a knowledge-based curriculum to one where problem solving and reasoning skills are paramount. Such skills are best developed by active problem solving exercises. The constraints of active learning in a physiology class are stressed because many students take the course. A technique that can be used in such situations was developed in our school. The tutor designed problems with instructional objectives. Students were instructed to group themselves into small physiology teams. Teams selected particularly problems from the mini-library of cases. They were guided to approach the problem systematically through the search for relevant materials, consultation with the faculty and visits of practical sites. After the exploration of the scenarios whole class presentations followed. Students who participated in the program evaluated the problem oriented approach. Results are generally favorable; students felt that the learning became meaningful and improved their ability to solve problems. This study has demonstrated that active student-centered teaching can be employed in large class settings. However, a change in learning methods requires a concomitant change in assessment systems.*

### Introduction

The goal of education as a whole is to assist the individual to achieve self-actualization, or, as Maslow (1971) puts it "to help the person to become the best that he is able to become." Such an objective can never be attained through teaching by giving knowledge. Besides, knowledge giving does not meet the

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### Introduction

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facilitation of learning and change. Hence, science education is in the process of shifting from the mastery of a large body of factual information to an emphasis on the development of reasoning skills and the solving of practical problems. The need for this change is derived from long-standing concerns about a gross overcrowding of most undergraduate curricula (WHO/WFME, 1993; WFME, 1993; MOE, 1997; Somjen, 1990) which tax the memory but not the intellect and emphasizes the passive acquisition of knowledge much of which is forgotten or outdated and whose relevance is hardly appreciated by the students (MOE, 1997; Somjen, 1990) "Tomorrow's Doctors" (GMC, 1993) suggests a series of objectives in terms of knowledge, skills and attitudes which students should achieve by graduation. These objectives should be achieved via curricula that are "student-centered" and "problem based" learning that fosters the acceptance of responsibility to contribute to personal knowledge, attitude, and skills (Model & Michael, 1993; Abatt, 1992; Quinn, 1988). Problem-based curricula use problems as the main or sole method of student learning and have only been adopted in a few medical schools. More common is the use of a Problem-Oriented Learning (POL) or approach where problems are used to illustrate and contextualise learning.

Much has been written about what should be expected of a preclinical student (Arthur, 1994; MOH, 1997). The current preclinical approach in our medical schools does not ensure acquisition of problem solving skills and does not generally help students to apply biomedical knowledge to clinical practice. The need to change has been especially felt in the instruction of physiology (Sukker, 1984; AAMC, 1994) because of its integrative and holistic nature of the subject. Because physiology bears the organizing principles that originally arose from the study of anatomy, it retained the anachronistic organizational system structure until the present day even though the function of integration of the systems should be the primary approach, that is, the present approaches are inadequate to attain the course objectives (Table 1). It was considered that a problem-oriented system would engage the students and promote a more

integrative approach to the teaching and learning of physiology. The new method was introduced as an additional method of physiology education as a two-year pilot program (in the 1996/97 and 1997/98 academic years) and was designed for two categories of students (health officer and medicine) of the school.

The objectives of the program were twofold:

- To improve the student learning experience by:
  - ◆ exemplifying the significance of physiology for clinical medicine
  - ◆ encouraging to develop an appropriate attitude to learning by a self directed-approach
  - ◆ integrating organ-system teaching into whole organism teaching
- To assess the usefulness of this learning program in the context of a large class in an Ethiopian setting using a structured student feedback.

## **Materials and Methods**

### *Nature of the Physiology Course*

*Medicine:* The educational setting for the project was a 10 credit hours lecture and laboratory based year course (two-semesters) of human physiology (Phys 201 and Phys 202). Second year medical students take this course together with anatomy, histology, embryology and biochemistry. The enrollment ranges from 55 to 75 students. Students have five hours of lecture and a session of laboratory experiment in a week.

*Health Officer:* Human physiology (Phys 201 and Phys 202) is a two-semester, four credit hour lecture-based (only a few laboratory demonstration) course. First year post basic students who are upgraded from comprehensive nurse (after a minimum

of five years rural experience) to a bachelor degree in public health take the course. They have taken a seven credit hour course of anatomy and physiology during their nursing training. The enrollment ranges from 50 to 60 students. The total number of students included in the study was 214.

*Problem-Oriented and Student Centered Approach:* At the beginning of the academic year students were instructed to group themselves into small physiological teams (5-8). The teams were assigned to work on a problem in which the members were particularly interested. They selected a problem from a mini-library of cases of situational physiology. Problems (clinical, environmental, life style, nutritional or other perturbations of a physiological system) were designed by the tutor to a common framework set to match the educational objectives of the course. All problems were capable of resolution from materials presented in the didactic lecture format. Problems were designed so that students needed to integrate knowledge from various parts of the course and many were set in a simple clinical context bearing objective reality in order to maintain enthusiasm. They were guided to approach the problem systematically through exploration of knowledge by the search of relevant materials and consultation of preclinical and clinical staff members. Attempts were made to increase student curiosity about the problem by relating information to patients in the hospital and by visits to practical sites. The role of the tutor was to act as a facilitator of learning by providing human and material resources for learning and obtaining permission for the students for easy access to facilities.

After careful exploration of the scenarios, teams held meetings in the presence of the tutor to share ideas, discuss points of view, articulate the rationale or justification for a particular suggestion and decide the final format and content for presentation. A general class presentation and discussion then followed which allowed students in the audience to critique, supplement, question, and/or provide feedback.

*Evaluation Instruments:* An evaluation instrument was adapted (Margaret et al., 1994) to check specific aspects of the exercise. The questionnaire asked students to rate on a five point likert scale (1 = strongly disagree, to 5 = strongly agree) the degree to which lecture, laboratory exercises, seminars and POL met the objectives of the course given in Table 1. The students further rated a specific aspect of POL (aims and objectives, components of a particular POL, relevance to physiology, level of understanding, recommendations and summary) on a 1-5 scale. Results from the evaluation were analyzed using descriptive statistics and were expressed as mean  $\pm$  SE.

Additional qualitative information was also obtained by "focus group discussion" i.e.; students (8-10 in number) were called upon and let to discuss every aspect of the material they presented to the whole class. Such a discussion was beneficial in evaluating the pilot program and assessing those behavioral and instructional objectives that were not delineated before the inception of the assignment.

## Results

All 214 students returned the questionnaire – 111 (51.9%) were medical and 103 (48.1%) were health officer students. Table 2 and Figure. 1 show students assessment of the teaching methodologies in relation to attaining the course objectives of medical physiology (Table 1). POL is rated high in meeting most course objectives particularly for understanding the mechanisms operating in our body, for obtaining basic knowledge as a prerequisite to understand disturbances and as a basis for clinical and experimental knowledge and skills. Some elements of the evaluation instrument and the responses of students are presented in Table 3. Generally, students thought the exercise was worthwhile, as can be seen from the distribution of the scores which tend to cluster at the higher end. They responded most positively to the following statements: POL should be integrated to the teaching of physiology as one solid teaching methodology ( $4.6 \pm 0.16$ ); POL helped me to realize the

application of biomedical knowledge to clinical practice ( $4.5 \pm 0.2$ ); I became more enthusiastic to learn physiology because I perceived its relevance to clinical practice ( $4.4 \pm 0.16$ ). It is essential to note that students rated POL less effective in the acquisition of knowledge ( $3.0 \pm 0.29$ ) and skills ( $3.2 \pm 0.27$ ) for improved performance in examinations.

In the focus group discussion, the students generally stressed that the POL exercise was well received. Comments reflected a sense of appreciation gained for one another's ideas, values and abilities and for increased confidence of working together. Samples of both favorable and not so favorable comments are given so that the spectrum of responses can be gauged.

### ***Students' Comments:***

#### *Favorable*

- Very helpful
- It made me look at the facts provided in lectures in a different manner
- I realized that I'm capable of analyzing and interpreting cases of substantial complexity from the seemingly little health science knowledge I have yet
- It encouraged me to embark on medical thinking now
- Helps me to recruit facts from different chapters of the lecture series
- I feel that I have developed humanistic interaction with my classmates and the faculty
- I would have liked to have special assessment to know how much I have benefited from POL

#### *Not so favorable*

- Being active in front of the class is uncomfortable
- It is frustrating not to have a good language command (English) to express my self as well as I desire

- It does not help me much in answering physiology examination questions
- It is an extra workload which consumes our time
- No need to have it, our seniors also did good without it
- It is a little too early.
- Giving a checklist (keywords provided as guidance) has biased my sphere of exploration and perception of the problem.

## Discussion

The salient finding of this study is that the course physiology in the context of a large class of health science students can be effectively taught by complementing the traditional teaching styles by POL. Most models of active learning are geared toward small groups or classes (8 – 15 in number) in which the interaction between students and instructors is optimal (Quinn, 1988; Abbatt, 1992). However, basic courses in physiology are often offered to large classes in which it is very difficult to employ active learning methods. This pilot study demonstrated that active methods could also be utilized in large class settings but presumably uses more resources. Furthermore, the study showed that a problem-oriented approach was a highly valuable learning method. It reinforced facts and concepts and helped solidify student understanding (Table 2). Students were forced to read supplemental materials and to visit practical sites to find solutions to their problems rather than relying passively on the instructor to provide answers. As they worked on the cases, students were forced to reformulate concepts in their own words and integrate diverse principles in physiology. In this way, students seemed to improve their higher order reasoning skills.

The learning of physiology associated with clinical cases in POL curricula is a step in the right direction because, as the result shows (Table 3), it makes explicit the significance of physiology for medicine and life style situations, and is likely to generate interest and enhance motivation for continued learning among students. This is in line with the results of some medical schools

which have successfully made use of case analysis in their problem oriented approach (Engelberg, 1992; Herreid, 1994; Reagen & Menninger, 1994; Cliff & Wright, 1996).

The study suggests that a shift from the classroom teaching to an active problem-oriented strategy is a realistic approach in Ethiopia. This is important given that both the family and the school prepare youth for a passive role (Cox, 1967; Tekeste, 1990; Abreham, 1969; Ayele, 1969). Most students spend their school career in passive learning environments in which they are required to regurgitate factual material disseminated in class. This discourages student participation (Caglayan, 1994). The role of the teacher in stimulating and encouraging learning needs to be enhanced.

The main weakness of this method is the potential increase in the need for resources and the difficulty in evaluating the learner's achievement – which need to be addressed in future studies. Comparative studies would be interesting but are rare. Caglayan (1994) found out that students in active teaching perform better in exams than those taught in the traditional style. It is essential to note that POL is rated less effective in acquisition of knowledge and skills for improved performance in examinations. This may be seen in view of the traditional examination types still employed in physiology, which test students' memorization of facts rather than problem solving skills. This demonstrates that changes in learning methods need to be accompanied by congruent changes in assessment methods if students are to feel secure.

The results of this study suggest that an effective model for teaching would be a framework of teacher-centered lectures providing basic knowledge in an organized manner. Subsequent recall and relevance can be facilitated by a problem-oriented approach. For most institutions problem oriented learning will remain a supplementary learning procedure (Cliff & Wright, 1996). Finally, it is of interest to mention that the lower acceptance of laboratory, seminars and to a lesser extent

lectures (Fig. 1) should not lead to an erroneous conclusion that they are inferior. It could possibly reflect the formally structured style they are delivered. Lectures, textbook reading, seminars and laboratory exercises still serve as important methods for conveying the necessary facts, figures and principles that a student must learn (Richardson and Bridge, 1995).

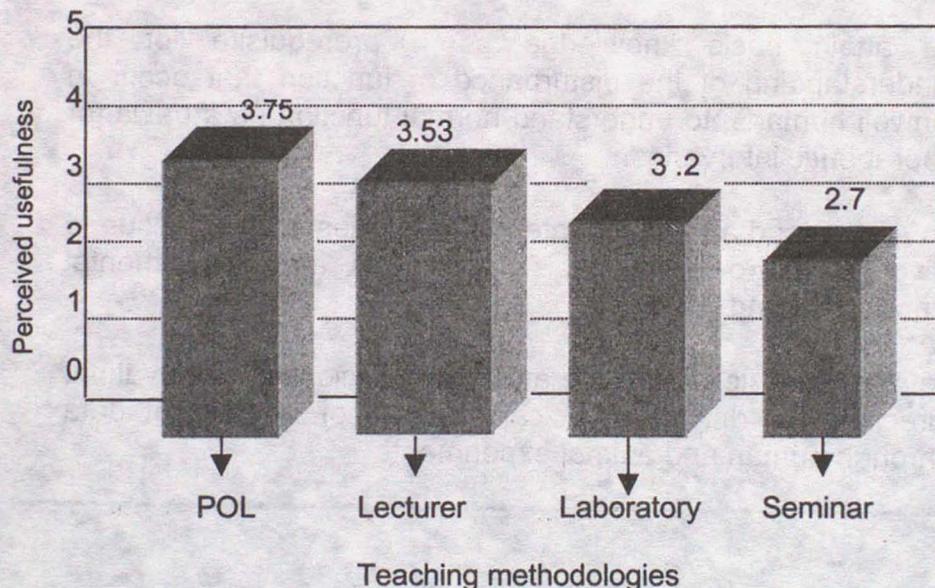
**Table 1: Objectives of teaching Physiology in Schools**

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1. to understand in physical, chemical and biological terms, the mechanisms that operate in human body at all levels ranging from the subcellular to the integrated whole human being
  2. to understand the extent of physiological (biological) variations and adaptational changes that occur within a population of healthy individuals
  3. to attain basic knowledge as a prerequisite for the understanding of the disturbance of function that occur in unwell humans; to understand normal function as a basis for therapeutic intervention
  4. to understand and appreciate the properties of living tissue in vivo and vitro as a basis for clinical and experimental knowledge and skills
  5. to get the basic knowledge and skills in scientific observation, precise recording and critical analysis of biomedical data through human and animal experiments
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**Table 2: Ranking of perceived usefulness of the teaching methodologies for attaining physiology course objectives**

| Course Objectives | Lecture   | Laboratory | Seminars  | POL       |
|-------------------|-----------|------------|-----------|-----------|
| 1                 | 4.5 ± 0.4 | 1.9 ± 1.2  | 4.0 ± 0.7 | 4.3 ± 0.5 |
| 2                 | 3.8 ± 0.7 | 3.9 ± 0.8  | 2.9 ± 1.2 | 3.1 ± 0.9 |
| 3                 | 4.2 ± 0.5 | 1.9 ± 1.3  | 3.7 ± 1.2 | 4.5 ± 0.9 |
| 4                 | 3.9 ± 0.7 | 2.5 ± 0.8  | 2.6 ± 1.2 | 3.5 ± 0.4 |
| 5                 | 2.9 ± 1.1 | 4.5 ± 0.3  | 1.6 ± 1.5 | 4.6 ± 0.4 |
| 6                 | 1.9 ± 1.0 | 4.5 ± 0.3  | 1.5 ± 1.3 | 2.5 ± 1.0 |

Objectives 1-6 are the objectives of human physiology course in the school which are stated in Table 1. Results based on a scale of 1 - 5 are expressed as mean ± SE.



**Fig. 1** Ranking (on a Scale 1 to 5) of perceived usefulness of the teaching methodologies in meeting course objectives. Results are given as mean.

**Table 3: Students' ranking (on a scale 1 to 5) of POL course components and its impact on their learning capability**

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| <b>Knowledge objectives</b>  | <b>Mean ± SE</b> |
|--|------------------|
| 1. Acquisition of knowledge for improved Performance in examinations                                 | 3.0 ± 0.29       |
| 2. The materials are appropriate for students in this Course   | 4.1 ± 0.31       |
| 3. The factual knowledge that you have is fairly enough to understand the presented problem          | 4.2 ± 0.26       |
| 4. The integration and interactive nature of these materials facilitated my learning of content area | 4.3 ± 0.28       |
| 5. The POL was educationally attractive  | 3.9 ± 0.26       |
| 6. I am enthusiastic to learn physiology because of its relevance to clinical practice               | 4.4 ± 0.26       |
| 7. I realize the application of biomedical Knowledge to clinical practice                            | 4.5 ± 0.20       |
| <b>Skill objectives</b>  |                  |
| 8. I have acquired skill for improved performance in examination                                     | 3.2 ± 0.27       |
| 9. I discovered new aspects of how knowledge is Acquired, such as self exploration                   | 3.8 ± 0.25       |
| 10. I have developed self confidence and improved interpersonal relations                            | 3.8 ± 0.21       |
| 11. I learned not to memorize but to understand  | 4.0 ± 0.24       |
| 12. I have improved my group study skills  | 3.9 ± 0.18       |

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### Conclusions and Recommendations

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|--|------------|
| 13. This method of learning was as effective as any other I have encountered       | 4.1 ± 0.17 |
| 14. I would recommend the utilization of similar materials for other content areas | 4.3 ± 0.22 |
| 15. It should be integrated as a component of teaching physiology                  | 4.6 ± 0.16 |
| 16. Visits to wards and practical sites should be intensified                      | 4.6 ± 0.19 |
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