การศึกษาเปรียบเทียบทัศนคติของนิสิตแพทย์ชั้นปีที่ 6 ที่ศึกษาในหลักสูตรเดิมและหลักสูตรการเรียนรู้โดยใช้ปัญหา ในคณะแพทยศาสตร์ จุฬาลงกรณ์มหาวิทยาลัย

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COMPARING ATTITUDES OF THE SIXTH YEAR MEDICAL STUDENTS TRAINED IN CONVENTIONAL AND PROBLEM-BASED CURRICULA IN CHULALONGKORN MEDICAL SCHOOL

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อนันต์ ศรีเกียรติขจร: การศึกษาเปรียบเทียบทัศนคติของนิสิตแพทย์ชั้นปีที่ 6 ที่ศึกษาในหลักสูตรเดิมและหลักสูตรการเรียนรู้โดยใช้ปัญหาในคณะแพทยศาสตร์ จุฬาลงกรณ์มหาวิทยาลัย (COMPARING ATTITUDES OF THE SIXTH YEAR MEDICAL STUDENTS TRAINED IN CONVENTIONAL AND PROBLEM-BASED CURRICULA IN CHULALONGKORN MEDICAL SCHOOL) อาจารย์ที่ปรึกษา: ศ.นพ.กัมมันต์ พันธุมจินดา, พ.บ., วว. (ประสาทวิทยา) M.Sc., อาจารย์ที่ปรึกษาร่วม: รศ.นพ.กิจประมุข ตันตยาภรณ์, พ.บ. วว., M.Ed. 99 หน้า. ISBN 974-346-294-5

รายงานนี้เป็นการศึกษาเปรียบเทียบทัศนคติของนิสิตแพทย์ชั้นปีที่ 6 ที่ศึกษาในหลักสูตรเดิมและหลักสูตรการเรียนรู้โดยใช้ปัญหาในคณะแพทยศาสตร์ จุฬาลงกรณ์มหาวิทยาลัย โดยเปรียบเทียบระหว่างนิสิตชั้นปีที่ 6 ที่ศึกษาในปีการศึกษา 2541 และ 2542 จำนวนทั้งสิ้น 121 และ 125 คนตามลำดับ รวมทั้งเปรียบเทียบผลสัมฤทธิ์ทางการศึกษาด้านความรู้ของนิสิตทั้งสองหลักสูตร ตลอดจนศึกษาความสัมพันธ์ระหว่างทัศนคติและผลสัมฤทธิ์ทางการศึกษา ในการศึกษานี้ได้พัฒนาแบบสอบถามเพื่อใช้ในการวัดทัศนคติ โดยเครื่องมือที่สร้างขึ้นประกอบด้วยจำนวนคำถาม 30 คำถามครอบคลุมเนื้อหาต่างๆ ของทัศนคติต่อหลักสูตร และผ่านการประเมินโดยผู้ทรงคุณวุฒิในสาขาวิชาแพทยศาสตร์ศึกษาจำนวน 5 ท่าน การทดสอบความเที่ยงของเครื่องมือพบว่ามีค่า Cronbach alpha เท่ากับ 0.8913 เมื่อใช้เครื่องมือดังกล่าววัดทัศนคติของนิสิตแพทย์พบว่า นิสิตแพทย์ในหลักสูตรเดิมมีทัศนคติต่อหลักสูตรดีกว่านิสิตในหลักสูตรการเรียนรู้โดยใช้ปัญหา เมื่อวิเคราะห์โดยวิธี Factor analysis พบว่านิสิตในหลักสูตรการเรียนรู้โดยใช้ปัญหามีทัศนคติในส่วนของความสัมพันธ์ของเนื้อหาดีกว่านิสิตในหลักสูตรเดิมและหลักสูตรการเรียนรู้โดยใช้ปัญหาเน้นการเรียนรู้ด้วยตนเองมากขึ้น เมื่อศึกษาผลของการเปลี่ยนแปลงหลักสูตรต่อผลสัมฤทธิ์ทางการศึกษา โดยเปรียบเทียบผลการสอบวิชาเวชปฏิบัติทั่วไปของนิสิตทั้งสองกลุ่มไม่พบว่ามีความแตกต่างอย่างมีนัยสำคัญทางสถิติ ทั้งในส่วนของคะแนนรวม และการประเมินในระดับความจำ, การแปลผล และการแก้ปัญหา เมื่อศึกษาความสัมพันธ์ระหว่างทัศนคติและผลการสอบวัดคุณภาพ ไม่พบว่าตัวแปรทั้งสองมีความสัมพันธ์กัน

การศึกษานี้แสดงว่านิสิตชั้นปีที่ 6 ของคณะแพทยศาสตร์ จุฬาลงกรณ์มหาวิทยาลัยที่ศึกษาในหลักสูตรการเรียนรู้โดยใช้ปัญหามีทัศนคติในเชิงบวกต่อหลักสูตรต่ำกว่านิสิตที่ศึกษาในหลักสูตรเดิม อย่างไรก็ตามไม่พบการเปลี่ยนแปลงในความสามารถในการเรียนรู้และผลสัมฤทธิ์ทางการศึกษา การปรับปรุงและพัฒนาแนวทางการใช้หลักสูตรดังกล่าวเป็นสิ่งจำเป็นเพื่อแก้ไขทัศนคติดังกล่าว

ภาควิชา ..... ลายมือชื่อนิสิต .....

สาขาวิชา ..... ลายมือชื่ออาจารย์ที่ปรึกษา .....

ปีการศึกษา ..... ลายมือชื่ออาจารย์ที่ปรึกษาร่วม .....

4175390330 MAJOR HEALTH DEVELOPMENT
KEUWORD: PROBLEM-BASED LEARNING/ ATTITUDE/ MEDICAL CURRICULUM
ANAN SRIKIATKHACHORN : COMPARING ATTITUDES OF THE SIXTH YEAR MEDICAL STUDENTS TRAINED IN CONVENTIONAL AND PROBLEM-BASED CURRICULA IN CHULALONGKORN MEDICAL SCHOOL. THESIS ADVISOR: PROFESSOR KAMMANT PHANTHUMCHIDA, M.D., M.SC., THESIS CO-ADVISOR: ASSOCIATE PROFESSOR KITPRAMUK TANTAYAPORN, M.D., M.Ed. 99 pp. ISBN 974-346-294-5

This study aimed to investigate the attitude of the sixth year medical students in Chulalongkorn Medical School training in conventional and problem-based learning (PBL) curriculum. The study was conducted in the academic year 1998 and 1999. Total number of students included in the study were 121 for conventional batch and 125 for PBL batch. A 30-item questionnaire was developed for measuring the students' attitude. The validity of the scale was approved by five experts in the field of medical education. The reliability of the scale was evaluated using its internal consistency as an indicator. The Cronbach coefficient of this scale was 0.8913. The results of the study showed that students training in the conventional curriculum demonstrated more favorable attitude towards their curriculum than students in the PBL curriculum. Factor analysis demonstrated that PBL students had more positive attitudes in the area of relevancy of the content and emphasis more on the active learning. The study also investigated the effect of PBL implementation on the academic performance by comparing the scores obtained from the comprehensive examination between the two groups. No significant difference was demonstrated when the comprehensive examination scores were compared. Subgroup analysis based on level of knowledge measurement (recall, interpretation, and problem-solving levels) also demonstrated no significant difference. No definite correlation between the attitudes and academic performance was demonstrated.

The study can be concluded that the first cohort of PBL students in Chulalongkorn Medical School had less favorable attitudes towards their curriculum compared with the last cohort of conventional curriculum. Improvement in curriculum design is needed to change this undesirable attitudes.

Department …… Student's signature……
Field of study…….. Advisor's signature ……..…….
Academic year…….. Co-advisor's signature ……..……..

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Finally and apparently most importantly, I would like to thank the students of the classes 1998 and 1999, whose attitudes became the backbone of this research.

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LIST OF ABBREVIATIONS

AAMC	Association of American Medical Colleges
CI	Confidence interval
CTPB	Community-Targeted, Problem-Based curriculum track
GPAX	Cumulative Grade Point Average
MESRAP	Medical Education for Students from Rural Areas Project
MSOP	Medical School Objective Project
NMBE	National Board Medical Examination
PBL	Problem-based learning
SDL	Self-directed learning
USMLE	the United States Medical Licensing Examination

CHAPTER 1

BACKGROUND AND RATIONALE

During recent years, undergraduate medical education is changing. The general thrust of this pressure of change is towards reducing factual load in the curriculum and encouraging students to develop their skills at directing their own learning in preparation for continuing personal and professional development. This represents a shift in emphasis away from absorbing medical facts to acquiring the knowledge, skills and attitudes thought to be desirable in a modern doctor. A major trend of change is the replacement of conventional discipline- and lecture-based curriculum by problem-based curriculum. In fact, the problem-based approach to learning can be considered as the most significant innovation in the field of medical education in the past three decades. Problem-based learning (PBL) has been introduced in medical education firstly by the staffs in McMaster Medical School in Canada (see Neufeld et al 1989). This teaching method has become more popular and many medical schools adopted this method worldwide. According to Albanese and Mitchell (1993), PBL is described as "an instructional method characterized by the use of patient problems as a context for students to learn problem-solving skills and acquire knowledge about the basic and clinical sciences". Four key objectives in the education of doctors have been proposed to be achieved by this learning method, including (1) motivating learning, (2) developing clinical reasoning, (3) structuring knowledge in clinical context, and (4) developing self learning skills (Barrow 1986). Although various studies show some advantages of this teaching method, some disadvantages were also evidenced. (For review see Albanese and Mitchell 1993, Berkson 1993, Vernon and Blake 1993, Wolfs 1993, Thomas 1997).

In Thailand, the Faculty of Medicine of Chulalongkorn University adopted the PBL method in 1988. This teaching technique has been firstly implemented to a small group of nineteen medical students and was named the "community targeted problem-based medical education" or CTPB program. During the interim period, this problem-based curriculum was conducted in parallel to conventional curriculum, which

implemented to majority of students. In 1993, the Faculty Board decided to set up an innovative MD curriculum based on their experiences with conventional and CTPB programs. All of the previous curricula were replaced by this combined curriculum in 1994. The first batch of these PBL students will graduate in the academic year 1999.

One important factor that has great impact on achievement of academic goals is the student's attitude towards their curriculum. Based on behavioral science theory, attitude is second to knowledge in process of behavioral modification. In the context of PBL, various areas of attitude have been explored and data were compared to students' training under conventional curriculum (Vasconez et al 1993, Kaufman and Mann 1996, Vernon 1995, Vernon and Hosokawa 1996). However, all of previous studies were performed in western countries. No information in this regard has been inadequately probed in eastern countries. Since different basic training in primary education, cultures and beliefs have influence on human attitudes therefore existence of differences in student's attitude between western and eastern students can be predicted. This urges the need for re-evaluation of the attitude towards this teaching method in Asian countries.

The present thesis aims to compare the attitudes of students in a new PBL medical curriculum and in the previous conventional curriculum after they finished their final curriculum year. Besides the attitude, the academic performance of both groups of students was also compared to see the effect of PBL implementation on the academic achievement. The possible correlation between attitudes towards their curriculum and their academic achievement were also investigated. The results from this study would be beneficial in clarifying the impacts of curricular changing upon students' attitude as well as their academic achievement.

CHAPTER 2

LITERATURE REVIEW

Medical education plays an important role in shaping doctors of the present and future. Medical schools set ideals and standard in many ways. In the early days, when medical education was gained through an apprenticeship, the standards of quality that new doctors were expected to follow were set by their instructors. As medical education gained a greater degree of formality, the substance of medical education evolved. As a result, in the past century curricula and teaching methodologies have been transformed, leading to the development of extremely high professional and ethical standards in the practice of modern medicine.

Despite its success in the past, some pertinent problems are evident in conventional medical education using discipline-based curriculum. Such problems include the irrelevance of some of the knowledge which students have to acquire in conventional curricula, the lack of integration of subject-matter from different medical disciplines and the need for continuing education after graduation. It is also evident that conventional instructional procedures do not always enable students to make appropriate use of their knowledge, e.g. to solve problems.

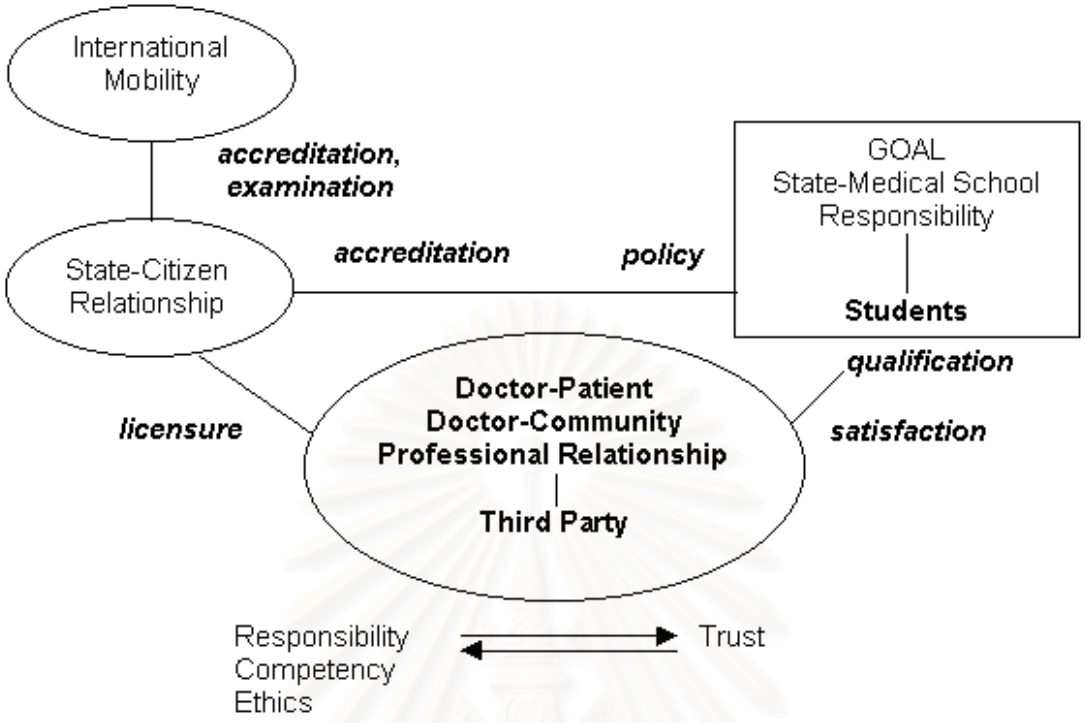
2.1 CURRICULUM REFORM: THE RATIONALE

The ultimate goal of medical school is to produce the medical graduates that suite societal expectation. Similar to other professions, medical profession holds a monopoly over its work. Such autonomy can be preserved only so long as medical profession meets responsibilities expected of it. Therefore, there must be balance between professional privileges and the public's perception that profession is serving the public welfare. Thus, one of the most important responsibilities of every doctor is the nurturing of that relationship through the building of trust based on professional competence and high ethical standards. It is the responsibility of the profession and of

the state to ensure that practicing doctors work and behave in an acceptable manner. (Suwanwela 1995) The relationship between medical schools, physicians and social expectation is depicted in the figure 2.1.

Societal expectation can be reflected by various attributes of medical professionalism as they relate to physicians' responsibility, not only to individual patients but to wider communities as well. Having a clear concept of medical professionalism will help medical schools in understanding the societal expectation and, as a consequence, preparing graduates to meet such expectation. In 2000, Swick has proposed a normative definition and has asserted that the concept of medical professionalism must be grounded both in the nature of profession and in the nature of physicians' work. He identified nine behaviors that constitute medical professionalism and that physicians must exhibit if they are to meet their obligations to their patients, their communities, and their profession. Such behaviors comprise (1) subordinating their own interests to the interests of others especially patients, (2) adhering to high ethical and moral standards, (3) responding to societal needs, (4) evincing core humanistic values, (5) exercising accountability for oneself and for their colleagues, (6) demonstrating a continuing commitment to excellence, (7) exhibiting a commitment to scholarship and to advancing their fields, (8) being able to deal with high levels of complexity and uncertainty, and (9) reflecting dispassionately upon their actions and decisions. (Swick 2000) If the above list is acceptable, it is the primary objective of medical schools to make the character of their graduates to be compatible with those desirable behaviors.

Figure 2.1 The medical profession in context (from Suwanwela 1995).



To suite the above expectation, academic medicine community is trying to define a model for medical education that will carry the profession into the next century. Society's changing needs, advancing knowledge, and innovations in education require constant changes of medical curricula. In the recent years, many observers of medicine have expressed concerns that new doctors are not well prepared as they should be to meet society's expectations of them. This view is held also by some within the medical profession and, more specifically, the medical education community. To address these concerns, medical educators must understand how changes in society's view of health and diseases and changes in the organization, financing, and delivery of health care shape expectations of physicians. They must then use this understanding to inform the design, content, and conduct of medical education programs.

In January 1996, the Association of American Medical Colleges (AAMC) embarked on a new major initiative – the Medical School Objective Project (MSOP) – to assist medical schools in their efforts to respond to these concerns. The goal for the first phase of the project was to develop a consensus within medical education community on the attributes that medical students should possess at the time of graduation, and to set forth learning objectives for the medical school curriculum derived from those attributes. The output of the first phase has been published in *Academic Medicine* in 1999. The AAMC believes that the objectives set forth published in such article can guide medical schools in developing their own objectives that reflect an understanding of the implications for medical practice and medical education of "evolving societal needs, practice patterns, and scientific developments." (Association of American Medical Colleges 1995) During the initial phase of the MSOP, a consensus was reached among the leaders of the medical education community on the attributes that physicians need to meet society's expectations of them in the practice of medicine. Such desirable physician's attributes comprise altruism, being knowledgeable, skillful and dutiful. (Medical School Objective Writing Group 1999) Each attribute is followed by a set of learning objectives that reflect consensus on the contribution that the medical school experience should make toward the achievement of those attributes. (see Table 1) At the end of their first report (Report I of the MSOP), the group stated three important comments. Firstly, they believed that if a school's curriculum is shaped by the set of learning objectives, the graduates will be well prepared to assume the limited patient care responsibilities expected of new residents and also will have begun to achieve that attributes needed to practice contemporary medicine. Secondly, medical schools should feel a sense of urgency in responding to the intent of the report. And, finally, it is important to measure the outcomes of learning objectives, and better assessment methods should be developed, particularly ones to assess outcomes related to attitudes and values.

Table 2.1 Desirable attributes of medical graduates and related learning objectives as proposed by MSOP committee. (The Medical School Objectives Writing Group 1999).

Desirable Attributes	Related Learning Objectives
Physician must be altruistic. Physicians must be compassionate and emphatic in caring for patients, and must be trustworthy and truthful in all of their professional dealings.	Knowledge of the theories and principle that govern ethical decision making, and of the major dilemmas in medicine
	Compassionate treatment of patients, and respect for their privacy and dignity
	Honesty and integrity in all interactions with patients' families, colleagues, and other with whom physicians must interact in their professional lives.
	An understanding of, and respect for, the roles of other health care professionals, and of the need to collaborate with others in caring for individual patients and in promoting the health of defined populations
	A commitment to advocate at all times the interests of one's patients over one's own interests
	An understanding of the threats to medical professionalism posed by the conflicts of interest inherent in various financial and organization agreements for the practice of medicine
	The capacity to recognize and accept limitations in one's knowledge and clinical skills, and a commitment to continuously improved one's knowledge and ability
Physician must be knowledgeable. Physicians must understand the scientific basis of medicine and be able to apply that understanding to the practice of medicine.	Knowledge of the normal structure and function of the body (as an intact organism) and of each of its major organ systems
	Knowledge of the molecular, biochemical, and cellular mechanisms that are important in maintaining the body's homeostasis
	Knowledge of the various causes (genetic, developmental, metabolic, toxic, microbiologic, autoimmune, neoplastic, degenerative, and traumatic) of maladies and the way in which they operate on the body (pathogenesis)
	Knowledge of altered structure and function (pathology and pathophysiology) of the body and its major organ systems that are seen in various diseases and conditions
	An understanding of the power of the scientific method in establishing the causation of disease, and understanding of the efficacy of traditional and nontraditional therapies

Table 2.1 (continued)

	An understanding of the need to engage in lifelong learning to stay abreast of relevant scientific advances, especially in the disciplines of genetics and molecular biology
Physician must be skillful. Physicians must be highly skilled in providing care to individual patients.	The ability to obtain an accurate medical history that covers all essential aspects for the history, including issues related to age, gender, and socioeconomic status
	The ability to perform both a complete and an organ-system-specific examination, including a mental status examination
	The ability to perform routine technical procedures, including at a minimum venipuncture, inserting an intravenous catheter, arterial puncture, thoracentesis, lumbar puncture, inserting a nasogastric tube, inserting a foley catheter, and suture lacerations
	The ability to interpret the results of commonly used diagnostic procedures
	Knowledge of the most frequent clinical, laboratory, roentgenologic, and pathologic manifestations of common maladies
	The ability to reason deductively in solving clinical problems
	The ability to construct appropriate management strategies (both diagnostic and therapeutic) for patients with common conditions, both acute and chronic, including medical, psychiatric, and surgical conditions, and those requiring short- and long-term rehabilitation
	The ability to recognize patients with immediate life-threatening cardiac, pulmonary, or neurological conditions regardless of etiology, and to institute appropriate initial therapy
	The ability to recognize and outline an initial course of management for patients with serious conditions requiring critical care
	Knowledge about relieving pain and ameliorating the suffering of patients
	The ability to communicate effectively, both orally and in writing, with patients, patients' families, colleagues, and others with whom physicians must exchange information in carrying out their responsibilities

Table 2.1 (continued)

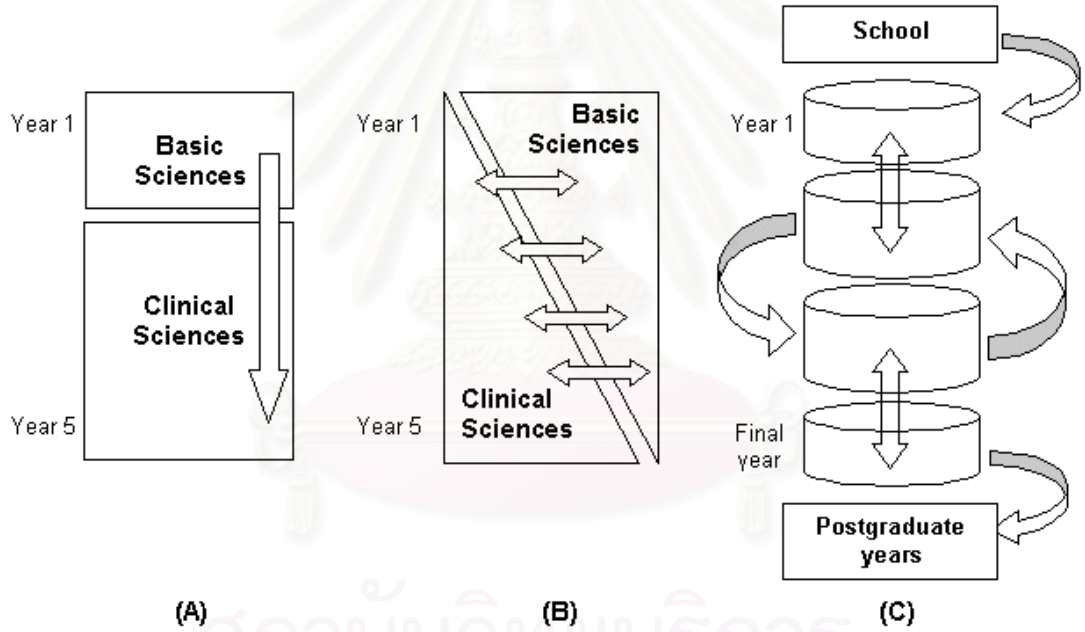
Physicians must be dutiful. Physicians must feel obliged to collaborate with other health professionals and to use systematic approaches for promoting, maintaining, and improving the health of individuals and populations.	Knowledge of the important non-biological determinants of poor health and of the economic, psychological, social, and cultural factors that contribute to the development and/or continuation of maladies
	Knowledge of the epidemiology of common maladies within a defined population, and the systematic approached useful in reducing the incidence and prevalence of those maladies
	The ability to identify factors that place individuals at risk for disease or injury, to select appropriate tests for detecting patients at risk for specific diseases or in the early stage of disease, and to determine strategies for responding appropriately
	The ability to retrieve (from electronic databases and other resources), manage, and utilize biomedical information for solving problems and making decisions that are relevant to the care of individuals and populations
	Knowledge of various approaches to the organization, financing, and delivery of health care
	A commitment to provide care to patients who are unable to pay and to advocates for access to health care for members of traditionally underserved population

As a consequence of changes in health care management, advances in medical science, and changes in societal expectation, undergraduate educational programs in many medical schools have been redesigned. (Mennin and Kalishman 1998) A novel approach to curriculum design is replacing familiar course structures with more fluid and complex design. Figure 2.2 shows an example of the change in curriculum outline. (Bligh 1999)The conventional curriculum, characterized by two-year intensive basic medical science teaching followed by two or three years period of clinical instruction (Figure 2.2A) is replaced by an integrate curriculum (Figure 2.2B). In this structure, basic and medical sciences are studies alongside each other and early, controlled clinical experience for students is provided in clinical skill centers. Students relate knowledge to clinical skills more readily and are able to apply information in a clinical setting. The basic sciences continue to play a significant part in learning in the later, more clinical, years. The curriculum can become even more complex (Figure 2.3C). In this approach, student learning is progressive and sequential with information integrated between disciplines and across years. As they progress through the course, students revisit material at increasing levels of complexity. This ensures both broad and detailed coverage of the core syllabus. Figure 2.2C also shows that greater attention is being paid to the selection of students for entry to medical school, and at the end of the course, where collaboration with employers is leading to a closer match between the medical graduate and the requirements of work place.

Professionalism and professional development are priorities in medical education. And having well-integrated medical curriculum is an important step in this process. Like clinical reasoning, professionalism cannot flourish without its necessary basis of knowledge, methods and skills. In 2000, Wear and Castellani pointed out the need for an intellectual widening of medical curriculum. They showed that students need to acquire not only the necessary tools of scientific and clinical knowledge, methods, and skills but also other relevant tools for professional development that can be provided only by particular knowledge, methods and skills outside bioscience domains. Other bodies of knowledge – philosophy, sociology, literature, spirituality, and aesthetics – are often the ones where compassion, communication, and social responsibility are addressed, illuminated, practiced and learned. Cooperation of these bodies of

knowledge will foster the medical students to develop the desirable quality of medical profession.

Figure 2.2 Outlines and trend of medical curricula. (A) Conventional curriculum, (B) a modern integrate curriculum and (c) learning pathways within an innovative curriculum.



Although reformation of curriculum is necessary, the process to achieve the successful curriculum reform is not easy. Successful curricular change occurs in only through the dedicated efforts of effective change agents. The process has been comprehensively reviewed by Bland and colleagues (2000). In their review, the authors demonstrated a set of characteristics that are associated with successful curriculum change. The frequent reappearance of the same characteristics among various medical schools of varied setting suggests they are robust contributors to successful change. The characteristics are in the areas of the organization's mission and goals, history of change in the organization, politics (internal networking, resource allocation, relationship with external environment), organization structure, need for change, scope and complexity of the innovation, cooperation climate, participation by the organization's members, communication, human resource development (training, incorporating new member, reward structure) evaluation, performance dip (i.e., the temporary decrease in an organization's performance as a new program is implemented), and leadership. In the same year, Bernier et al reported their experiences in curricular changing in two different American Medical Schools, namely the University of Pittsburgh School of Medicine and the University of Texas Medical Branch at Galveston (Bernier et al 2000). The change process took place over a three- to four-year period in each medical school, involved students, faculty, and administration, and utilized task forces and retreats as communication vehicles. They demonstrated that barriers encountered (e.g., belief by some that the curriculum needed no change; concern over loss of departments' control) and the processes employed to overcome them and the to radically change the curricula (e.g., commitment of the central administration and dean to the change, involvement of all segments of the school in the change process, and creation of a strong curriculum committee that gave authority to faculty and students) are identical. Therefore, learning from the previous experiences in other medical schools will be valuable for the medical school that will undergo their curriculum.

2.2 CURRICULAR REFORM IN CHULALONGKORN MEDICAL SCHOOL

Chulalongkorn Medical School is the second oldest medical school in Thailand. Since it was founded in 1947, several curricula were developed and have been implemented in this medical school. The first curriculum was conventional discipline-based in nature and largely followed those implemented in the western countries. This curriculum was successful in term of academic excellence especially those concerning the tertiary medical care.

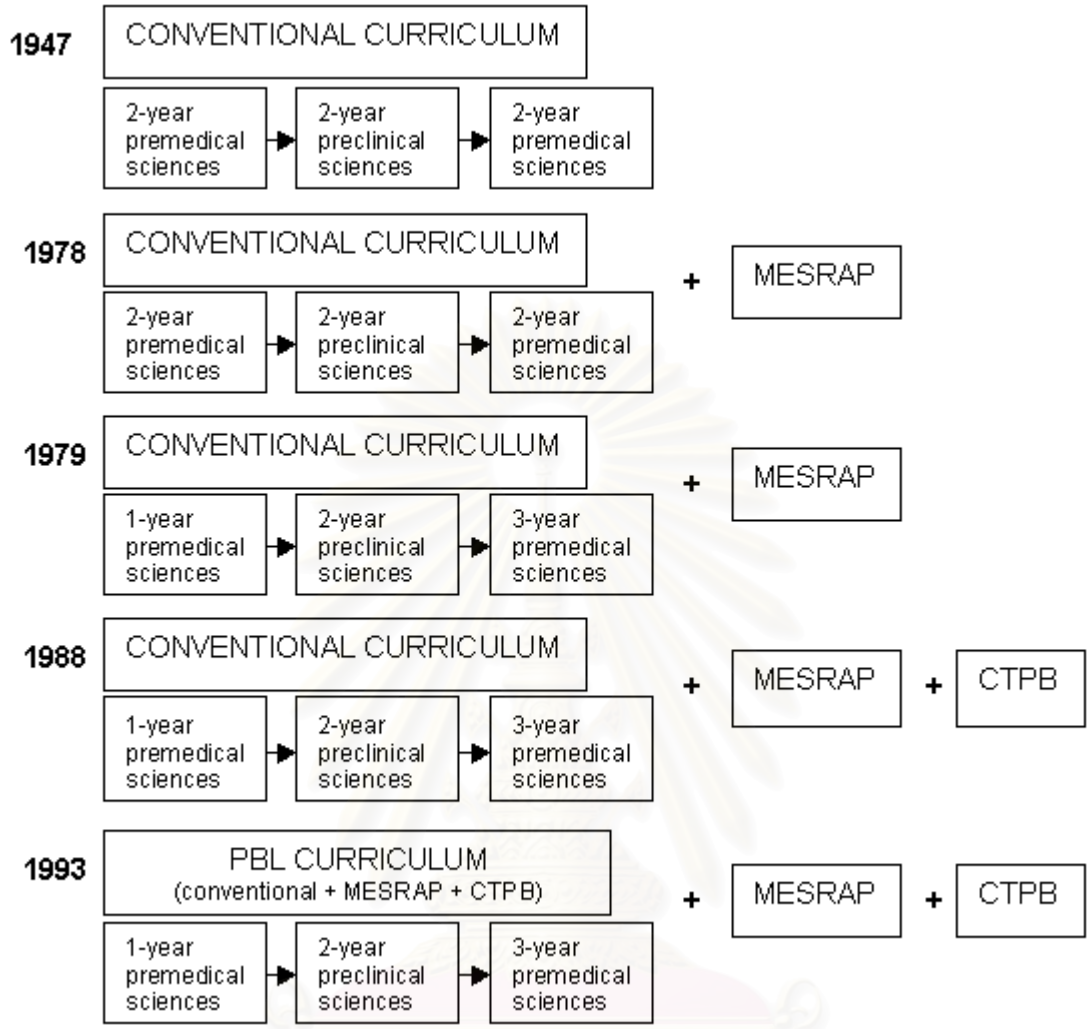
However, such success could not satisfactorily solve the health-related problem in Thailand since the majority of those who need medical care resided in the rural communities. Since 1971, national medical education in Thailand has targeted two primary national needs: the general need for more doctors and the particular need for more physicians in rural areas. In 1978, a new experimental track, named the Medical Education for Students from Rural Areas Project (MESRAP) was added at Chulalongkorn Medical School (Suwanwela 1991). Two basic hypotheses constitute the philosophy of MESRAP. Firstly, doctors trained in provincial and district hospitals and in health centers would be as competent as those with conventional training in urban teaching hospitals (judged by meeting the competencies set by the Thai Medical Council and by the Chulalongkorn Medical School). The other concept is that graduates would be better prepared and more willing to serve in rural areas if they were recruited from rural areas; if they agreed, before matriculation, to serve in needy areas; and if the curriculum was problem-oriented, with early and sustained exposure to community medicine (Suwanwela et al 1993). The MESRAP graduates possess knowledge and skills comparable to those of graduates of the conventional medical school track. They have been found to have a more positive attitude toward rural practice, and a large percentage of them, compared with conventional track graduates, work in rural areas.

In 1986, a report of the Faculty on the shortcomings of medical education at Chulalongkorn identified a series of areas of deficits in their students' abilities. These include (1) biomedical problem solving, (2) certain manual skills, (3) community-health problem solving, (4) critical decision making, (5) self-learning ability, and (6) administrative skill. These qualities have been accepted as requirements for all medical graduates, following a resolution from the Fifth National Medical Education Conference. This resolution suggested that the training sites and teaching/learning methods greatly affect the physician quality. A new innovative medical curriculum, which promotes the desired qualities in graduates must be sought.

As a result of the self-study, the Community-Targeted, Problem-Based curriculum track (CTPB) was created and nineteen students were accepted as the first cohort in May 1988. The goal of this track is to train doctors to be better health care providers and to be administrators, primary health care supporters, teachers, and researchers, mostly in urban areas. Unlike the admission policies for the conventional and MESRAP tracks, that for CTPB focuses on more experienced and mature students who have already received their first degrees in different fields. And unlike the creation of the MESRAP, the creation of the third track entailed involvement and input of the whole medical faculty. This strategy led to broad ownership and support for this innovation. The CTPB graduates have shown equal competency but better communication and problem solving abilities compared with conventional and MESRAP graduates.

In 1993, the Faculty Board decided to set up an innovative M.D. curriculum based on their past experiences with all three M.D. programs. The good aspects of each program were combined in the fourth curriculum. This combined curriculum, known as Community-Targeted, Lectured-Based, Problem-Based curriculum, was implemented in 1994. This program is indeed a reform in medical education, a major step leading to making medical education more relevant to societal needs. This program is aimed at increasing medical experiences in community health care services, building self-directed learning, and instilling good moral and professional ethics (Tantayaporn 1997).

Figure 2.3 Curriculum development in Chulalongkorn Medical School



2.3 PROBLEM-BASED LEARNING CURRICULUM: THE CHARACTERISTICS

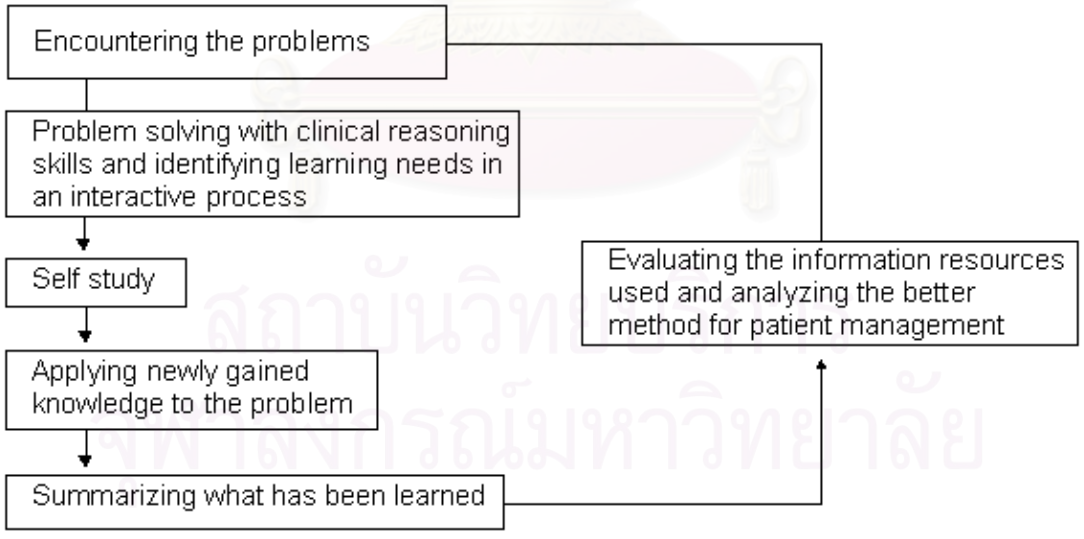
Problem-based learning (PBL) is an instructional innovation in medical education, which has been proposed to solve the above problems. This teaching technique had its roots at McMaster University in the mid-1960s. Since initiation, it has spread throughout North America and in other parts of the world. Variations of PBL curricula have been implemented at institutions such as the University of Mexico, Harvard University, etc. This teaching method has been described by Albanese and Mitchell (1993) as "an instructional method characterized by the use of patient problems as a context for students to learn problem-solving skills and acquire knowledge about the basic and clinical sciences". In Thailand, this teaching method has been applied in only a few medical schools.

Problem-based learning at its most fundamental level is an approach to learning and instruction in which students tackle problems in small groups under supervision of a tutor. In most of the cases, a problem consists of a description of a set of phenomena or events that can be perceived in reality. In medical education, they usually take the form of a description of a patient presenting a complaint supplemented with some clinical signs and symptoms. These phenomena or problems are used as a context for students to learn problem-solving skills and acquire knowledge about basic and clinical sciences. Problems have to be analyzed and explained by the group in terms of underlying principles, mechanisms or processes. The tools used in order to do that are discussion of the problem and study relevant resources. (Schmidt 1993, Albanese and Mitchell 1993)

The basic outline of the PBL process is: encountering the problem first, problem solving with clinical reasoning skills and identifying learning needs in an interactive process, self study, applying newly gained knowledge to the problem, and summarizing what has been learned. (Barrows 1985) In the closed loop or reiterative form of PBL described by Barrows (1986), the PBL process concludes with students' evaluating the information resources they used and then analyzing how they might have better managed the patient problem. (figure 2.4)

Problems or scenario selected as a context of learning must be effective in facilitating students to identify relevant learning issues. It is crucial to PBL that the problem must raise compelling issues for new learning and that students have an opportunity to become actively involved in the discussion of these issues, with appropriate feedback and corrective assistance from faculty members. The faculty role in all of this is to facilitate the problem-solving process by guiding, probing and supporting students' initiatives, not by lecturing, directing or providing solutions. In PBL, the problem is presented first, before students have learned basic sciences or clinical concepts, not after. This distinguishes PBL from other problem-centered methods, such as the case method, etc.

Figure 2.4 Steps in PBL method as proposed by Barrows (1985).



Schmidt (1983) describes seven steps in PBL which include (1) clarification of terms and concepts which are not readily understandable, (2) to define the problem, (3) problem analysis, (4) setting up a systematic inventory of the explanations, (5) formulation of learning objectives, (6) collection of additional information outside the group and synthesis and test the newly acquired information. Walton and Matthews have added motivational terms such as “challenge” and “encouragement” to the steps. (Walton and Matthews, 1989) The extensive literature by experimental psychologists over the past three decades on problem solving in groups, which is based on observations in wide variety of political, educational and social groups, concurs with this formulation although observes that groups may delay, avoid or repeats as member cope with the diversity of objectives, knowledge and motivation among a group members. (Thomas 1997)

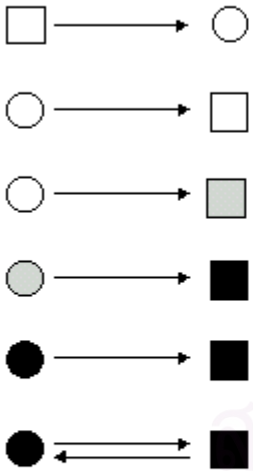
Characteristics of problem-based curriculum have been described by Neufeld and colleagues (Neufeld et al 1989). They articulated key features of PBL curriculum at McMaster University as being ”the analysis of health care problems as the main method of acquiring and applying knowledge; the development of independent lifelong learning skills by students; and the use of small tutorial groups, with five or six students and a faculty tutor in each group, as the central educational event. Such description appears to be typical for other PBL curricula implemented elsewhere. The essential characteristics of a PBL curriculum are the use of problems as a focus for learning basic science and clinical knowledge along with clinical reasoning skills in an integrated, rather than separate, fashion.

GOALS OF PBL

There are certain skills that are generally accepted as being central goals in higher education. Such goals include ability to think critically and independently, problem-solving skills and decision making. Regarding medical education, it is obvious that problem-solving and analysis of problems for decision making are very important skills for practice of medicine as well as for research. PBL is developed based on

concepts and method that are designed to promote the described skills. Self-directed skill is an important skill in preparing medical students for continuing medical education for life (Abrahamson et al 1999).

Figure 2.5 Varieties of problem-centered teaching methods and their effective-ness in achievement of four major academic goals. Scores vary from 0-5 in increasing order (0=minimum, 5=maximum). (abbreviation: SCC, structuring knowledge in clinical context; CRP, clinical reasoning process; SDL, self-directed learning; MOT, motivation; square, lecture; circle, case; blank, teacher-oriented; filled, student-oriented)



	SCC	CRP	SDL	MOT
Lecture-based cases	1	1	0	1
Case-based lectures	2	2	0	2
Case method	3	3	3	4
Modified case-based	4	3	3	5
Problem-based	4	4	4	5
Closed-loop PBL	5	5	5	5

Barrows (1986) articulated four major educational goals of PBL. The first is the structuring of knowledge for use in clinical contexts. Inherent in this goal is the notion that retention, recall and application of new knowledge are enhanced as knowledge of the basic and clinical sciences are acquired in a problem context. A second goal of PBL is the development of clinical reasoning process that include hypothesis generation, inquiry, data analysis, problem synthesis, and decision making. The third goal is the development of self-directed learning skills deemed critical for doctors as they confront an expanding knowledge base and unusual or unique problems in practice. The final goal is to enhance motivation for learning. This goal is based on assumption that opportunity for medical problems early in their education is inherently motivation. Based on Barrows' paper, he also suggested that PBL, especially closed loop PBL, is the most effective mean to achieve these four objectives compared with other problem-centered teaching methods. (figure 2.5)

2.4 EVALUATION AND QUALITY ISSUES IN PBL

In spite of its growth, there is continuing controversy whether PBL can be effectively replace the conventional curriculum. Actually, PBL has generated a great interest in the literature with regard to its strength and weakness compared with conventional instruction. Numerous studies, have examined the outcomes of PBL in a variety of cognitive and non-cognitive domains. In 1993, three reviews, including one meta-analysis, were published (Albanese and Mitchell 1993, Berkson 1993, Vernon and Black 1993). The problem regarding interpretation of these original studies and reviews were addressed recently by Colliver (2000). Since 1993 (the year that three comprehensive reviews were published), nine new studies – three randomized and six non-randomized – that involved comparisons of curriculum tracks were published.

The Effect of PBL on Motivating Learning

Although motivation is one of the initial and central concerns of PBL, the effects of PBL on student motivation are among the least well documented outcomes of the curriculum. Despite belief that PBL can promote the motivating learning, no direct evidence as to how specific aspects of problems stimulate learning applicable to patient care is available. In contrary, PBL may cause frustration for some students. Those who feel insecure in guiding their personal learning experiences may, through frustration or poor performance, lose interest in subject matter. Group dynamics can potentially stimulate or interfere with the experience of learning. Introverted students may feel comfortable in self-directed study but threatened by obligatory group discussion. (Berkson 1993, Thomas 1993)

Research on whether PBL problems motivate learning is limited to assessing to what extent PBL problems motivate students to study the same range of problems identified by expert staff. Such kind of research have been conducted at University of Lundberg in the Netherlands, University of Colorado etc. In summary, research to date has not shown that PBL problems usually motivate students to study problems additional to those identified by teaching staffs.

The Effect of PBL on Academic Achievement

Evaluations of PBL effect on academic achievement have been explored by using several outcome variables, including the standard test such as NBME I (National Board of Medical Examiners Part I examination), incidence of academic failure etc. Vernon and Blake (1993) analyzed previously published studies using method of meta-analysis. Based on data from NBME I, their analysis revealed a significant trend favoring conventional teaching methods (weighted mean of effect size = -.18, CI_{95} = -.10 to -.26). Concerning the performance on basic science factual knowledge, the observed trend in favor of conventional teaching approaches was not statistically significant (weighted mean of effect size = -0.9, . CI_{95} = +.06 to -.24). These results

were in accord with another review study reported by Albenese and Mitchell (1993). The study at the University of New Mexico School of Medicine also showed that the PBL students scored significantly and considerably lower than did the conventional students on NMBE I. No significant difference was observed when the score of NMBE II and III among the two groups were compared (Menin et al 1993). Another study conducted in Harvard medical school showed no significant difference in the performance on NMBE I between the PBL and conventional track students. A subtle increase in NMBE I subtest on behavioral science was observed in the PBL students (Moore et al 1994).

Although a substantial number of studies confirmed the poorer performance of PBL students in basic science examination, the more recent study performed by Blake and colleague at the University of Missouri-Columbia School of Medicine showed a contradictory result (Blake et al 2000). In this study, the investigators compared the students' performance on Step 1 and Step 2 of the United States Medical Licensing Examination (USMLE) between the groups trained under PBL curriculum with the previous batches trained under conventional curriculum. They found that the mean scores were higher in USMLE Step 1 for class in the PBL curriculum than for classes in the conventional curriculum. The mean scores for Step 2 were above the national mean for PBL class whilst those of conventional curriculum was lower than national mean. They concluded that PBL revisions of the curriculum did not compromise the performance of medical students on the licensing examination.

The results of study comparing academic failure in PBL and conventional tracks are still controversial. At Michigan state, academic attrition was slightly more common among PBL students., while other studies reported no significant difference (Jone et al 1984).

The Effect of PBL on Clinical Reasoning

To achieve the objective of developing effective clinical reasoning, PBL problems must arise students in developing skills to derive thorough lists of hypotheses and to then testing them with focused databases similar in quality to those that an expert possess or obtain.

Whether students form PBL and conventional curricula use different methods of reasoning has been assessed. Advantage of PBL on academic process has demonstrated. A meta-analysis study based on data from four articles suggested that PBL trained students place more emphasis on "meaning" (understanding) than on "reproducing" (rote learning and memorization), and that of opposite pattern prevailed among students in conventional programs. The effect size of these sample ranged from +.44 to +.79 (Vernon and Blake 1993). The same problem has been investigated in another study of 72 students at McMaster and McGill. The authors described the PBL students as tending to "reason backwards from clinical information" to theory, and producing extensive elaboration about the data. The conventional curriculum students tended to "reason forward from theory", and stayed closer to the clinical facts. They also showed that PBL students were less decisive in reaching diagnosis (Patel et al 1991). Difference in the recall and reasoning process were also demonstrated by Claessen and Boshuizen (1986). They results revealed a greater recall for the PBL students confronted with the atypical patient case, while the reverse was true for the classic case. However, the magnitude of such difference did reach the statistically significant level. Both of the mentioned studies suggest that backward reasoning process - a key component of PBL - can interfere with developing forward reasoning skills, by focusing the subjects' attention on goal.

The Effect of PBL on Structuring Knowledge in Clinical Contexts

Various types of tests have been used to evaluate effect of PBL in clinical functioning such as rating and test of clinical performance (often based in observation of behaviors with real or simulated patients), tests of clinical knowledge (such as NBME II),

etc. In contrast to what observed in comparison of performance in basic science knowledge, there was a trend in favor PBL students on clinical examination. The weighted summary effect size was +.28 and CI_{95} was +.16 to +.40 (Albenese and Mitchell 1993). Preclinical PBL curricula also enhance performance of medical students in their clerkship years (Richards et al 1996).

Some researchers are skeptical about possible effects of PBL on the diagnostic performance of students. For instance Schmidt et al demonstrated that most of the medical-expertise literature suggests that medical problem solving is case-specific to an extent that the existence of the knowledge-independent clinical-reasoning skills can be seriously questioned (Schmidt et al 1990). This problem was investigated in a large scale study by Schmidt and his colleagues. (Schmidt et al 1996) They compared the diagnostic ability of medical students among three medical schools using different curricula. The results showed that students trained within problem-based framework and the students trained within the integrated curriculum made more accurate diagnoses than those trained within the conventional curriculum. There are also a few studies on whether learning using PBL methods improves the patient care of practicing doctors. A comparison of 48 graduates from McMaster and 48 from Toronto several years after graduation showed that McMaster (PBL) students scored 5 points higher (CI_{95} = 1.9 to 8.2) on an 82-point test of knowledge about hypertension (Shin et al 1993).

In conclusion, with respect to clinical functioning, the performance of PBL students, as measured in a variety of way, was better than that of conventional lecture-based students.

The Effect of PBL on Self-Learning Skills

A commonly expressed concern of educators is that the conventional curriculum encourages students to study for the short-term goal of passing an examination. Promotion of self- and life-long learning behavior is one of the major goal of PBL.

To assess self-learning skills, the range, depth and appropriateness of the databases accessed by students should be monitored. Some studies have shown that PBL students have different study patterns than conventional curriculum students. Vernon and Blake (1993) found for 97 students in four medical schools that the PBL students used more journal articles, electronic searches, books and self-selected resources, and felt more competent in information-seeking skills. Albenese and Mitchell (1993) showed that, compared with their conventional track peers, PBL students consulted more textbooks (effect size = 1.71), journals and other books (effect size = 1.74) and had more informal discussions with staff and their peers (effect size = 0.61). The greater use of library books continue into clinical years (40 vs. 11 books per year for conventional track students).

These results suggest that PBL students tend to study differently than conventional students. They are less likely to study for short-term recall and more likely to study for understanding to analyze what they need to know for a given task and study accordingly. They also control a substantial greater degree of their learning efforts than do conventional students. This would be consistent with the reduced amount of scheduled class time and more student-directed environment provided in a PBL curriculum. PBL students are also substantially more likely to use the library and library resources to study.

2.5 ATTITUDES TOWARDS PBL

The psychological term *attitude* has various definitions, although "theorists agree that (a) evaluation constitutes a central, perhaps predominant, aspect of attitudes, (b) attitudes represent in memory, and (3) affective, cognitive, and behavioral antecedents of attitudes can be distinguished, as can affective, cognitive and behavioral consequences of attitudes" (Olsen and Zanna 1993). Allport, one of the most famous social psychologists of his day, defined attitude as a mental or neural state of readiness, organized through experience, exerting a directive or dynamic influence upon the individual's response to all objects and situations with it is related. The central feature of

all definitions of attitude is the idea of readiness for response. That is attitude is not behavior, not something that a person does; rather it is a preparation for behavior, a predisposition to respond in a particular way to the attitude object. The term attitude object is used to include things, people, places, ideas, actions, or situations either singular or plural. The general literature on attitude supports this hypothesis: in short, attitudes mediate behavior.

Attitude is a popular and useful concept in psychology and behavioral sciences. This term can summarize many different behaviors. It can reflect the way people perceive the world around them. Attitude can be considered the *cause* of a human behavior and also helps to explain the consistency of a person's behavior towards another person or an object. Based on these reasons, researches to identify attitudes towards various attitude objects have been conducted.

Many studies have been conducted to evaluate students attitudes to, and opinion of, their studies at medical schools. The data regarding program evaluation appear to consistently favor PBL (Vernon and Blake 1993). Based on data from eight articles, Vernon and Blake performed a meta-analysis and found that the calculated weighted mean effect size was +.55 (CI_{95} = +.40 to +.70) in favor of PBL. The favorable effect of PBL was also demonstrated by studies of class attendance, students' selection rates of PBL option and retention rate. These results were supported by more recent studies. For instance, Kaufman and Mann (1996) demonstrated that students trained in PBL curriculum believed strongly that their preclinical medical curriculum was characterized by the highly valued features of PBL, namely higher-level thinking, managing information, and stimulating self-directed learning. Vasconez and colleagues showed that, similar to those in preclinical years, PBL was also positively accepted by students in the clerkship years (Vasconez et al 1993).

Birgegard and Lindquist investigated students' opinion of the extent of which their studies at medical school encourage independent, critical thinking, problem-solving skills, decision making and other behaviors usually put forward as important. Their results showed that students studying in conventional curriculum generally have low opinion of the extent to which their education encouraged such virtues. (Birgegard and Lindquist, 1998) They also observed that significant changes took place after introduction of PBL. The students' opinion of medical school curriculum were improved in many areas. In spite of such improvement, student ratings of PBL as learning tools were rather poor, and many students felt insecure with regard to how to cover the subject matter for the examination.

Concerning attitudes and opinions of faculty members about PBL, Vernon has conducted a study using questionnaire-survey in 22 United State and Canadian medical schools. His results showed that faculty members rated PBL more superior than conventional method. This was especially evident in the ratings of student interest and enthusiasm, faculty interest and enthusiasm, staffs' personal satisfaction, student reasoning, and preparation for clinical rotation. He also observed that, conventional methods were judged to be superior in teaching factual knowledge of basic science (Vernon 1995). However, based on more recent evidence reported from the same investigator, this positive attitude can vary. In 1996, Vernon and Hosokawa showed that the attitudes of faculty varied with their teaching roles in PBL. Those whose primary roles were as tutors or as leaders of other small discussion groups were more favorable to the PBL curriculum than those who primarily served as lecturers.

Based on previously published studies, it is apparently observed that students satisfy the teaching with PBL method. There seem to be consistent findings that students enjoy the small-group interactions and atmosphere created by PBL. Attitudes towards PBL can be improved by direct exposure to this teaching method as showed by Bernstein and his colleagues. They demonstrated that direct experience with PBL led to more favorable attitudes among the students and faculty (Bernstein et al 1995).

2.6 CONCLUSION

Overall, previous results support the superiority of the PBL approach over more conventional methods in several of the outcome program evaluation. With respect to program evaluation, data on students' attitude, class attendance, and student mood or distress were constantly more positive for PBL than for conventional courses or curricula. The limited information available suggests that faculty member who had participated in both PBL and more conventional teaching were also relatively positive about PBL. Several studies found that the process of learning was different for PBL students: the pattern of resource used suggested more self-directed learning in PBL programs, and PBL students placed greater emphasis on understanding and correspondingly less emphasis on memorizing. With respect to clinical functioning, the performance of PBL students was better than that of conventional students; there was no significant difference between the two groups of clinical knowledge, although the trend favored PBL. In contrast, conventional teaching methods were generally associated with higher scores on tests of basic science knowledge.

Although, some available evidences confirm that PBL produces learning and/or learners different from or superior to those derived from conventional approach, the generalization of these results is limited due to defects of primary data (Wolf 1993). Results from previous studies are often incomplete, poorly reported and likely to be drawn from a limit number of subjects. Recently, Colliver published an article addressing the problem of interpretation of pervious data. He pointed out that the effect sizes reported in those studies are rather small and unlikely to be clinically significant (Colliver 2000). He also showed that three randomized studies failed to prove a significant positive effect of PBL on the NBME licensure examinations (Mennin et al 1993, Moore et al 1994, Schmidt et al 1996). The author concluded that no convincing evidence demonstrate that PBL improves knowledge base and clinical performance, at least not of the magnitude that would be expected given the resources required for a PBL curriculum (Colliver 2000). Moreover, since attitude towards study has a major effect on academic achievement, the generalization of such conclusion to Asian

countries like Thailand may not be possible. The problem of generalization is further complicated by vast difference in details of teaching and academic environment among various medical schools. Therefore, there is tremendous need for well-designed, creative primary research-evaluation studies that examine important relevant behaviors and outcomes.

CHAPTER 3

RESEARCH METHODOLOGY

3.1 RESEARCH QUESTIONS

Primary Question:

Do students trained under PBL format have at least 25% difference in the attitudes towards their curriculum to those trained under conventional track?

Secondary Question:

Does training under PBL format cause any differences in student's academic performance compared to conventional method?

1. To what level of academic process (recall, interpretation or problem-solving) that PBL can promote?
2. Does the difference in students' attitude towards PBL and conventional curriculum produce any effects on their academic achievement?

3.2 RESEARCH OBJECTIVES

1. To evaluate students' attitudes to and opinions of their studies, comparing between conventional and PBL curriculum.
2. To compare students' academic achievement between students trained under PBL and conventional tracks.
3. To evaluate specific domains of academic process that can be altered by changing the medical curriculum from conventional to PBL format.
4. To demonstrate possible correlation between student's attitude towards their curriculum and their academic achievement between the PBL and conventional track students.
5. To compare the effectiveness of PBL implementation in Faculty of Medicine, Chulalongkorn University to previous reports from other countries.

3.3 OPERATIONAL DEFINITIONS

PBL: An instructional method characterized by the use of patient problems as a context for students to learn problem-solving skills and acquire knowledge about the basic and clinical sciences; the development of independent lifelong learning skills by students; and the use of small tutorial groups of students and a faculty tutor as the central educational event.

Conventional Curriculum: An instructional method characterized by instructor-provided learning objectives and assignments, large-group lectures, structured laboratory experiences, and periodic tests (mostly multiple-choice) of achievement.

Curriculum: The course of the study including three major components, i.e. objectives, learning experience and evaluation. In this study, only the attitude towards the learning experience was measured. Neither objectives nor evaluation components were included in the analysis.

Attitudes: A mental or neural state of readiness, organized through experience, exerting a directive or dynamic influence upon the individual's response to all objects and situations with it is related.

Academic Achievement: The degree of success in study as determined by various knowledge tests such as standard comprehensive examination etc. In this research, the academic achievement will be measured by the comprehensive examination for the sixth year Chulalongkorn medical students.

3.4 RESEARCH DESIGN

The study was conducted during the academic year 1998-1999. In the academic year 1998, the final batch of conventional curriculum students studied in the final year of their clinical clerkship whilst the first batch of PBL finished their fifth curricular year. Since the study aimed to investigate the differences of students' attitudes and their academic achievement after completing the whole curriculum, therefore the measurement was performed only in the final year of curriculum. Therefore, the measurement was performed in the students trained under conventional method in academic year 1998 and to PBL students in academic year 1999. The results were then be compared. The design of the study can be classified as an observational study with cross sectional method.

3.5 POPULATION AND SAMPLE

3.5.1 POPULATION

Target Population

The target populations to whom the result will be inferred are students in medical schools.

Sampled Population

Sampled population were medical students in Chulalongkorn Medical School who studied with either conventional or PBL curriculum. All of the sixth year students in academic year 1998 (conventional track) and 1999 (PBL track) were recruited in the study.

3.5.2 ELIGIBILITY CRITERIA

Inclusion criteria:

The sixth year medical students in the academic year 1998 and 1999 who finished their coursework and clerkship were included. To minimize possible variation in terms of academic performance, socioeconomic status, etc., only those who matriculated Chulalongkorn Medical School by passing a standard university entrance examination were recruited.

Exclusion criteria:

Medical students in particular tracks, including students from Medical Education for Students in Rural Area Program (MESRAP) and students in the CTPB (Track III) program.

3.5.3 SAMPLE SIZE AND SAMPLING TECHNIQUE

This study aimed to include all the sixth year medical students in the defined academic years who fulfilled the eligible criteria. This comprised the number around 150 students per group. Therefore no method for sample size calculation or sampling technique was needed. The more important statistical test for study of which number of sampled population were known beforehand was to calculate the power of statistics based on the observed effect size. The power can be calculated by using the formula for sample size calculation.

$$\text{sample (n/group)} = \frac{2\,(Z_{\alpha}+Z_{\beta})^2 \times \sigma^2}{\Delta^2}$$

where Z_{α} = Z score for type I error

Z_{β} = Z score for type II error

σ^2 = pool variance = $(sd_1^2 + sd_2^2)/2$

Δ = effect size difference

Power = 1-type II error

The post-study power was calculated for each outcome variable. More attention would be paid on the variables of which their differences could not reach the statistical significant level. This was to check whether the differences were real non-significant or due to the inadequacy of statistical power.

3.6 INTERVENTION

The intervention of interest in this study is implementing different methods of medical teaching. These curricula have already been implemented officially by the Faculty, therefore, there will be no particular intervention applied in this study.

3.7 MEASUREMENT

3.7.1 MEASURING TOOL FOR THE PRIMARY OUTCOME VARIABLE:

Development of Questionnaire for Measuring Students' Attitude

In this study, the students' attitudes towards their medical curriculum were measured using a newly constructed questionnaire. The approach to attitude-scale construction in this work followed guidelines presented by DeVillis (1991) and Comrey (1988), which have been used successfully to develop other attitude measures (McGaghie et al 1993 and 1995). According to their suggestions, the following eight steps were performed.

1. **Determining what is to be measured.** The goal of this study was to assess attitudes among medical students towards the medical curriculum. The main construct was derived primarily from the context of medical profession as proposed by the previous president of Chulalongkorn University, Professor Charas Suwanwela in 1995 (Suwanwela 1995). To guarantee its content validity, all possible dimensions of attitude towards the curriculum were identified by the extensive literature review and discussion with experts in the field of medical education. However, the curriculum attempted to be measured confined only to the content and pattern of learning and did not include the objectives and evaluation component.

2. **Generating an item pool.** An initial of 30 items, addressing the purpose of the attitude scale was written. Each item was cast as a brief declarative statement about attitudes of student towards their curriculum. Item pool was generated in order to cover all areas of goals of medical education (Rolfe et al 1995, Suwanwela 1995, Rosenthal and Ogden 1998, The Medical School Objectives Writing Group 1999) and goals of PBL study in particular (Birgegard and Lindquist 1998).
3. **Determining the questionnaire format.** Likert-type format ranging from 1, strongly disagree, through 3, uncertain, to 5, strongly agree, was chosen. This format is easy to use and familiar to the responders. Using the more precise scale, e.g. zero-to-ten rating scale seemed to be inappropriate since attitude was unlikely to be able to be graded up to that precision.
4. **Having the initial pool reviewed by the experts.** The initial pool of 30 items was carefully evaluated by five experts in the field of medical education (see the validity testing section displayed below). The items were then edited for clarity according to experts' suggestions.
5. **Considering inclusion of validation terms.** Validation items are questions aimed at evaluating whether individuals are responding appropriately. Eight items were stated negatively and reverse scored to control for potential response bias.
6. **Administering the items to a development sample.** The 30 scale items were ordered randomly and administered to an initial (pretest) sample of 45 medical students. Students trained in both curricula were included in the pretest study. However, due to the time constraint, re-administration of the scale to determine its stability cannot be possible.
7. **Evaluating the items.** Responses from the pretest study were used for reliability estimation. Reliability were done to provide item means and standard deviations, item intercorrelations (including reverse-scored items), and coefficient alpha. These psychometric evaluations are needed to ensure that the item and scale data are technically sound, and can be used to reach trustworthy inferences about student attitudes.

8. **Optimizing scale length.** In addition to submitting the pretest data to reliability studies, the data should be also subjected to factor analysis using principle component analysis with varimax rotation. The process was performed to determine whether more than one factor or dimension existed among the items, which would allow formation of subscales.

3.7.2 MEASURING TOOL FOR THE SECONDARY OUTCOME VARIABLE: Tools for Measuring the Academic Achievement

In this study, the academic achievement is selected as one dependent variable as it can represent a final outcome of education. The scores from the comprehensive examination were used as an indicator for this outcome measure. To determine whether the score obtained from the annual comprehensive examination could be the indicator of academic achievement or performance, the correlation between the observed score and the students' cumulative grade point average (GPAX), another measure of knowledge measurement was performed.

It is apparently that the scores obtained from the two measurements can be compared directly, if and only if, the characteristics of the measuring tool must be identical or at lest equivalent. However, it was impossible that all questions contained in the examination scales of the two consecutive years can be totally similar. To guarantee their equivalence, three aspects of comprehensive examination scales of the two years were compared. Those to be compared variables are:

1. **Level of knowledge**. According to the education theory, three levels of knowledge can be measured, namely, recall, interpretation and problem solving. Each level can be measured separately depends on how the question is written. In the process of developing the scale for the comprehensive examination, all question-writers were asked to provide information regarding the level to which each question would attempt to measure. The obtained information then was further approved by the Ad Hoc Committee for Organizing the Comprehensive Examination. This Ad Hoc Committee is appointed by the Faculty and consists of member from every department. In case that, question-writers did not specify the level of knowledge measurement, those questions would be ranked by the Ad Hoc Committee. Such information obtained from two comprehensive examination scales was gathered and then was compared using Chi square test.
2. **Level of difficulty**. Difficulty of the two scales was compared based on their difficulty factor (DF). The DF is a measure of the difficulty of each items based on the judgement of the examiner who wrote that item. For multiple choice question (MCQ), this measure can be obtained by averaging the difficulty of all (in this case the number of choice in each questions was five.) choices which can be either 0, easy, 0.5, intermediate and 1, difficult. Therefore, the value of DF for each question will range from 0 to 1. Data regarding DF obtained from every item were averaged. The obtained data from the two scales were then compared using the Student's t-test for two independent samples.
3. **Combination of medical specialty**. The scales were also compared regarding their composition. Thirteen clinical departments participate in preparation of these scales. The details of such combination were displayed in the table. Chi square test would be employed, to determine whether statistically significant difference existed.

3.8 DATA COLLECTION

The measurements were performed once in each group. Normally, the annual comprehensive examination of the Chulalongkorn Medical School takes place during the first or second week of March. The examination comprises two days of examination using multiple choice questions and one day of the examination using OSCI. The questionnaire for measuring attitudes was administered on the first day of the annual comprehensive examination.

To measure the degree of academic achievement, the answer sheet from each student was rechecked using a new set of keys. The keys comprised three answer sheets for checking the correct answers in each level of knowledge measurement (recall, interpretation and problem solving). The total score obtained from comprehensive examination was used as an indicator of academic achievement. Information regarding characteristics of comprehensive examination scales, i.e. DF, composition, etc., were collected from the Academic Affairs of the Faculty.

3.9 DATA ANALYSES

The statistical analyses used in this study comprised two main parts. The first part contained statistical methods for questionnaire development. The other comprised the statistical tests for analyzing the obtained data. The details of statistical methods used in each part are described in the following section.

3.9.1 STATISTICAL METHODS FOR SCALE DEVELOPMENT

Various statistical methods were employed to test the characteristics of this newly developed questionnaire. The results of the tests were demonstrated as below.

Estimation of Validity

Validity concerns the extent to which an instrument measures what it is intended to measure. Content validity refers to the adequacy with which the universe of content is sampled by a test. To verify content validity of the proposed measuring tool, copies of Thai version of the newly developed questionnaire was sent to five content experts in the field of medical education. The content experts chosen for evaluating the content validity in this study were:

(1) The dean of Faculty of Medicine, Chulalongkorn University,
(2) The associate dean for the Academic Affair of Faculty of Medicine, Chulalongkorn University,
(3) The associate dean for the Academic Affair of Faculty of Medicine, Srinakarinwirot University,
(4) Head of the Medical Education Unit, Faculty of Medicine, Chulalongkorn University, and
(5) Expert in the field of medical education working at the Faculty of Medicine, Siriraj hospital.

All experts were asked to evaluate the relevance and the adequacy of this questionnaire to explore students' attitude. The scoring system is as followed:

+1 for relatively valid item
0 for not sure
-1 for relatively irrelevant item

The obtained scores from each item were calculated to demonstrate the validity of each item by using the formula below:

$$IC = \frac{\Sigma R}{N}$$

where IC = item correlation

R = total score of that item

N = number of experts

The results of this content validity testing are showed in table 3.1.

Table 3.1 Demonstrate the results of content validity testing of attitude questionnaire

Item number and stem		1	2	3	4	5	IC
1.	Critical thinking skill	1	0	1	0	1	0.6
2.	Problem identification	1	0	1	0	1	0.6
3.	Problem solving	0	1	1	1	1	0.8
4.	Decision making	1	1	1	-1	1	0.6
5.	Possesses integrating feature	1	1	1	1	1	1.0
6.	Content coverage	-1	1	1	1	1	0.6
7.	Passive learning	1	1	1	1	1	1.0
8.	Promote study in detail	1	1	1	1	1	1.0
9.	Emphasis on self study	1	1	1	1	1	1.0
10.	Promote study for examination	1	1	1	1	1	1.0
11.	Create knowledge gap	1	0	1	0	1	0.6
12.	Content overload	0	0	1	1	1	0.6
13.	Contain up-to-date content	0	1	1	0	1	0.6
14.	Stressful	1	1	1	1	1	1.0
15.	Create the feeling of insecurity	1	1	1	-1	1	0.6
16.	Time consuming	1	1	1	0	1	0.8
17.	Information searching skill	1	1	1	1	1	1.0
18.	Ability in using information technology	1	1	1	1	1	1.0
19.	Encourage the academic argument	0	1	1	1	1	0.8
20.	Contain irrelevant details	0	1	1	1	1	0.8
21.	Promotes the holistic approach	1	1	1	1	1	1.0
22.	Working with paramedic personnel	1	1	1	1	1	1.0
23.	Promotion of team working	1	0	1	1	1	0.8
24.	Promote communication skill	0	1	1	1	1	0.8
25.	Relationship with the third party	1	1	1	1	1	1.0
26.	Emphasis on ethical issues	1	1	1	1	1	1.0
27.	Self-studying after graduation	1	1	1	1	1	1.0
28.	Achieve the international standard	0	1	1	0	1	0.6
29.	Passing the international exam.	0	1	1	1	1	0.8
30.	Students' satisfaction	1	1	1	1	1	1.0

The results showed in the above table indicated the experts' acceptability of the questionnaire. No item was scored less than 0.6. Therefore, all 30 items were included in the questionnaire after minimal modification in wording as suggested by the experts.

In this study, besides content validity, no other types of validity will be explored. Since there is no standard criterion for measurement of attitude in this area, determination of the criterion-related validity cannot be possible. The construct validation seems relevant in this kind of instrument as it tends to measure an abstract concept. As this scale was constructed based in the theoretical context of PBL and goals of medical education and was subjected to expert evaluation, its construct validity was possibly acceptable. However, the process of construct validation present a considerable challenge as constructs are not real and cannot be directly observable.

Estimation of Reliability

The reliability can be defined as an estimate to which a test score is free from error, that is, to what extent observed scores vary from true scores. As it is not possible to know the true score, the true reliability of a test can never be calculated. Therefore, other parameters are used to define degree of test reliability. Such parameters include variance, reliability coefficient, test-retest reliability, rater reliability, internal consistency and so on. As this test will be delivered as self-administered questionnaire, therefore test for rater reliability is not necessary. To scale was tested for its reliability by calculating its internal consistency.

The most important kind of reliability testing in this setting is test for internal consistency. In this study, the data collected from pretest population will be analyzed and **Cronbach's coefficient alpha** will be computed using computer program SPSS version 9. The formula for calculation of Cronbach-alpha is as followed:

$$\text{alpha} = \frac{n}{n-1}\left[\frac{\Sigma S_i^2}{1-S_t^2}\right]$$

When n = number of items

S_i^2 = item variance = $\frac{\Sigma (x-\bar{x})^2}{n-1}$

S_t^2 = total variance = $\frac{n\Sigma x_t^2 - (\Sigma x_t)^2}{n(n-1)}$

To get this information, the 30-item questionnaire was tested in the pretest population. The pretest population comprised 45 students training in either conventional and PBL curriculum. The obtained results were evaluated firstly by inspection for the incomplete or incredible answer, e.g. pattern response, etc. Responses from five pretest subjects were excluded based on the incompleteness of data. The responses from 40 cases were then analyzed for the internal consistency using computer software SPSS version 9 (for windows). The calculation revealed the Cronbach's coefficient and the standardized item alpha to be 0.8956 and 0.8991, respectively. The obtained results indicated the good reliability (alpha exceeded 0.8) of the scale. The details of the reliability testing using Cronbach's alpha as an indicator are demonstrated in table 3.2.

Table 3.2 Showing the item-total statistics of the pretested questionnaire

Item number and stem		Scale mean if item deleted	Scale variance if item deleted	Corrected item-total correlation	Alpha if item deleted
1.	Critical thinking skill	87.7500	213.7308	.6284	.8893
2.	Problem identification	87.3250	215.1994	.6111	.8899
3.	Problem solving	87.5500	213.8949	.6764	.8889
4.	Decision making	87.4500	215.0231	.5748	.8903
5.	Possesses integrating feature	87.0250	223.4609	.2465	.8958
6.	Content coverage	88.0000	223.4359	.2307	.8962
7.	Passive v.s. active learning	87.1500	230.4897	-.0184	.9004
8.	Promote study in detail	87.8000	215.8564	.4200	.8930
9.	Emphasis on self study	87.4250	211.5840	.6062	.8892
10.	Promote study for examination	87.8500	219.2590	.2682	.8968
11.	Create knowledge gap	88.4250	217.0199	.3692	.8941
12.	Content overload	87.5750	219.2250	.3177	.8951
13.	Contain up-to-date content	87.3250	219.9173	.4320	.8928
14.	Stressful	88.2750	224.7686	.1616	.8978
15.	Create the feeling of insecurity	88.0500	219.1256	.2730	.8967
16.	Time consuming	88.1250	220.1635	.2800	.8959
17.	Information searching skill	87.2750	217.3840	.3854	.8936
18.	Ability in using information technology	87.4250	215.9429	.4218	.8929
19.	Encourage the academic argument	87.5750	211.5840	.6222	.8890
20.	Contain irrelevant details	87.7750	226.1788	.1422	.8975
21.	Promotes the holistic approach	87.3750	214.2917	.5698	.8902
22.	Working with paramedic personnel	87.8250	206.3532	.7048	.8867
23.	Promotion of team working	87.5000	206.4103	.7133	.8866
24.	Promote communication skill	87.4750	208.7686	.6964	.8873
25.	Relationship with the third party	88.0250	213.6660	.5690	.8901
26.	Emphasis on ethical issues	87.3250	217.7635	.4086	.8931
27.	Self-studying after graduation	87.2750	218.2558	.4594	.8922
28.	Achieve the international standard	87.6000	214.9641	.6010	.8899
29.	Passing the international exam.	88.2750	212.8712	.5324	.8906
30.	Students' satisfaction	87.7500	207.9359	.7220	.8868

Criteria for Judgement

After instrument pretesting, the results will be interpreted. The IC over 0.5 and alpha coefficient over 0.8 are rated as acceptable.

Determination of Subscale

After pretesting the questionnaire, the results obtained from pretest population was used to calculate the correlation among items. Presence of subscale was tested using factor analysis. This statistical method is a multivariable method intended to explain relationship among several correlated variables in term of a few conceptual meaningful relatively independent factors. The method generally proceeds in four steps, including (1) preparation of the correlation matrix; (2) determination of initial factors by principle-components analysis;(3) rotation of initial factors (varimax rotation was used in this study.); and (4) determination of the component scores.

The results of the factor analysis revealed eight components, which had Eigenvalue of more than one. The details are shown in table 4. However, since the number of pretest subjects was rather limited and low beyond the suggested number for factor analysis (It has been suggested that the number of respondents must exceed 10 cases per item.), therefore the results obtained from the pretest population were unlikely to be credible. Thus, the information used for final analysis was based on the factor analysis performed in the study population.

CONCLUSION FOR RESULTS OF SCALE ANALYSIS

Based on these pretest results, the developed scale can be judged as an acceptable tool. Its content validity was acceptable according to the experts' opinion. Its reliability was good since its alpha was substantially high. Therefore, this 30 item-scale was used as a measuring tool for measuring student attitudes in this study.

Table 3.3 Showing the factor analysis results of the attitude questionnaire obtained from the pretest population

No.	Item content	Component							
		1	2	3	4	5	6	7	8
2.	Problem identification	.848							
1.	Critical thinking skill	.799							
4.	Decision making	.720							
3.	Problem solving	.715							
9.	Emphasis on self study	.595							
30.	Students' satisfaction	.551							
28.	Achieve the international standard		.801						
13.	Contain up-to-date content		.749						
6.	Content coverage		.691						
19.	Encourage the academic argument		.572						
24.	Promote communication skill		.570						
23.	Promotion of team working		.528						
17.	Information searching skill			.845					
18.	Ability in using information technology			.817					
25.	Relationship with the third party			.592					
27.	Self-studying after graduation			.527					
14.	Stressful				.821				
16.	Time consuming				.815				
29.	Passing the international exam.				.734				
11.	Create knowledge gap				.498				
21.	Promotes the holistic approach					.686			
5.	Possesses integrating feature					.658			
8.	Promote study in detail					.656			
20.	Contain irrelevant details						.874		
12.	Content overload						.564		
22.	Working with paramedic personnel						.468		
7.	Passive v.s. active learning							-.890	
15.	Create the feeling of insecurity							.563	
26.	Emphasis on ethical issues								.761
10.	Promote study for examination								.508

3.9.2 DETERMINATION OF CORRELATION BETWEEN COMPREHENSIVE EXAMINATION SCORE AND GPAX

As stated above, the correlation between observed score from the annual comprehensive examination and the cumulative grade point average of each student would be determined. To assess whether these two variables are associated, the product-moment correlation coefficient (or Pearson coefficient) was calculated. The hypothesis testing for significance of the null hypothesis of no association would also be performed based on the *t* distribution. The correlation between these two variables would be displayed by scatter diagram of the data. Different categories of sample (i.e. curriculum, etc) will be indicated by different symbols. The value of *r* (ranging between -1 and +1) was given to two decimal places, together with the P value. The $100r^2$ would be calculated to show the percentage of the variability of the data that can be explained by the association between the two variables.

3.9.3 STATISTICS FOR COMPARING VARIABLES BETWEEN PBL AND CONVENTIONAL CURRICULA

The results of attitude and academic achievement measurements from two consecutive academic years (1998 and 1999) were then summarized and compared using the following statistical methods.

Data Summary

The base line data including age, sex and grade point average from the two groups were displayed for comparison. Since medical students in other particular tracks have already been excluded from the study, the above baseline variables would be likely to be quite similar. In case of questionable difference of any baseline variables between two groups, statistical methods will be employed to determine whether such difference reach statistically significant level. The statistical methods include Student t-test for independent samples for continuous variables and χ^2 test for categorical variables.

Concerning the primary and secondary outcomes of interest, scores in from each test was analyzed using descriptive statistics. As previously mentioned, the score from both attitude and academic achievement tests would be considered as interval or continuous data. Therefore the measure of central tendency was calculated as arithmetic mean and variation was shown as standard deviation and 95% confidence interval.

Statistical Tests For Comparing Results Obtained From Two Groups

The null hypothesis for the primary question in this study was "There is no significant difference in students' attitude towards their curriculum between PBL and conventional curriculum". To determine whether there is significant difference in outcome of interest between two independent groups, the appropriate method of hypothesis testing is **two sample t test**. In this study, the test was performed in two-tail manner with type I error of 5%.

The value of *t* is calculated as

$$t = \frac{\text{mean}_{\text{CONVENTIONAL}} - \text{mean}_{\text{PBL}}}{\text{standard error of the difference in the mean}}$$

The obtained *t* value will be compared with the *t* distribution with $n_1 + n_2 - 2$ degree of freedom. The degree of freedom in this study will be 150+150-2 = 288. In this study, this statistical test will be performed using computer software, SPSS for windows version 9.0. The magnitude of difference as well as effect size were calculated and expressed as mean and 95% confidence interval.

The two sample test described above was designed for variables with normal distribution. In this study the sample size in each group would be quite large, therefore, based on the central limit theorem, it would be very likely that the variables normally distributed. This assumption of Normality can be assessed by performing **normal (P-P) plot** and see whether or not it is straight line. However, Normality can be tested more precisely by performing some statistical test such as **Shapiro-Wilk W test**. In case that the assumption of Normality could not be hold, the **Mann-Whitney test,** a non-parametric

alternative to the *t* test for comparing data from two independent groups, will be employed.

The same method was also applied to determine whether or not there was significant difference in academic performance between the two groups of medical students. The data obtained from each level of knowledge measurement, namely recall, interpretation and problem solving was analyzed separately.

Statistical Tests for Determination of the Correlation Between Attitude and Academic Achievement

One of the secondary questions in this study is whether or not there is correlation between attitude and academic achievement. To assess whether these two variables are associated, the **product-moment correlation coefficient (or Pearson coefficient)** was calculated including its confidence interval. The hypothesis testing for significance of the null hypothesis of no association would also be performed based on the *t* distribution. The correlation between these two variables would be displayed by scatter diagram of the data. Different categories of sample (i.e. sex, etc) will be indicated by different symbols. The value of *r* (ranging between -1 and +1) was given to two decimal places, together with the P value. The $100r^2$ would be calculated to show the percentage of the variability of the data that can be explained by the association between the two variables.

In this study, if the above statistical test reveals significant correlation between the two variables, further step of analysis will be performed. This includes the statistical method known as regression analysis. The purpose of performing regression analysis is to enable the value of one variable to be predicted from any known value of the other variable. It also describes the relationship between the outcome variables. In this study, the standard method of regression known as **least square regression** will be employed. In simple form or simple regression, the regression line can be explained by the following equation.

$$Y = \alpha + \beta X$$

Where Y = Response or dependent variable

X = Predictor or independent variable

α = Intercept

β = Slope

The data from two groups of students will be tested separately by fitting the two separate regression equations.

$Y_{PBL} = \alpha_{PBL} + \beta_{PBL} X$ For PBL students

$Y_{CON} = \alpha_{CON} + \beta_{CON} X$ For conventional students

The slope of regression line obtained each group (β_{PBL} and β_{CON}) will be compared using two sample *t* tests. Null hypothesis of this test of parallelism will be

$$\beta_{PBL} = \beta_{CON}$$

Results will demonstrated as scatter plot, regression line and its 95% confidence interval for the regression line.

Another method to determine whether difference in curriculum used has any effects of academic achievement is to cooperate the factor "curriculum" into the regression equation. The method for prediction of outcome variable based on several predictors is called **multiple regression**. Unlike attitude score, data concerning curriculum is categorical type. The number 0 and 1 will be used to represent conventional and PBL curriculum in the regression equation. The final regression equation will be as followed.

$$Y = \alpha + \beta_{att} X_{att} + \beta_{curri} X_{curri} + \beta_{interaction} X_{att} X_{curri}$$

Where X_{att} = Predictor I (in this case: attitude score)

X_{curri} = Predictor II (in this case: curriculum type)

$X_{att}X_{curri}$ = Interaction term

The obtained slope or β_{curr} value will be tested against the null hypothesis (β = 0). This hypothesis testing is performed by calculating $\beta/se(\beta)$ and compared with the *t* distribution with*n* - 2 degrees of freedom.

CHAPTER 4

RESULTS

4.1 DEMOGRAPHIC DATA OF THE SUBJECTS

The numbers of students fulfilling the eligibility criteria and were recruited in the study were 135 for the conventional batch and 138 for the PBL batch. The filled-up questionnaires were primarily inspected and those in which contained incomplete data or inappropriate responses were excluded. The number of cases excluded from the analyses were 13 for the conventional batch and 13 for the PBL batch. The details of total cases recruited, excluded cases and cases included in the analysis were demonstrated in table 4.1.

Table 4.1 Number of cases reached eligibility criteria and cases excluded from analysis

	Conventional batch	PBL batch
Total cases recruited	135	138
Total cases excluded	14	13
- Incomplete data	12	7
- Non-responders	0	2
- Pattern responders	2	4
Total cases included in the analyses	121	125

After exclusion, the numbers of cases included in the analysis were 121 and 125 for the conventional and PBL groups, respectively. The details of demographic data were showed in table4.2.

Table 4.2 Demographic data of conventional and PBL students. The data were expressed as mean (SD).

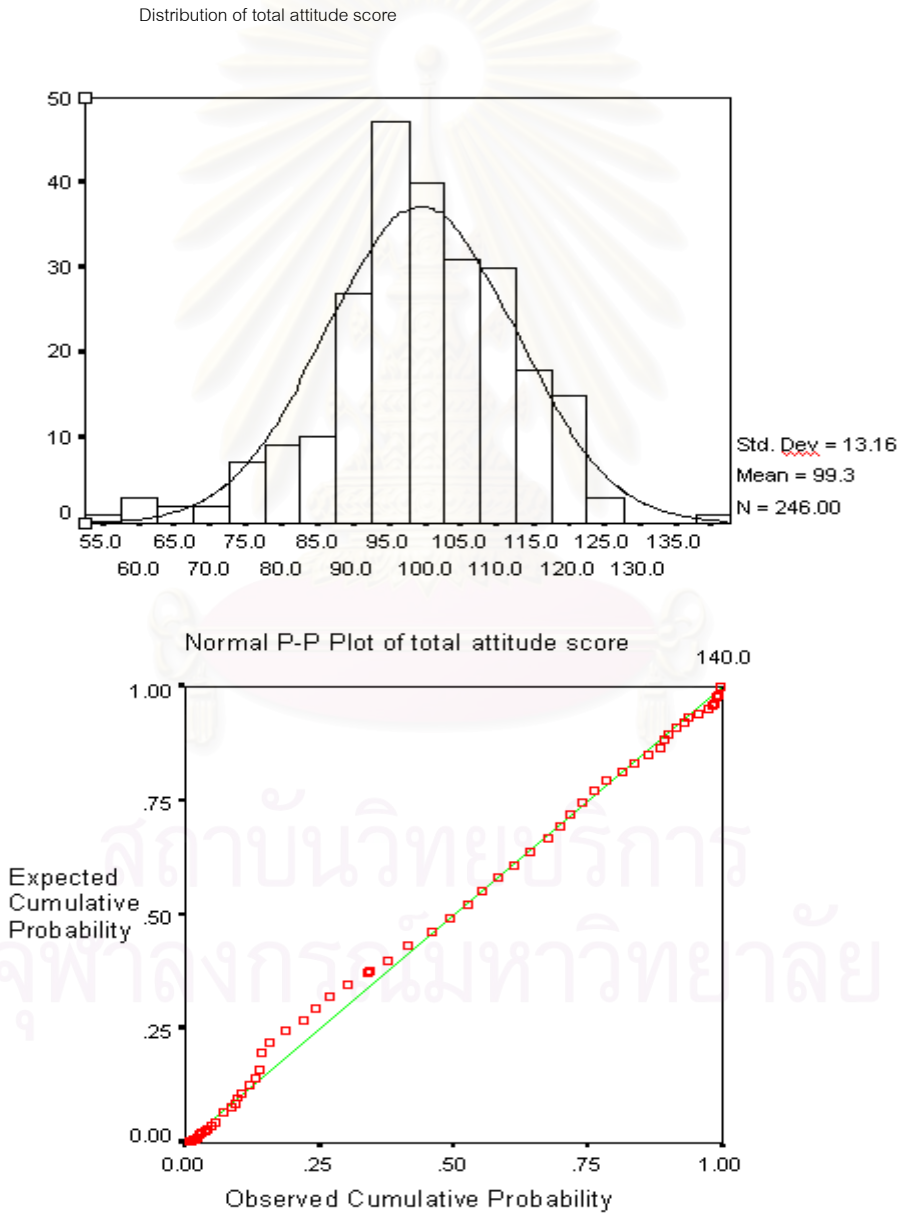
Variable	Conventional batch	PBL batch
Gender (male : female)	66 : 55	71 : 54
Age	22.76 (1.16)	22.77 (1.09)
Cumulative Grade Point Average (GPAX)	3.21 (0.33)	3.27 (0.29)
Total	121	125

4.2 COMPARING THE ATTITUDE SCALE BETWEEN TWO CURRICULA

4.2.1 COMPARING TOTAL ATTITUDE SCORE

The summed score of the attitude scale observed in these two groups are 103.5 (12.7) and 95.1 (12.3), for conventional and PBL curriculum, respectively. The data regarding the attitude scores of the two groups were tested for the normality using histogram and P-P plots. The result of the plot showed acceptable normality.

Figure 4.1 Distribution of total attitude score (upper) and P-P plot (lower).

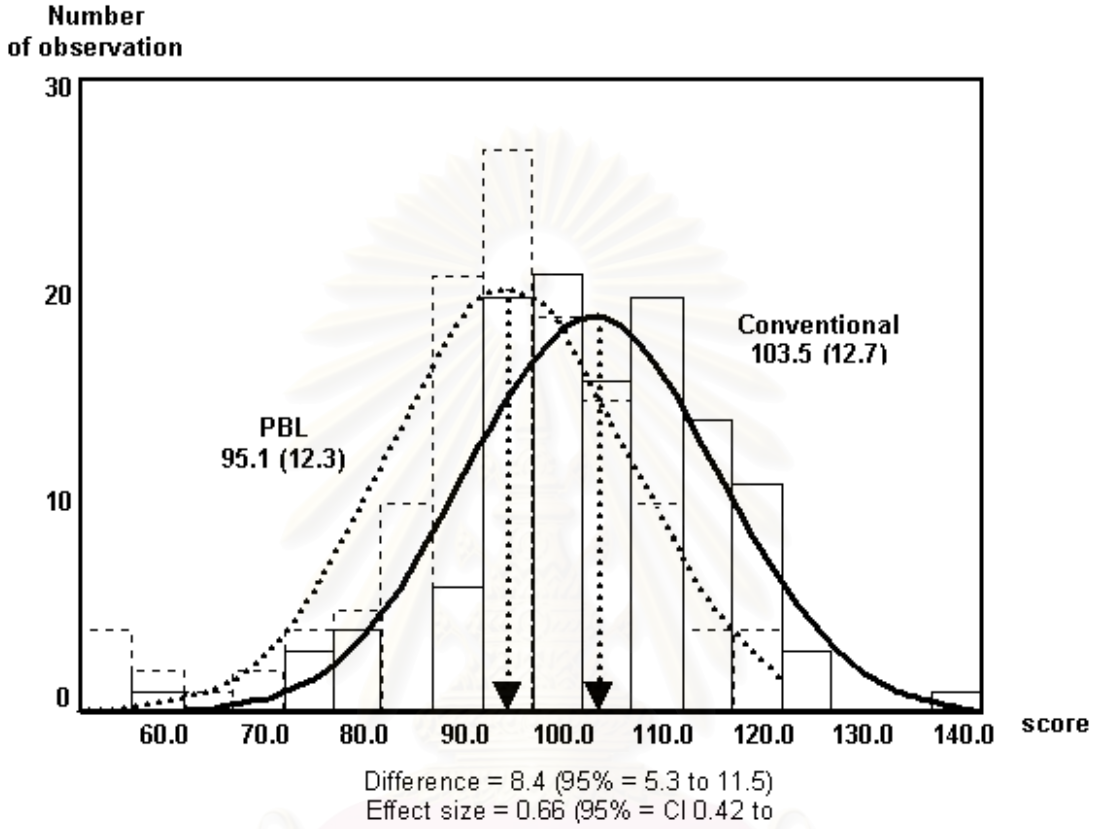


Since the assumption of normality if sample distribution could be hold, the parametric statistical method was used for further analysis. The mean (standard deviation) of the attitude scale obtained from conventional and PBL students were 103.52 (12.70) and 95.12 (12.29), respectively. The responses from each academic year were then compared using Student's t-test for independent variable. The resulted showed the difference in attitude scale between two groups to be significant ($t = 5.27$, $p < 0.001$). The magnitude of difference is 8.4 points (95%CI 5.3 to 11.5) in favor of conventional curriculum. The calculated effect size was 0.66 (95%CI 0.42 to 0.91)

Table 4.3 Comparison of attitude score between conventional and PBL students.

Curriculum	N	Mean	Std. Deviation	Magnitude of difference	Effect size (95% CI)	P value
Conventional	121	103.52	12.70	8.4	0.66	<0.001
PBL	125	95.12	12.29	(5.3 to 11.5)	(0.42 to 0.91)	

Figure 4.2 Distribution of total attitude score in PBL and conventional batches. The diagram demonstrated the size of the difference by superimposing the distribution histograms of the PBL group (dashed line) and the conventional group (solid line) with their normal curves. The number below the legend of each group indicated the mean (S.D.) of each group.



4.2.2 COMPARING THE SCORE FOR INDIVIDUAL ITEM

Besides comparing the total score, the score from each single item was also compared. Although the response in Likert's scale was actually ordinal in nature, statistical calculation as if it was interval was widely accepted. Therefore, the data from each item was compared using t- statistics. However, non-parametric method using Chi-square was also employed form comparison. The statistical comparison using both methods revealed four items of which their differences reached statistically significant level in favor of PBL curriculum, nineteen items which were statistically significant different in favor of conventional curriculum and seven items of which their differences could not be proved to be statistically significant. The details were as followings.

Items with statistically significant difference in favor of PBL curriculum. Items that were confined in this category were:

Item 7: passive v.s. active learning

Item 17: enabling information-searching skill

Item 18: promoting the ability to use information technology

Item20: relevancy of content

It can be seen that students felt that PBL curriculum enabling them to have information searching skill including the ability to use the information technology. They also realized that the teaching in the PBL curriculum was less passive than those performed in the conventional track. Moreover, the students' attitude reflected that the content of their curriculum was rather relevant.

Items with statistically significant difference in favor of conventional curriculum. Out of thirty items, nineteen items were found to possess statistically significant difference in favor of the conventional curriculum. This group included:

Item 1: critical thinking,

Item 2: problem identification

Item 3: problem solving

Item 4: decision making

Item 6: content coverage

Item 8: promote study in details

Item 11: create knowledge gap

Item 13: contain up-to-date content

Item 14: stressful

Item 15: create the feeling of insecurity

Item 16: time consuming

Item 22: working with paramedic personnel

Item 23: promotion of team working

Item 24: promote communication skill

Item 26: emphasis on ethical issue

Item 27: Self-studying after graduation

Item 28: Achieve the international standard

Item 29: Ability to pass the international examination

Item 30: Students' satisfaction

Items of which their differences were not statistically significant. This category included:

Item 5: Possesses integrating feature

Item 9: Emphasis on self study

Item 10: Promote study for examination

Item 12: Content overload

Item 19: Encourage the academic argument

Item 21: Promotes the holistic approach

Item 25: Relationship with the third party

Table 4.4 Comparing students' attitude towards curriculum in each item. Data were expressed as mean (S.D.)

Item number and stem		Conventional	PBL	t-statistics	p-value
1.	Critical thinking skill	3.78 (.74)	3.32 (.68)	5.063	<.001
2.	Problem identification	3.62 (.78)	3.32 (.71)	3.242	.001
3.	Problem solving	3.80 (.74)	3.28 (.75)	5.511	<.001
4.	Decision making	3.87 (.82)	3.27 (.80)	5.851	<.001
5.	Possesses integrating feature	3.52 (.91)	3.43 (.95)	0.744	.457
6.	Content coverage	3.79 (.86)	3.00 (.91)	6.964	<.001
7.	Passive v.s. active learning	2.47 (.93)	3.28 (.83)	-7.200	<.001
8.	Promote study in detail	3.55 (1.02)	3.25 (.86)	2.483	.014
9.	Emphasis on self study	3.45 (.94)	3.43 (.83)	2.000	.842
10.	Promote study for examination	3.07 (1.13)	3.15 (1.00)	-0.570	.569
11.	Create knowledge gap	2.63 (.95)	2.28 (.95)	2.948	.004
12.	Content overload	3.33 (1.17)	3.16 (.92)	1.333	.184
13.	Contain up-to-date content	3.90 (.81)	3.43 (.84)	4.464	<.001
14.	Stressful	2.85 (.96)	2.55 (.95)	2.448	.015
15.	Create the feeling of insecurity	3.37 (.90)	2.77 (.89)	5.240	<.001
16.	Time consuming	3.22 (.91)	2.51 (.93)	6.066	<.001
17.	Information searching skill	3.23 (.86)	3.55 (.90)	-2.846	.005
18.	Ability in using information technology	3.19 (.94)	3.44 (.94)	-2.095	.035
19.	Encourage the academic argument	3.48 (.92)	3.32 (.85)	1.412	.160
20.	Relevancy of contents	2.45 (.93)	2.79 (.73)	-3.165	.002
21.	Promotes the holistic approach	3.64 (.71)	3.56 (.82)	0.862	.389
22.	Working with paramedic personnel	3.60 (.86)	3.22 (.91)	3.347	.001
23.	Promotion of team working	3.76 (.87)	3.43 (.89)	2.927	.004
24.	Promote communication skill	3.95 (.71)	3.40 (.86)	5.474	<.001
25.	Relationship with the third party	3.12 (.87)	3.06 (.91)	0.529	.597
26.	Emphasis on ethical issues	3.71 (1.00)	3.36 (1.00)	2.752	.006
27.	Self-studying after graduation	3.82 (.85)	3.55 (.82)	2.576	.011
28.	Achieve the international standard	3.83 (.86)	3.01 (.87)	7.420	<.001
29.	Ability to pass the international exam.	3.50 (.85)	2.86 (.95)	5.559	<.001
30.	Students' satisfaction	3.92 (.89)	3.07 (.88)	7.572	<.001

Note: Negative sign indicated the favorable attitude towards PBL curriculum.

4.2.3 SCALE ANALYSIS: RELIABILITY TESTING

The developed scale for measuring student's attitude towards their curriculum was tested for reliability by estimating its internal consistency. In this study, the internal consistency of the scale was determined using the Cornbach's method. To do this, the data obtained from two groups (conventional and PBL curricula) were pooled and analyzed. The total number of data was 246.

The results show the internal consistency of this scale to be high. The overall Cronbach's alpha was 0.8849 and the standardized item alpha was 0.8913 (see details in table 4.5). There were three items (item number 7, 11, and 20) that show negative correlation with the overall scale. However, despite the negative correlation, those three items were still included in the analysis since they did not much compromise the alpha of the overall scale. The mean and standard deviation of each item was shown in table 4.6.

Table 4.5 Reliability analysis of the questionnaire (Cronbach's alpha). N = 246

Statistics for Scale	Mean	Minimum	Maximum	Range	Max/Min	Variance
Statistics for Scale (variables = 30)	99.2520					173.1444
Item Means	3.3084	2.4553	3.6870	1.2317	1.5017	.1056
Item Variances	.8344	.5511	1.1380	5870	2.0652	.0217

Table 4.6 Mean and standard deviation of each item in attitude scale. Data was pooled from conventional and PBL students.

Item number and Content		Mean	S.D.
1.	Critical thinking skill	3.5447	.7423
2.	Problem identification	3.4715	.7594
3.	Problem solving	3.5366	.7855
4.	Decision making	3.5691	.8627
5.	Possesses integrating feature	3.4756	.9332
6.	Content coverage	3.3943	.9663
7.	Passive v.s. active learning	2.8821	.9680
8.	Promote study in detail	3.4024	.9501
9.	Emphasis on self study	3.4431	.8823
10.	Promote study for examination	3.1138	1.0668
11.	Create knowledge gap	2.4553	.9626
12.	Content overload	3.2480	1.0534
13.	Contain up-to-date content	3.6626	.8547
14.	Stressful	2.6992	.9684
15.	Create the feeling of insecurity	3.0691	.9386
16.	Time consuming	2.8618	.9842
17.	Information searching skill	3.3943	.8961
18.	Ability in using information technology	3.3171	.9417
19.	Encourage the academic argument	3.4065	.8884
20.	Relevancy of contents	2.6260	.8514
21.	Promotes the holistic approach	3.6016	.7692
22.	Working with paramedic personnel	3.4106	.9070
23.	Promotion of team working	3.5935	.8929
24.	Promote communication skill	3.6707	.8338
25.	Relationship with the third party	3.0935	.8872
26.	Emphasis on ethical issues	3.5325	1.0127
27.	Self-studying after graduation	3.6870	.8449
28.	Achieve the international standard	3.4187	.9559
29.	Ability to pass the international exam.	3.1789	.9565
30.	Students' satisfaction	3.4919	.9804

Table 4.7 Item-total Statistics of attitude scale. Analysis was performed in the pooled data from conventional and PBL students.

Item number and stem		Scale mean if item deleted	Scale variance if item deleted	Corrected item-total correlation	Squared multiple correlation	Alpha if item deleted
1.	Critical thinking skill	95.7073	159.0813	.7216	.7165	.8763
2.	Problem identification	95.7805	160.2128	.6426	.6259	.8776
3.	Problem solving	95.7154	159.7881	.6415	.7213	.8775
4.	Decision making	95.6829	158.6582	.6323	.6829	.8772
5.	Possesses integrating feature	95.7764	160.3784	.5033	.4826	.8797
6.	Content coverage	95.8577	159.1348	.5364	.5044	.8789
7.	Passive v.s. active learning	96.3699	177.4993	-.2052	.2962	.8951
8.	Promote study in detail	95.8496	160.6181	.4827	.4687	.8801
9.	Emphasis on self study	95.8089	161.3062	.4935	.5551	.8800
10.	Promote study for examination	96.1382	165.6053	.2331	.3023	.8863
11.	Create knowledge gap	96.7967	173.3218	-.0436	.4195	.8917
12.	Content overload	96.0041	168.6245	.1246	.1722	.8888
13.	Contain up-to-date content	95.5894	161.0430	.5241	.4621	.8794
14.	Stressful	96.5528	169.7503	.0973	.4140	.8887
15.	Create the feeling of insecurity	96.1829	164.0195	.3429	.4360	.8832
16.	Time consuming	96.3902	164.2226	.3153	.4746	.8840
17.	Information searching skill	95.8577	164.0082	.3630	.5098	.8827
18.	Ability in using information technology	95.9350	164.6978	.3128	.4846	.8839
19.	Encourage the academic argument	95.8455	158.8495	.6031	.5063	.8777
20.	Relevancy of contents	96.6260	175.0759	-.1179	.3088	.8919
21.	Promotes the holistic approach	95.6504	161.1916	.5817	.4694	.8787
22.	Working with paramedic personnel	95.8415	160.7870	.5015	.6051	.8798
23.	Promotion of team working	95.6585	159.1237	.5870	.6524	.8780
24.	Promote communication skill	95.5813	159.0444	.6374	.6023	.8772
25.	Relationship with the third party	96.1585	163.4156	.3942	.3997	.8821
26.	Emphasis on ethical issues	95.7195	156.2679	.6261	.5848	.8766
27.	Self-studying after graduation	95.5650	157.9202	.6833	.6407	.8762
28.	Achieve the international standard	95.8333	155.6415	.6955	.7099	.8752
29.	Ability to passing the international exam.	96.0732	159.0395	.5468	.5633	.8787
30.	Students' satisfaction	95.7602	154.7463	.7149	.7128	.8746

4.2.4 SCALE ANALYSIS: DETERMINATION OF SUBSCALE

The presence of subscale was tested using factor analysis. The data were extracted to determine the presence of subscale using principle component method. After obtaining the primary extraction, the rotation was performed using varimax rotation. The results showed the presence of 6 factors, which had eigenvalue more than 1. These six factors could explain 61.5% of total variance. The variance explained by each factor was displayed in the Scree plot. Such factors or subscales were summarized as the followings.

Factor 1. Academic domain of the curriculum
(Eigenvalue 9.564, variance explained 31.88%)

This factor contained 10 items including Items 3 (problem solving), 1 (critical thinking), 4 (decision-making), 28 (achieve the international standard), 2 (problem identification), 30 (students' satisfaction), 6 (content coverage), 13 (up-to-date content), 29 (ability to passing the international examination), and 5 (possess integrating features). The items were listed in the order of its correlation with factor.

Factor 2. Skill and desirable attitude towards self-directed learning
(Eigenvalue 3.276, variance explained 10.92%)

This factor contained 6 items, including items 18 (ability in using information technology), 17 (information searching skill), 9 (emphasis on self-studying), 19 (encourage the academic discussion), 8 (promote study in details), and 27 (self-study after graduation).

Factor 3. Communication skill
(Eigenvalue 1.913, variance explained 6.38%)

Six items were confined in this factor. Those items were items 26 (emphasis on ethical issue), 22 (working with paramedic personnel), 23 (promotion of team working), 25 (relationship with the third party), 24 (promote communication skill), and 21 (promote the holistic approach).

Factor 4. Emotional response towards the curriculum
(Eigenvalue 1.533, variance explained 5.11%)

This factor contained 4 items, including items 14 (feeling of stressful), 16 (time consuming and inability in time management), 11 (create knowledge gap), and 15 (create feeling of insecurity).

Factor 5. Content loading and its irrelevancy
(Eigenvalue 1.149, variance explained 3.38%)

Two items were confined within this factor, including items 20 (relevancy of content) and 12 (content loading).

Factor 6. Learning technique and examination
(Eigenvalue 1.018, variance explained 3.39%)

This factor comprised two items, including items 10 (promote study for examination) and 7 (passive v.s. active learning).

Figure 4.3 Scree plot demonstrating the factors and their variance explained.

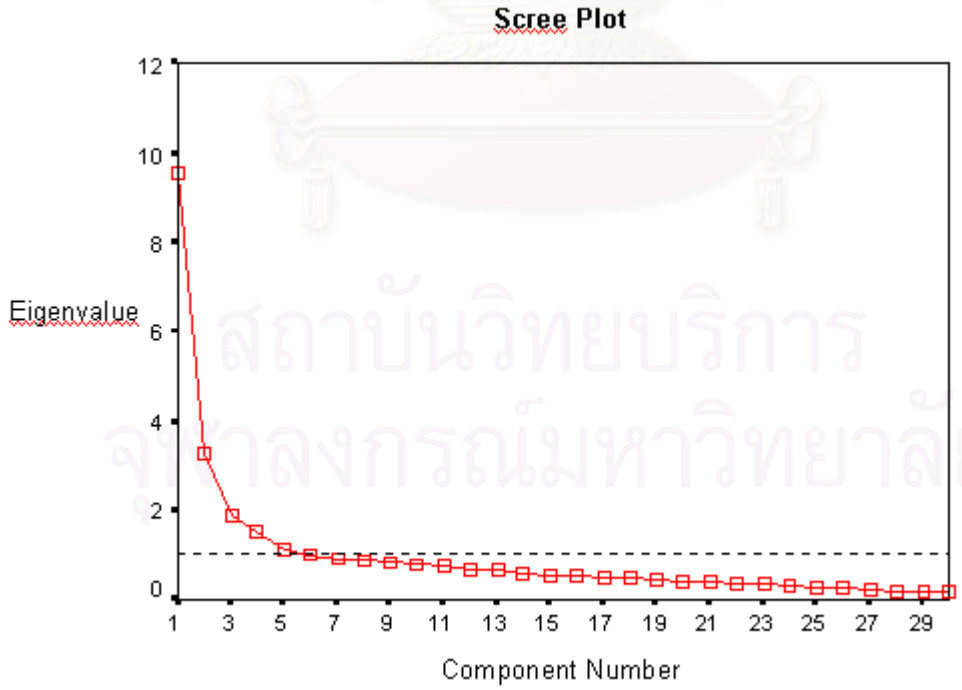


Table 4.8 Factor analysis: The Rotated Component Matrix

Item No.	Content	1	2	3	4	5	6
3.	Problem solving	.854					
1.	Critical thinking skill	.811					
4.	Decision making	.808					
28.	Achieve the international standard	.726					
2.	Problem identification	.718					
30.	Students' satisfaction	.707					
6.	Content coverage	.642					
13.	Up-to-date content	.590					
27.	Self-studying after graduation	.555	.519				
29.	Ability to pass the international exam.	.535			.375		
5.	Possesses integrating feature	.470					
26.	Emphasis on ethical issues	.438	.351	.418			
18.	Ability in using information technology		.764				
17.	Information searching skill		.726				
9.	Emphasis on self study		.696				
19.	Encourage the academic argument		.526				
8.	Promote study in detail	.466	.479				
22.	Working with paramedic personnel			.814			
23.	Promotion of team working			.730			
25.	Relationship with the third party			.694			
24.	Promote communication skill	.443		.620			
21.	Promotes the holistic approach	.390	.372	.398			
14.	Stressful				.786		
16.	Time consuming				.715		
11.	Create knowledge gap				.621		
15.	Create the feeling of insecurity	.401			.548		
20.	Relevancy of contents					.680	
12.	Content overload				.408	.494	
10.	Promote study for examination						.741
7.	Passive v.s. active learning						.602

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.

a Rotation converged in 11 iterations.

4.2.5 COMPARING THE SCORE FOR EACH FACTOR

The results of the attitude scale were further analyzed to determine the difference in attitude for each factor. The score obtained from each item were summed together according to the factor identified by factor analysis. The summed score of each factor was then normalized by dividing the summed score with the number of items confined within each factor. The obtained resulted from each curriculum was compared using Student's t-test for independent samples. The statistical comparison showed significant difference in four out of six factors. The factors showed to demonstrate statistically significant difference are factors 1, 3, 4 and 6. The others (factors 2 and 5) showed no statistically significant difference.

The factors that pro the Conventional Curriculum. The students expressed the more favorable attitude towards conventional curriculum in three factors. Such factors include factor 1 (academic domain), factor 3 (communication skill) and factor 4 (emotional response). The magnitude of difference is greatest in the score obtained from factor 1 (magnitude of difference = 0.55, 95%CI 0.40 to 0.70), whereas factor 3 showed modest difference (magnitude of difference = 0.29, 95%CI 0.13 to 0.45).

The factors that pro the PBL Curriculum. The favorable attitude towards PBL curriculum was observed in one factor, namely factor 6 (examination). The students felt that PBL curriculum emphasize less on the study for the examination.

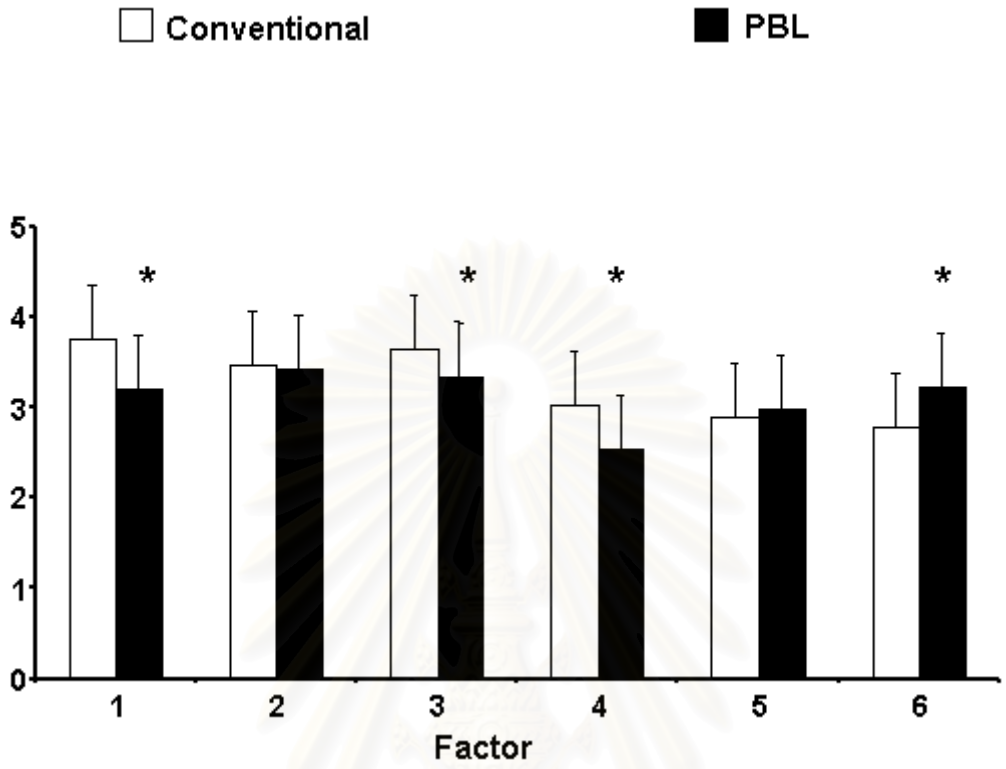
The Factors of which the difference did not reached the statistically significant level. No statistically significant difference was observed when attitudes towards curricula in two factors were compared. Such factors included factor 2 (skill and attitude towards self-directed learning) and factor 5 (content loading and its relevancy).

Table 4.9 Comparison of attitude scale for each factor between PBL and conventional groups

	Curriculum	Mean	S.D.	t-statistics	Magnitude of difference	Effect size	p-value
FACTOR1	Convent	3.75	.61	7.352	.55	0.90	<.001
	PBL	3.20	.58		.41 to .70	0.67 to 1.15	
FACTOR2	Convent	3.46	.66	.368	.03	0.05	.713
	PBL	3.43	.64		–1.3 to .19	–1.97 to 0.30	
FACTOR3	Convent	3.63	.62	3.569	.29	0.47	<.001
	PBL	3.34	.67		.13 to .45	0.21 to 0.73	
FACTOR4	Convent	3.02	.63	5.672	.49	0.78	<.001
	PBL	2.53	.72		.32 to .66	0.51 to 1.05	
FACTOR5	Convent	2.90	.83	-.842	-.08	0.10	.401
	PBL	2.98	.63		-.26 to .11	–0.31 to 0.13	
FACTOR6	Convent	2.77	.79	-4.759	-.44	-0.56	<.001
	PBL	3.22	.67		-.63 to -.26	–0.79 to –0.33	

Note: Negative sign indicated the favorable attitude towards PBL curriculum

Figure 4.4 Comparing the students' attitude in each factor. The * indicated significant difference of the P value less than 0.001.



4.3 COMPARING ACADEMIC ACHIEVEMENT BETWEEN PBL AND CONVENTIONAL STUDENTS

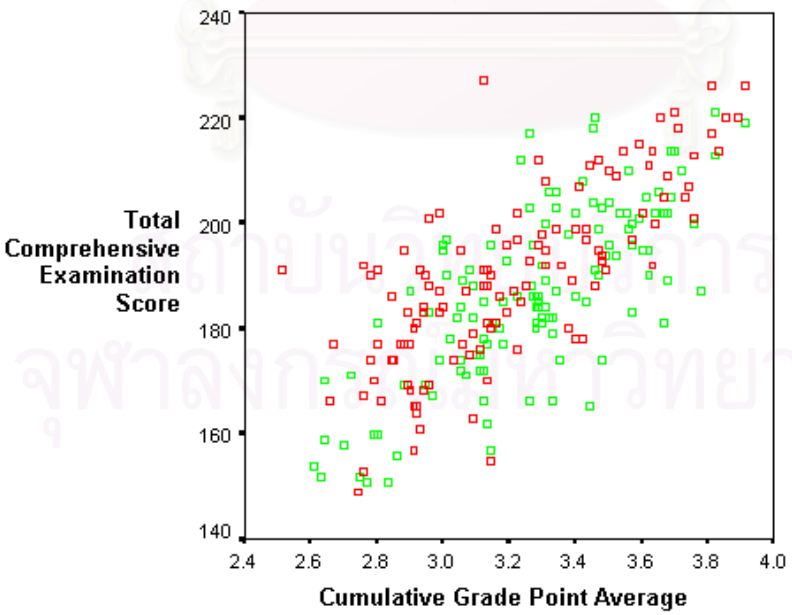
4.3.1 ANALYSIS OF MEASURING TOOL FOR THE SECONDARY OUTCOME VARIABLE:

Correlation between Comprehensive Examination Score and GPAX

To determine whether the score obtained from the annual comprehensive examination could be the indicator of academic achievement or performance, the correlation between the observed score and the students' cumulative grade point average (GPAX), another measure of knowledge measurement was performed.

The result showed that two variables correlated significantly ($p < 0.001$). The Pearson correlation coefficient (r) between the two variables was 0.726. The calculated $100r^2$ was 52.5. The distribution of all variables was displayed in the scatter plot (figure 4.3). The correlation between the two measures of knowledge measurement indicated the appropriateness to use the score obtained from the annual comprehensive examination as an indicator for the academic achievement.

Figure 4.5 Scatter plot between the GPAX and comprehensive examination score ($r = 0.726$, $p < 0.001$).



Evidence of Similarity of the Comprehensive examination scales Implemented in the academic year 1999 and 2000

Three important features of comprehensive examination scale were compared to investigate the possible comparability obtained from the results. Such variables to be compared include:

1. **Level of knowledge.** The details of the composition of the three levels of knowledge measurement observed in each comprehensive examination scales were displayed in the following table. Such data were subjected to the statistical analysis using X^2 method. The observed Chi square value was 2.014 (*df* = 2) and the calculated p-value was 0.319. Based on the results of this analysis, no statistically significant difference can be observed regarding the level of knowledge measurement.

Table 4.10 The comparison between scale used in the academic year 1998 (conventional curriculum) and 1999 (PBL curriculum) based on the level of knowledge measurement.

Level of Measurement	Academic Year (Type of Curriculum)	
	1998 (conventional)	1999 (PBL)
Recall	77	67
Interpretation	74	68
Problem Solving	149	165
Total	300	300

2. **Level of difficulty.** The results showed the mean (S.D.) of the DF values to be 0.51 (0.17) and 0.50 (0.09) for the comprehensive examination scales used in the academic year 1998 and 1999, respectively. Means of the DF values obtained from the two scales were then compared using Student t-test for independent sample. The statistical comparison revealed no significant difference (t = 1.168 and p = 0.243).

3. **Combination of medical specialty.** The details of composition of questions regarding the medical specialty confined in each comprehensive examination scales were displayed in the table. To determine whether statistical significantly difference exists in regard to the medical composition, Chi square test was applied. The results revealed the Chi square value to be 5.429 and p value to be 0.942 (*df* = 12).

The above comparisons demonstrated the comparability of two scales. Therefore, in the following analyses, results from the two scales would be compared directly.

4.3.2 COMPARING THE COMPREHENSIVE EXAMINATION SCORE BETWEEN THE PBL AND CONVENTIONAL STUDENTS

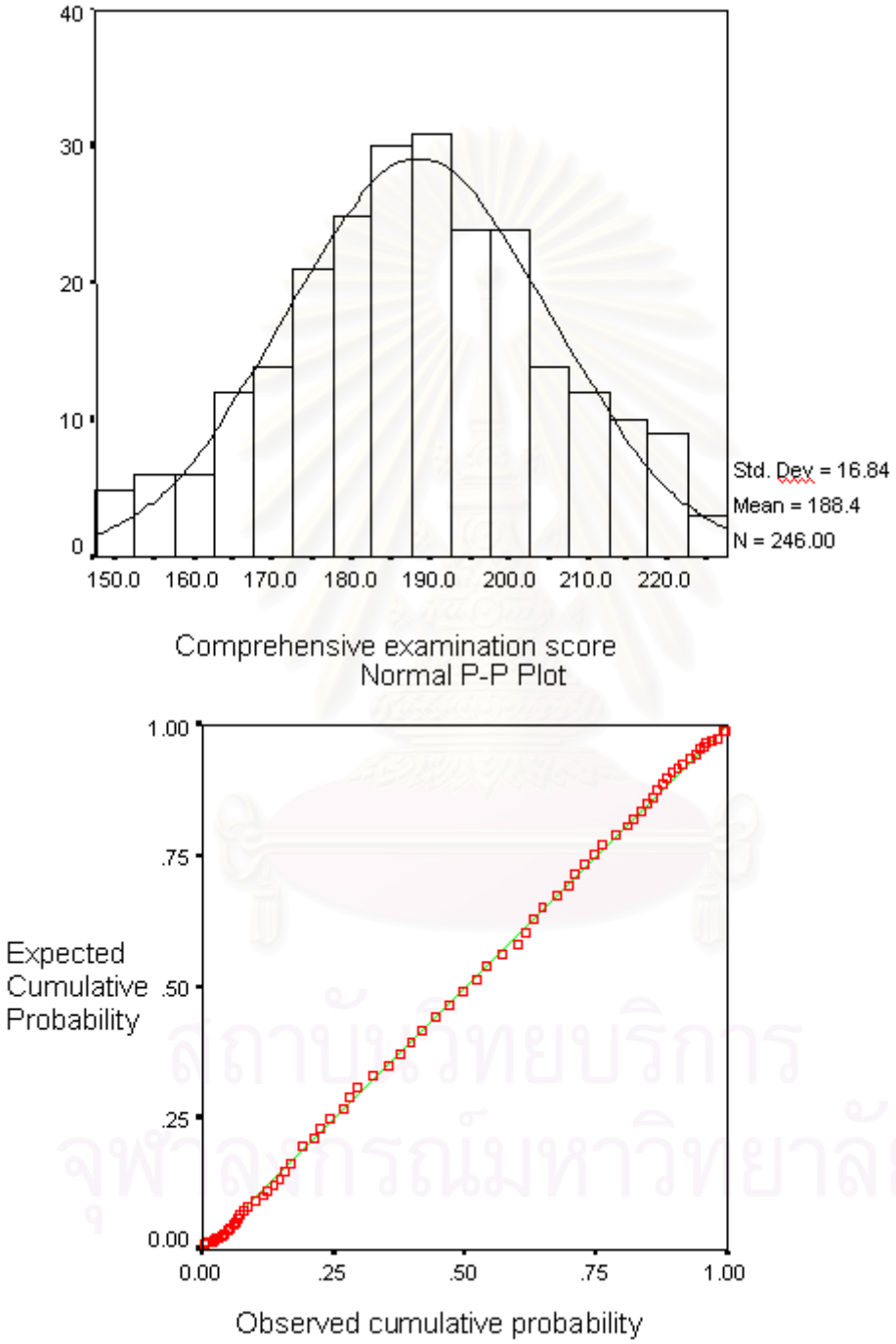
Based on the results of comparability of the two scales as demonstrated in the above analyses, the total scores were compared directly. The data were tested for normality using histogram and p-p plot. Since the assumption of normality was hold therefore the use of parametric statistics was justified. Regarding the comparison of score in each level of knowledge measurement, since the number of items in each level in the two years were not similar, so the scores obtained from each years were normalized to percentage prior to comparison using student t-test.

Table 4.11 Comparison of component of comprehensive examination scale based on distribution of medical specialties.

Medical Specialty	Academic Year (Curriculum)	
	1998 (conventional)	1999 (PBL)
Medicine	60	65
Surgery	60	64
Obstetrics and Gynecology	50	49
Pediatrics	49	49
Preventive Medicine	20	20
Psychiatry	13	10
Radiology	10	8
Orthopedics	9	9
Oto-rhino-laryngology	9	5
Anesthesiology	8	8
Ophthalmology	7	5
Forensic Medicine	5	5
Physical Medicine and Rehabilitation	0	3
Total	**300**	**300**

Note: In the academic year 1998, the scale to measure the knowledge in PM&R was under subtopics of orthopedics.

Figure 4.6 Histogram (upper panel) and P-P plot of the comprehensive examination score data. The appearance of plots indicated the acceptable normality of the data.



The statistical analysis showed that scores obtained from the students from two curricula were not significantly different either in total number or any level of knowledge measurement.

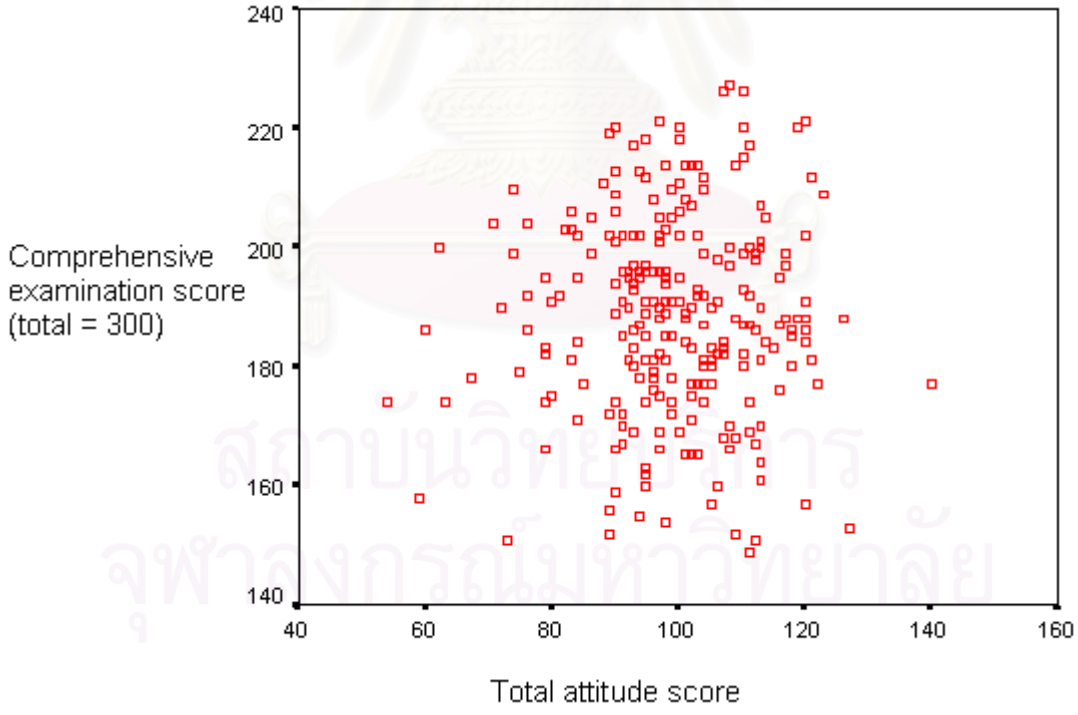
Table 4.12 Comparing the comprehensive examination score between the two curricula. No statistically significant difference was demonstrated.

Level	Curriculum	Mean	S.D.	S.E.	t-statistics	Magnitude of difference	P-value
RECALL	Conventional	59.91	6.55	.60	2.222	1.96	.027
	PBL	57.95	7.29	.65		0.22 to 3.71	
INTERPRE	Conventional	64.66	6.89	.63	-.074	-0.07	.941
	PBL	64.73	6.93	.62		–1.80 to 1.67	
PBSOLV	Conventional	64.42	6.022	.55	1.355	1.02	.177
	PBL	63.40	5.77	.52		–0.46 to 2.50	
GRTOTAL	Conventional	63.32	5.70	.52	1.471	1.05	.143
	PBL	62.27	5.50	.49		–3.6 to 2.46	

4.4 CORRELATION BETWEEN ATTITUDE AND ACADEMIC ACHIEVEMENT

The data were further analyzed to demonstrate whether the students' attitude correlate with their academic performance. The distribution of summed attitude score and the score obtained from the comprehensive examination was depicted using scatter plot (figure 4.5). The result showed no correlation between the two variables. The data were then tested statistically using Pearson's correlation coefficient. The obtained *r* was 0.016 whilst the p-value was 0.806. Therefore, it could be concluded that there was no significant correlation between the students' attitude and their academic performance. Since no significant correlation was demonstrated, further analysis using regression method could not be performed.

Figure 4.7 Scatter plot between attitude score and comprehensive examination score. No significant correlation was demonstrated. (r = 0.016, p= 0.806)



CHAPTER 5

DISCUSSION

The results of this study showed that the implementation of PBL curriculum in large scale in Chulalongkorn Medical School did not result in a favorable outcome. The students' attitude towards their curriculum was poorer than those observed in the conventional curriculum students, as reflected by significant lower score in the attitude measurement compared with those observed in the conventional batch. However, there were some areas that students in the PBL batch gave a higher score than the conventional curriculum student did. Despite their unfavorable attitudes, the academic performance of the students in the PBL did not significantly differ from those observed in the conventional curriculum students.

COMPARISON OF STUDENT ATTITUDE

The results obtained here revealed that the student in PBL curriculum possessed less desirable attitude towards their curriculum. This was quite different from previous experiences reported from the western countries. In 1993, Vernon and Blake performed a meta-analysis based on the results from previous eight studies and found that the calculated weighted mean effect size was +.55 (95%CI = +.40 to +.70) in favor of PBL. However, the magnitude of difference of only .55 raises doubts for its importance. More positive attitude toward PBL curriculum was also demonstrated by Kaufman and Mann (1996). They conducted study comparing attitudes between PBL and conventional students after the second curriculum year at the Dalhousie University Faculty of Medicine in Canada. It was found that the students in PBL class had more positive attitudes toward their learning environment. Individual-item analyses revealed that the PBL students were more positive about vigorous class discussions, faculty enthusiasm, outstanding course offerings, decisions made democratically, and students encouraged to criticize policies and/or practices. Interestingly, they found a significant difference favoring conventional track on the student-interaction subscale. Vasconez

and colleagues showed that, similar to those in preclinical years, PBL was also positively accepted by students in the clerkship years (Vasconez et al 1993).

Effect of curriculum exposure on changing of students' attitude has been demonstrated previously. Berstein et al (1995) conducted a study in University of Toronto to evaluate students' attitude after five weeks of exposure to PBL curriculum. They found that direct experience with PBL led to more favorable attitudes among the students. However, students still rated conventional methods as better for knowledge acquisition, whereas PBL methods were rated better for improving teamwork and doctor-patient relationship. Unfortunately, attitudes toward both subscales were in favor of conventional method in this study. The effect of curriculum exposure on attitude change was confirmed by subsequent study by Birgegard and Lindquist (1998). They investigated students' opinion of the extent of which their studies at medical school encourage independent, critical thinking, problem-solving skills, decision making and other behaviors usually put forward as important. Their results showed that students studying in conventional curriculum generally have low opinion of the extent to which their education encouraged such virtues. They also observed that significant changes took place after introduction of PBL. The students' opinion of medical school curriculum were improved in many areas. However, in spite of such improvement, student ratings of PBL as learning tools were rather poor, and many students felt insecure with regard to how to cover the subject matter for the examination.

In 1998, Rosenthal and Ogden explored medical students' beliefs about medical education at the Royal Free Hospital School in London. The study was conducted in order to seek the degree of agreement between students' belief and the recommendation for curriculum changes proposed by General Medical Council. The features of recommended curriculum reform was consistent with PBL format (i.e., small group learning, working in team, etc). They found that most students agreed with the majority of recommendations for change.

So, what is the explanation of the contradictory result observed in this study? The differences in details of curriculum, pattern of implementation and evaluation, attitude of the faculty as well as the students' past learning experience can be the reason. Generally, the Asian students are not familiar with the self-directed learning since the pre-university education in these countries is based primarily on passive learning. As a result, students are not well prepared for independent study.

One factor that might underlie the unfavorable attitude toward the PBL curriculum demonstrated here is the inconsistency of curriculum in promoting the skill necessary for independent learning. Analysis of the course description of the overall course used in this medical school (pre-clinical and clinical years) revealed an inconsistency of the teaching styles and not all of the courses emphasize on the PBL technique. To promote successful self-directed learning, the students must be equipped with some necessary skills. Like learning for other skills, skill cannot be developed by explicit explanation. On the contrary, development of skill formation is based on repeating practice. Therefore more emphasis must be paid for promoting the development of these skills. Such skills include (1) ability to develop and be touch with curiosities, (2) ability to perceive one's self objectively and accept feedback about one's performance non-defensively, (3) ability to diagnose one's learning needs in the light of models of competencies required for performing life roles, (4) ability to formulate learning objectives in terms that describe performance outcome, (5) ability to identify human, material, and experiential resources for accomplishing various kinds of learning objectives, (6) ability to design a plan of strategies for making use of appropriate learning resources effectively, (7) ability to carry out a learning plan systematically and sequentially, (8) ability to collect evidence of the accomplishment of learning objectives and have it validated through performance. These skills must be promoted throughout the curriculum.

Analysis of subscale also showed that PBL curriculum implemented in this school did not achieve its goal in many areas. Students rated conventional method to be more superior in development of communication skill. On the bright side, though students' attitude on SDL subscale were rather comparable, individual item analysis demonstrated the PBL method provided better skills in information searching and the use of information technology. Both skills are considered valuable for the promotion of life-long learning.

One important factor that can affect students' attitude is the attitude of the faculty. It is apparently clear that successful implementation of PBL curriculum significantly depends on the faculty staffs corroboration. The faculty must adapt their teaching methods to promote the development of student SDL skills. Therefore, role of the faculty staffs must be changed from the "teacher" to the "facilitator". Rather than being resource of knowledge, facilitator for PBL curriculum must have primary role in helping students in diagnosing the learning need, formulating the learning objectives, identifying the learning resources and setting evaluation criteria for the evidence of learning achievement. This different role of the faculty member may not be familiar to the faculty staffs. Moreover, some of the faculty members may have negative attitude towards the PBL curriculum. Evaluation of the attitudes of the faculty members is also needed for better explanation of the less favorable attitudes observed in the PBL students in this study.

PROBLEM-BASED LEARNING AND ACADEMIC ACHIEVEMENT

This study demonstrated that there was no significant change in educational effectiveness between the PBL and conventional batches in the light of the comparable performance on the comprehensive examination score. Further analyses focusing on the level of knowledge measurement (i.e., recall, interpretation and problem-solving levels) also showed no significant difference.

In contrast to the attitudes, effectiveness of PBL curriculum on academic achievement is more controversy. Various indicators such as performance on the standard test (e.g. NMBE), incidence of academic failure, etc., have been used to compare this method with the conventional one. Selection of the appropriate outcome variable is the most crucial step in this comparison since PBL is emphasized more on the process of knowledge acquisition than content storage. Previous experiences summarized in three reviews published in 1993 showed quite unique picture of little or no effect on student achievement (Albanese and Mitchell 1993, Vernon and Blake 1993 and Berkson 1993). Vernon and Blake (1993) analyzed previously published studies using method of meta-analysis. Based on data from NBME I, their analysis revealed a significant trend favoring conventional teaching methods (weighted mean of effect size = -.18, 95%CI = -.10 to -.26). Concerning the performance on basic science factual knowledge, the observed trend in favor of conventional teaching approaches was not statistically significant (weighted mean of effect size = -0.9, . 95%CI = +.06 to -.24). The study at the University of New Mexico School of Medicine also showed that the PBL students scored significantly and considerably lower than did the conventional students on NMBE I. No significant difference was observed when the score of NMBE II and III among the two groups were compared (Menin et al 1993). Another study conducted in Harvard medical school showed no significant difference in the performance on NMBE I between the PBL and conventional track students. A subtle increase in NMBE I subtest on behavioral science was observed in the PBL students (Moore et al 1994).

The picture emerging from these previous experiences is PBL is less effective in providing factual knowledge (especially basic science knowledge) but rather comparable to the conventional method in clinical science. However, the more recent study performed by Blake and colleague at the University of Missouri-Columbia School of Medicine showed a contradictory result (Blake et al 2000). In this study, the investigators compared the students' performance on Step 1 and Step 2 of the United States Medical Licensing Examination (USMLE) between the groups trained under PBL curriculum with the previous batches trained under conventional curriculum. They found that the mean scores were higher in USMLE Step 1 for class in the PBL curriculum than for classes in the conventional curriculum. The mean scores for Step 2 were above the national mean for PBL class whilst those of conventional curriculum was lower than national mean. They concluded that PBL revisions of the curriculum did not compromise the performance of medical students on the licensing examination. The similar trend was also shown by Finch (1999) studied in a medical school in Canada. Moreover, he showed that the PBL students performed better in tests of deeper understanding and cognitive skills related to patient management.

Whether or not PBL curriculum can improve the academic performance is still unclear. One major problem regarding this question is the appropriate method for measurement. It has been argued that PBL emphasizes more on the process of requiring knowledge than magnitude of knowledge content. Therefore, previous studies comparing the effectiveness of PBL by direct comparison of the performance on standard test may not be appropriate. To assess its effectiveness, more comprehensive student assessing methods are required. Several important points have been discussed by Mennin and Kalishman (1998) in their paper based primarily on the results of curriculum reform in eight medical schools in the United State. The desired assessment technique should be comprehensive, integrated performance examinations across the curriculum.

One important point, which must be kept in mind, is assessment drives learning. The evaluation technique commonly used in this medical school can be still considered traditional and is based primarily on the measurement of content. To achieve the successful curriculum implementation, changing the way of student assessment is necessary. Evaluation systems should be well aligned with the nature and intent of the instructional approach that has been adopted. When the focus and intent of the PBL approach to education are considered, it becomes apparent that traditional evaluation methods do not adequately address the issue of student assessment.

RELATIONSHIP BETWEEN ATTITUDE AND ACADEMIC PERFORMANCE

The psychological term *attitude* has various definitions, although "theorists agree that (a) evaluation constitutes a central, perhaps predominant, aspect of attitudes, (b) attitudes represent in memory, and (3) affective, cognitive, and behavioral antecedents of attitudes can be distinguished, as can affective, cognitive and behavioral consequences of attitudes" (Olsen and Zanna 1993). Allport, one of the most famous social psychologists of his day, defined attitude as a mental or neural state of readiness, organized through experience, exerting a directive or dynamic influence upon the individual's response to all objects and situations with it is related. The central feature of all definitions of attitude is the idea of readiness for response. That is attitude is not behavior, not something that a person does; rather it is a preparation for behavior, a predisposition to respond in a particular way to the attitude object. The term attitude object is used to include things, people, places, ideas, actions, or situations either singular or plural. The general literature on attitude supports this hypothesis: in short, attitudes mediate behavior.

Despite the acceptance of the concept, the present study did not discover any relationship between students' attitude and their academic performance. This might reflect the inappropriateness of the assessment method for the students trained under PBL curriculum.

COMMENT ON THE SCALE

The scale used in this study has been designed to cover most dimensions of attitude towards the medical curriculum. The primary results of questionnaire testing including reliability and validity testing were satisfactory. However, since the number of pretest sample was quite limited, the questionnaire was re-tested in the study population. The reliability test showed three items with negative (items number 7, 11, and 20) item-total correlation and three items with low (less than 0.3) item-total correlation (items number 10, 12, and 14). Excluding these items from the scale will raise the Cronbach's coefficient alpha to 0.9240. Re-evaluation of those items revealed that most of them were negatively posed items. To keep these items in the scale, changes in wording are needed.

The factor analysis conducted to demonstrate the subscale showed the presence of six factors. The context of the factor was quite reasonable. However, the results of this analysis will be change if six items with negative or low item-total correlation were excluded from the scale. Factor analysis based on 24-item scale revealed four factors. The first three factors were apparently the same as the previous analysis based on the 30-item scale. The final factor comprised the item 16 (time consuming and inappropriate time management) and 15 (feeling of insecurity). After scale reduction, the 24-item scale seemed to yield a better tool for the attitude measurement.

ASPECT OF GENERALIZATION

One important limitation exists regarding the interpretation and generalization of the results. The construct of the measuring tool developed in this study confined primarily on the content and learning experience portion of the curriculum. It did not intend to cover the objective and evaluation portions. Therefore the readers must keep in mind that the observed results may not reflect overall picture of the curriculum. To get clearer picture of the attitude, more extensive scale to cover the objective and evaluation portions is required. Since the design of this study is an observation one, many factors, i.e. contamination, can be controlled. This also limits the internal validity of the study.

Another question is the external validity of the results. Whether the results reported here could be generalize to other medical schools in the eastern countries is still unclear. Unlike the typical clinical trial, in the area of educational research, the result form one study cannot be absolutely generalized to others. The characteristics of curriculum, educators or learners always differ from one school to one another. The PBL curricula implemented in different schools have their own characteristics. As a consequence, this factor restricts the generalization of the results observed in one particular school. Therefore, the result must be viewed as evidence or an example of the experience of PBL implementation in one medical school.

CHAPTER 6

CONCLUSION

The achievement of excellent education, including professional education such as medical education, is a complex undertaking. It depends on many factors. Among these is, crucially, the conception of what is involved in the education in question; unavoidably, conception affects practice (Margetson DB 1999).

PBL curriculum is based on the principle of adult learning (Knowles 1973). The goal of this approach is to better facilitate the acquisition of the knowledge, skills attitudes and values that have been identified as the essential characteristics associated with medical professionals. These characteristics included clinical reasoning, self-directed or independent learning, motivation, interpersonal communication skills, etc. It seems that to achieve their full potential in practice, medical education courses need to be conceived, designed, taught, and administered in a PBL way. This requires the thorough integration of understanding, knowledge and skill. Although the PBL curriculum represents a major improvement on the traditional curriculum, its educational effectiveness remains unclear.

The results of this study demonstrated that implementation of PBL curriculum in this medical school could not be ascribed as successful. Though the PBL implementation did not make any significant change in educational performance, the students trained under PBL method expressed less favorable attitudes to their curriculum. Further studies, such as evaluation of the faculty's attitude, more comprehensive attitude evaluation to cover all dimensions of the curriculum, etc., are necessary to address the factors underlying the observation of less favorable students attitude towards the PBL curriculum. Moreover, improvement in the implementation of this PBL curriculum including the student evaluation technique must be considered.

However, due to some limitations, the results observed in this study must be carefully interpreted and generalized. The results obtained from the researches with observational design, like this study, is considered less credibility since a lot of confounding factors cannot be controlled. Moreover, the attitude scale developed in the study was intended to measure only the learning dimension of the curriculum and not the objective and evaluation component. The considerable difference in PBL curriculum implementation in different medical schools also limits the generalization of the results.

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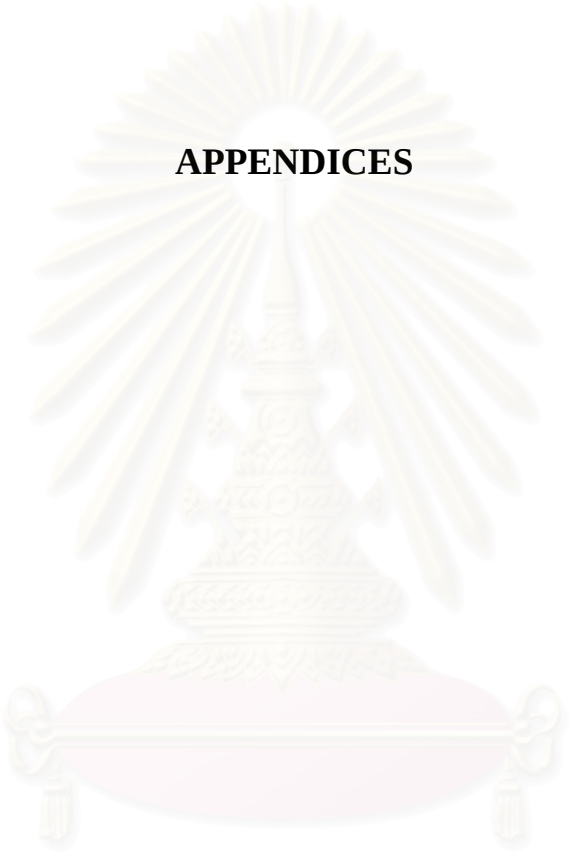
APPENDICES



APPENDIX 1

Attitude Scale (Thai Version)

แบบประเมินทัศนคติของนิสิตแพทย์ต่อหลักสูตรของคณะแพทยศาสตร์ จุฬาลงกรณ์มหาวิทยาลัย

อายุ ..... **ปี** **เพศ** ..... GPA ..... **ปีการศึกษา** .....

หลักสูตร ☐ **ปรกติ** ☐ **แพทย์ชนบท** ☐ **โครงการร่วมภูมิพล**

ข้อความต่อไปนี้เกี่ยวกับความเห็นของนิสิตแพทย์ที่มีต่อหลักสูตรของคณะแพทยศาสตร์ที่ท่านได้ศึกษามาแล้ว กรุณาแสดงความคิดเห็นว่าท่านเห็นด้วยกับข้อความดังกล่าวหรือไม่ โดยเติมเครื่องหมาย ✖ หรือ ✓ลงในช่องว่างท้ายข้อความตามความคิดเห็นของท่าน

1 = ไม่เห็นด้วยอย่างยิ่ง 2 = ไม่เห็นด้วยปานกลาง 3 = ไม่แน่ใจ

4 = เห็นด้วยปานกลาง 5 = เห็นด้วยอย่างยิ่ง

ตัวอย่าง

ข้อความ	**คะแนน**				
	1	2	3	4	5
1. หลักสูตรที่เรียนช่วยพัฒนาความสามารถทางภาษาของนิสิต					

หมายความว่า ไม่เห็นด้วยอย่างยิ่ง

ข้อความ	**คะแนน**				
	1	2	3	4	5
1. หลักสูตรนี้ส่งเสริมให้นิสิตสามารถคิดและพิจารณาปัญหาทางการแพทย์อย่างถี่ถ้วน					
2. หลักสูตรนี้ช่วยพัฒนาความสามารถของนิสิตในการกำหนดปัญหาและขอบเขตของปัญหาในทางการแพทย์และสาธารณสุข					
3. หลักสูตรนี้ส่งเสริมให้นิสิตสามารถแก้ไขปัญหาทางการแพทย์ได้อย่างมีประสิทธิภาพ					
4. หลักสูตรนี้ส่งเสริมให้นิสิตมีความสามารถในการตัดสินใจในปัญหาที่เกี่ยวข้องกับการดูแลและรักษาผู้ป่วยได้อย่างถูกต้อง					
5. โครงสร้างของหลักสูตรที่ศึกษา เน้นการผสมผสานเนื้อหาจากสาขาวิชาต่างๆเข้าหากัน					
6. นิสิตมีความมั่นใจว่าเนื้อหาในหลักสูตรนี้ครอบคลุมเนื้อหาในทุกสาขาวิชาทางการแพทย์					
7. หลักสูตรนี้ เน้นการสอนจากอาจารย์มากกว่าส่งเสริมให้นิสิตแสวงหาความรู้ด้วยตนเอง					
8. หลักสูตรนี้เปิดโอกาสให้นิสิตศึกษาอย่างละเอียดในหัวข้อที่นิสิตมีความสนใจ					
9. หลักสูตรนี้ส่งเสริมให้นิสิตเรียนรู้ด้วยตนเอง โดยหาความรู้จากแหล่งอื่นๆ เช่น หนังสือในห้องสมุด, CAI เป็นต้น นอกเหนือจากตำราและเอกสารประกอบการสอน					
10. หลักสูตรนี้ส่งเสริมให้นิสิตเรียนเพื่อสอบให้ได้คะแนนสูง มากกว่าการนำไปใช้ประโยชน์					
11. หลักสูตรนี้อาจทำให้นิสิตแต่ละคนมีระดับความรู้ที่แตกต่างกันมากได้					
12. หลักสูตรนี้มีเนื้อหาและรายละเอียดมากเกินไป ซึ่งบางส่วนน่าจะสอนในระดับหลังปริญญา					
13. ในความเห็นของท่าน หลักสูตรนี้ให้ความรู้ที่ทันสมัย					
14. การเรียนในหลักสูตรนี้ทำให้นิสิตมีความเครียดสูง					

ข้อความ	คะแนน				
	1	2	3	4	5
15. การศึกษาในหลักสูตรนี้ทำให้ท่านรู้สึกไม่มั่นใจว่าจะมีความรู้เพียงพอที่จะนำไปใช้					
16. การเรียนในหลักสูตรนี้ทำให้ต้องใช้เวลามากในการแสวงหาความรู้ และนิสิตมักไม่สามารถบริหารเวลาได้อย่างมีประสิทธิภาพ					
17. หลักสูตรนี้ส่งเสริมให้นิสิตมีทักษะในการค้นหาข้อมูลจากแหล่งต่างๆ					
18. ระหว่างการศึกษาในหลักสูตรนี้ นิสิตสามารถพัฒนาทักษะในการใช้เทคโนโลยีเพื่อการค้นหาข้อมูล เช่น การใช้ internet					
19. หลักสูตรนี้ส่งเสริมให้นิสิตมีความสามารถในการแสดงความเห็นทางวิชาการ ทั้งในเชิงสนับสนุนและคัดค้าน					
20. หลักสูตรนี้เน้นเนื้อหาที่เป็นวิชาการทางการแพทย์มากกว่าปัญหาที่มีอยู่จริงในชุมชน					
21. หลักสูตรนี้เน้นในนิสิตมีความคิดอย่างเป็นองค์รวม (holistic approach)					
22. หลักสูตรนี้ส่งเสริมให้นิสิตสามารถทำงานร่วมกับบุคคลาการทางสาธารณสุขอื่นๆ เช่น พยาบาล เจ้าหน้าที่สาธารณสุข					
23. การเรียนในหลักสูตรนี้ทำให้นิสิตเกิดความเข้าใจในบทบาทของบุคคลอื่นในการทำงานร่วมกัน และสามารถทำงานเป็นกลุ่มได้					
24. หลักสูตรนี้สร้างเสริมความสามารถของนิสิตในการติดต่อสื่อสารกับผู้ป่วยได้					
25. หลักสูตรนี้ทำให้นิสิตเข้าใจบทบาทและความสัมพันธ์ของแพทย์ต่อบุคคลหรือระบบงานอื่นที่เกี่ยวข้อง เช่น ระบบประกันสังคม ทนาย ศาล					
26. หลักสูตรนี้เน้นให้นิสิตมีความรู้เรื่องจริยธรรม					
27. หลักสูตรนี้ทำให้นิสิตมีทักษะในการเรียนรู้ และสามารถแสวงหาความรู้ด้วยตนเองได้เมื่อจบการศึกษาไปแล้ว					
28. ท่านมีความเชื่อมั่นว่ามาตราฐานของหลักสูตรนี้อยู่ในระดับสากล และทัดเทียมกับมาตราฐานในประเทศที่พัฒนาแล้ว					
29. ท่านมีความมั่นใจว่าหลักสูตรนี้ทำให้ท่านมีความรู้มากพอที่จะสามารถผ่านการสอบเพื่อศึกษาต่อในประเทศที่พัฒนาแล้วได้					
30. ท่านมีความพึงพอใจในหลักสูตรนี้					

กรุณาตอบคำถามต่อไปนี้ตามความเห็นของท่าน

สิ่งใดคือความประทับใจของท่านต่อหลักสูตรนี้ .....

ท่านคิดว่าสิ่งที่ควรปรับปรุงแก้ไขในหลักสูตรนี้ คือ .....

ความเห็นอื่นๆ (โปรดระบุ).....

ขอขอบคุณในความร่วมมือ

APPENDIX 2

Attitude Scale (English Translation)

QUESTIONNAIRE FOR ASSESSING STUDENTS' ATTITUDE TOWARDS CHULALLONGKORN MEDICAL CURRICULUM

Age …… years. Gender ☐ male ☐ female Curricular year …….. GPA ……

The followings are statements concern student's attitudes towards the medical curriculum. Indicate to what extent you agree with such statement by filling ✘ or ✓ in the box at the end of each item (1 = strongly disagree, 2 = partially disagree, 3 = equivocal, 4 = partially agree, 5 = strongly agree).

Example: This curriculum helps me in improving my English. 1

	Item	Score				
		1	2	3	4	5
1	This curriculum encourages me to think critically.					
2	This curriculum and the methods of teaching improve my ability in formulation and definition of medical problems.					
3	This curriculum enables me to solve the clinical problem effectively.					
4	This curriculum enables me to make decision effectively.					
5	The structure of this curriculum has emphasis on the integration between different disciplines.					
6	I am sure that the content in the curriculum covers all areas of medicine.					
7	I feel that the curriculum is emphasis on passive acquisition of knowledge than active process.					
8	This curriculum emphasizes me to study more details in the subjects that I am interested.					
9	Learning within this curriculum promotes students to study outside textbooks and handouts.					
10	The curriculum promotes the study for examination rather than the study for real-life usage.					
11	This method of teaching can result in a wide knowledge gap among the students.					
12	I feel that this curriculum is overburden with factual load and some knowledge could be transferred to postgraduate training.					
13	To my opinion, this curriculum provides up-to-date knowledge.					
14	I feel that studying within this curriculum is stressful.					

Item	score				
	1	2	3	4	5
15 I feel insecure during the study within this curriculum.					
16 I feel that too much time is need for acquiring new knowledge and I cannot manage the time effectively.					
17 This curriculum promotes my information-searching skill.					
18 Studying within this curriculum enables students to develop the skill in using new technology for information searching, i.e. using the internet.					
19 This curriculum encourages my ability to argue systemically, pros/contras.					
20 I feel that this curriculum provides me only academic medical contents but inadequate knowledge concerning community problems.					
21 This curriculum encourages the holistic approach to the medical problems.					
22 This curriculum enables me to work with personnel in other health-related professions, i.e. nurses, paramedics.					
23 Learning within this curriculum helps me to understand the different roles of members in a team and helps me to behave properly as a team member.					
24 This curriculum promotes my ability to communicate with my patients effectively.					
25 This curriculum helps me in understanding the relationship between doctors and the third party, i.e. social security scheme, lawyer, etc.					
26 This curriculum adequately emphasizes on the ethical issue.					
27 Learning within this curriculum helps me in building up the ability to acquire further knowledge independently after graduation.					
28 I feel that the quality of medical education in this school reaches the international standard.					
29 I am sure that this curriculum provides me enough knowledge to the level that I can pass the examination for further study in other countries.					
30 This curriculum satisfies me.					

VITAE

Anan Srikiatkhachorn was born on January 29, 1961 in Bangkok. He got his medical degree from the Faculty of Medicine, Siriraj Hospital, Mahidol University in 1984 and Board of Neurology from Thai Medical Council in 1990. In 1994 he received the postdoctoral fellowship grant from the International Headache Society and conducted his research work in Institute of Neurological Sciences, at the University of New South Wales in Sydney, Australia.

He enrolled in the Thai CERTC training program in 1998 as funded by the Faculty of Medicine, Chulalongkorn University. Currently, he is working in the Neuroscience Unit, Department of Physiology, Chulalongkorn University.