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# HOW MEDICAL STUDENTS ADAPT LEARNING STRATEGIES

## TO PROBLEM-BASED LEARNING

By

Inkyung Lee

# A DISSERTATION

Submitted to Michigan State University in partial fulfillment of the requirements for the degree of

# DOCTOR OF PHILOSOPHY

Department of Counseling, Educational Psychology and Special Education

## ABSTRACT

# HOW MEDICAL STUDENTS ADAPT LEARNING STRATEGIES TO PROBLEM-BASED LEARNING

By

### Inkyung Lee

This study investigated how second-year medical students adapt their learning strategies to changes in the instructional context. During the second year of the preclinical program, students in the College of Human Medicine at Michigan State University experience problem-based learning (PBL), while during the first year, they attend large lectures.

The researcher interviewed 12 students, including 8 students who participated in a pilot study of first year medical students. The researcher also administered the Learning and Study Strategy Inventory (LASSI) to a larger sample of medical students.

Both interviews and LASSI data were compared with those of the pilot study (Lee, Yelon, Doig, & Smith, 1994) to observe the adaptation of students' learning strategies. Qualitative analysis showed that exams drove students' learning-strategy choice more than the curriculum did. Students used PBL classes as an arena in which to discuss exam materials. Demands or conditions of the context, such as amount of material to study and time constraints, also influenced students' choices of learning strategies. In general, second-year students added only one new strategy - use of computer programs. Instead of adding strategies, they changed the extent to which they used certain strategies. For example, they used more group study, more integration strategies such as making charts, and fewer memorization strategies such as mnemonics. Results of Multivariate Analysis of Variance of LASSI data indicated, although students changed their learning strategies significantly during their first year, they did not change those strategies significantly during their second year. This could mean that students who are entering a different instructional context in which a large amount of content must be learned in a limited time may need to adapt their learning strategies more than they needed to change their learning strategies for a different curriculum in medical school.

In terms of the effect of PBL, qualitative analysis showed that the PBL curriculum achieved some of its goals. While students thought that PBL classes provided a clinical context for learning, encouraged active learning, and helped develop small-group working skills, they did not think PBL classes provided a model of problem-solving.

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who always love and support me unconditionally.

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v

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# **TABLE OF CONTENTS**

Page
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×4.

- -- ·

LIST OF TABLES	<b>x</b>
LIST OF FIGURES	<b>xiii</b>

# Chapter

I.	INTRODUCTION	1
	Statement of the Problem	1
	Purpose of the Study	3
	Assumptions	4
	Rationale for and Significance of the Study	5
	Summary and Overview	7
II.	REVIEW OF THE LITERATURE	9
	Introduction	9
	Definitions of Learning Strategies.	10
	General Learning-Strategy Research	11
	Medical Contexts	
	Michigan State University Medical School	13
	Problem-Based Learning (PBL)	15
	Research on Problem-Based Learning.	
	Academic Achievement	
	Clinical Performance	30
	Program Evaluation	31
	The Study Process (Study Habits)	
	Summary of PBL Research	
	Summary of the Literature Review	
	Research Questions and Working Hypotheses	

Ш.	METHODOLOGY	41
	Introduction	41
	Subjects of the Study	41
	Population	
	Sample	
	Instrument	
	Interviews	
	Learning Study Strategy Inventory (LASSI)	
	Data Analysis.	51
	Interview Data	51
	The LASSI data	54
IV.	RESULTS	56
	Introduction	56
	Examples of Two Case Studies	56
	- Jim	57
	Laura	67
	Findings Pertaining to the Research Questions	76
	Research Question 1	76
	Research Question 2	79
	Research Question 3	94
	Research Question 4	97
	Summary	112
V.	DISCUSSION AND CONCLUSION	113
	Introduction	113
	Limitations of the Study	114
	Research Question 1	116
	Research Question 2	118
	Research Question 3	123
	Research Question 4	128
	Interview Results	128
	LASSI Results	132
	Conclusions	136
	Implications	140
	Implications for Theory	141
	Implications for Practice	143
	Recommendations for Future Research	

APPE

REFE

<b>A</b> .	Consent Form	148
В.	Interview Questions	149
<b>C</b> .	Descriptions of LASSI scales and Sample Items	151
D.	An Example of the PBL Process	155
E.	PBL-Sensitive Scale Items Versus PBL-Nonsensitive	
	Scale Items	158
F.	Case Descriptions by Research Ouestions	163

# LIST OF TABLES

Table		Page
2.1.	Comparisons of learning tasks between first-year and second-year MSU CHM medical students	.27
2.2.	Comparisons between general PBL and MSU PBL	.28
3.1.	Schedule and number of subjects for interviews and LASSI administrations	55
4.1.	Key features of Jim's learning strategies	66
4.2.	Key features of Laura's learning strategies	.75
4.3.	Resources students used to study learning issues	77
4.4.	How and what students read	.80
4.5.	Reasons for doing group study	81
4.6.	Integration strategies	84
4.7.	Memorization strategies	86
4.8.	Strategies for selecting main information	88
4.9.	Reasons for using computer programs	90
4.10.	Strategies for checking knowledge	92
4.11.	Influences on students' learning strategies	94
4.12.	The ways in which PBL classes helped the students	96
4.13.	Means and standard deviations on each LASSI scale for students who completed the LASSI at times 1, 2, and 3	100

.

4 4 4 F E F3 F4 E E E7 Fĝ

Fş

4.14.	Univariate <u>F</u> -Tests of Significance of all three LASSIs using the 10 LASSI scales	. 102
4.15.	Univariate <u>F</u> -Tests of Significance at time 1 and time 2 using the 10 LASSI scales	. 103
4.16.	Means and standard deviations on each LASSI scale for students who completed the LASSI at time 1 and time 2	. 104
4.17.	Means and standard deviations on each LASSI scale for students who completed the LASSI at time 2 and time 3	. 105
4.18.	Omnibus test of significance at time 2 and time 3 using the 10 LASSI scales	. 106
4.19.	Means and standard deviations on the PBL-related scale and the PBL-unrelated scale for students who completed the LASSI at all three times	. 109
4.20.	Means and standard deviations on the PBL-related scale and the PBL-unrelated scale for students who completed the LASSI at time 1 and time 2	. 110
4.21.	Means and standard deviations on the PBL-related scale and the PBL-unrelated scale for students who completed the LASSI at time 2 and time 3	. 111
<b>F.1</b> .	Key features of Mark's learning strategies	. 16 <b>8</b>
<b>F.2</b> .	Key features of Tom's learning strategies	. 175
<b>F.3</b> .	Key features of Ann's learning strategies	. 182
F.4.	Key features of Mary's learning strategies	188
<b>F</b> .5.	Key features of Andrew's learning strategies	. 194
<b>F.6</b> .	Key features of Roger's learning strategies	. 200
<b>F.7</b> .	Key features of Nancy's learning strategies	. 205
<b>F.8</b> .	Key features of Janet's learning strategies	.210
<b>F.9</b> .	Key features of Cindy's learning strategies	.212

<b>F</b> .10.	Key features of Susan's learning strategies	215
<b>F</b> .11.	Key features of Kelly's learning strategies	220
<b>F</b> .12.	Key features of Jane's learning strategies	225

# **LIST OF FIGURES**

Fig	Ire	Page
4.1.	Means on each LASSI scale for times 1, 2, and 3	101
4.2.	Means on the PBL-sensitive and the PBL-nonsensitive scales for time 1 and time 3	107
4.3.	Means on the PBL-related scale and the PBL-unrelated scale for times 1, 2, and 3	109
5.1.	Factors influencing students' choice of learning strategies	138

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## **CHAPTER 1**

## **INTRODUCTION**

#### Statement of the Problem

Educators do their best to construct instruction so their students will learn what is needed to perform in the real world. For example, educators build professional education programs with real-world-oriented general goals and specific objectives in mind. Although medical educators want students to remember many basic-science facts, concepts, and principles, they also want students to apply that knowledge to solve medical problems. Thus, they design the instruction so that students will learn as much as possible of the necessary knowledge and skill.

However, students are not passive recipients of knowledge and skill instruction. They employ learning strategies to make the most of what is provided in the instructional system. In the best of all worlds, educators provide instruction and students use compatible learning strategies so they learn what is needed quickly and accurately.

But sometimes the faculty's instructional system and the students' learning strategies are not compatible. Students may not have the skills to study in the most effective and efficient manner to complement the instructional methods or to attain the goals and the objectives of the instruction. Or students may study in their own way to

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achieve their goals regardless of the instructional goals or objectives. One could argue that the instruction should change, and that is a possibility. However, the reality in most situations is that the students must adapt to the instruction.

One typical example of an extreme change in curriculum can be found in the variations in each year's work in the medical schools. For example, at Michigan State University, medical faculty teach according to considerably different curriculum plans in the first two years of medical school. The first year, faculty teach mainly in large lectures. Students must learn to recall and understand large amounts of basic science, which they will eventually apply to medical practice. Even in year one, medical educators are concerned with the way medical students adapt their learning strategies from the typical undergraduate college classroom to the intensive learning experience of medical school. This concern is magnified for students who have not been as facile as other students in applying learning strategies in college and who may not have as wide a range of learning strategies to use.

As medical students enter year two, an even greater adjustment is required. Now they are expected to learn, integrate, and apply knowledge to solve medical problems. Furthermore, they must learn what they need to know to solve the problems on their own and through group discussion with peers and a facilitator. This approach is called

C 2 P 5 P f a t( 1 I 0 a; ĉ . ല je; Y problem-based learning (PBL). In this context, medical educators are concerned about the student's ability to switch learning strategies from year one and to adapt to the new mode of instruction and the new outcomes.

Instructional designers, curriculum developers, educational psychologists in general, and medical educators concerned about at-risk students and those concerned with planning medical curricula, in particular, want to know how students adapt their learning strategies to changing instructional contexts. If these professionals can understand this process of adaptation, they can advise students about the most effective learning strategies for the instructional system and can build courses in a way that will encourage effective and efficient learning strategies.

To expand the understanding of how students in general change their approaches to study, I explored how medical students adapted their learning strategies when instructional contexts changed. Because of the substantial changes that take place in medical school curricula, medical students are ideal people to study to assess adjustment of learning approaches as the instructional context changes.

## Purpose of the Study

The main purpose in this study was to examine how second-year medical students adapt their learning strategies to changes in the instructional context. I looked at the learning strategies of medical students who took part in a pilot study during their first year in a large-lecture-based curriculum (Lee, Yelon, Doig, & Smith, 1994). During the second year of the preclinical program, students in the College of Human Medicine at Michigan State University experience the new environment of problem-based learning

(PBL). This PBL curriculum, like others that have been adopted by some medical schools, is supposed to encourage students to use approaches that enhance their learning (Vernon & Blake, 1993). Because students' perceptions of context may affect their approach to learning (Ramsden, 1984), I also probed students' perspectives on PBL.

The pilot study by Lee et al. (1994) of first-year medical students at Michigan State University showed that students in a traditionally delivered, lecture-based curriculum had enormous study loads and limited time. Through the experience of their first semester of medical school, most of the pilot students became more effective and efficient in choosing learning strategies. For example, they frequently used the strategy of selecting important information, focusing on information that was likely to be on their multiplechoice exams. They also became efficient in time-management strategies, and were involved in group study to exchange information or to divide the study load. This finding is consistent with that of Malton and Saljo (1976b), who found that students adopted rote learning or memorizing strategies for what was most likely to be on the exam when faced with large amounts of factual information coupled with limited time.

### **Assumptions**

This study was based on two assumptions: (a) Learning strategies influence instructional outcomes, and (b) varied instructional contexts require changes in learning strategies. Each of these assumptions is discussed below.

One assumption made in this study was that students' use of learning strategies has a significant influence on their academic success and, perhaps more important, on the quality of the knowledge they acquire. Researchers studying learning strategies have

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found correlations among various aspects of study methods, habits or attitudes, and academic performance (Brown, Bransford, Ferrara & Campione, 1983; Garner, 1990; Paris, 1988). However, these investigators have not considered the complexity and dynamics of individuals' learning strategies.

A second assumption made in this study was that, although approaches to learning are determined partly by an individual's learning style, learning strategies are also significantly influenced by the instructional context. The combination of learning style and instructional context produces unique approaches to learning that are found in all groups of students, including medical students (Newble & Entwistle, 1986). In a recent study of the learning approaches of medical students, Arnold and Feighny (1995) found that students' perceptions of the instructional context influenced their learning approaches, which in turn influenced their performance. Students must learn how to learn to meet the changing demands of the learning strategies to the demands of the working environment. Therefore, it is important for students to be aware of learning demands and understand how to adjust their learning strategies to particular situations. Researchers have not considered all the aspects of how learning strategies change as instructional context changes.

## Rationale for and Significance of the Study

Although researchers have explored learning strategies and PBL, this study makes several unique contributions to the understanding of both topics.

First, researchers have conducted many studies on the learning strategies of children and undergraduate students. However, few researchers have focused on learning strategies of graduate professional students. This study focused on medical students, a unique subset of graduate professional students.

Second, whereas most learning-strategy studies have focused on relationships among various aspects of study methods, habits or attitudes, and academic performance (Brown et al., 1983; Garner, 1990; Paris, 1988), the focus of this study was on how learning strategies change as a function of changes in instructional context. I followed students from their first year of medical school to their second year, and examined how their learning strategies changed.

Third, in previous research on PBL curricula, findings have been inconsistent across programs in different medical schools. Thus, more studies of PBL in various areas are needed to establish the benefits of PBL. Each program is unique in its design, and the problems or cases used in PBL are a major variable (Barrows, 1986). Thus, a synthesis of the advantages of PBL is hard to achieve, and the careful study of each program and its characteristics is necessary. Further, the College of Human Medicine at MSU has its own characteristics which are different from other PBL schools. For example, MSU has different assessment methods than do other PBL programs. Thus, although previous researchers have tended to suggest that students study differently under PBL, this claim cannot be generalized to the MSU PBL curriculum. No studies have been conducted on learning strategies of students under the MSU PBL curriculum. Thus, this study will contribute to the understanding of the MSU

medical students' approaches to studying under PBL curricula. Further, investigating students' learning approaches in preclinical years under PBL curricula will enrich the understanding of medical students' general learning, in which there is a growing interest.

Finally, this study explored, in part, students' perceptions about their use of learning strategies in different contexts. As shown in the literature review, observed differences in approaches to learning are likely to reflect contrasts in the educational environment. However, it is impossible to say which components of the environment are the most influential, as there are substantial differences between PBL and traditional courses in terms of curriculum, teaching methods, assessment, and staff-student relationships, all of which are likely to contribute in some way. Thus, it is valuable to understand students' perceptions of which of these aspects affect their approach to studying in each curriculum so that this information can be used in future instructional designs in medical school.

### Summary and Overview

In this study, I explored learning strategies of second-year medical students at Michigan State University to determine how they adapt their learning strategies to a new curriculum--problem-based learning. I compared the students' second-year learning strategies with their first-year strategies. In addition, I studied the medical students' perceptions of PBL and its influences on their learning.

In Chapter 1, I set forth the necessity of studying how students adapt their learning strategies in different contexts. The chapter also contained the assumptions made in the study, purposes of the research, and four unique aspects of this study.

Chapter II contains a review of studies of learning strategies and the definition of learning strategies used in this study. Chapter II also contains an explanation of medical education in general as well as the specific medical context at Michigan State University. For example, I explain and compare the first- and second-year medical students' activities, curricula, and intellectual tasks. To consider the new context to which the students must adapt, I also review literature related to problem-based learning. From reviewing previous research on learning strategies, medical context, and PBL research, I formulated four research questions with specific working hypotheses.

Chapter III contains an explanation of the research methodology. Both qualitative and quantitative methods were used. I conducted interviews and administered a questionnaire called the Learning And Study Strategy Inventory (LASSI). Chapter III contains a description of the subjects of the study, including the population. The interview procedures and LASSI administration procedures are explained. Also, the data-analysis procedures are described.

The findings of this study are presented in Chapter IV in relation to each research question. The findings pertaining to the working hypotheses related to each research question also are provided.

In Chapter V, the limitations of this study are set forth before discussing the study findings. The findings are discussed in relation to those from previous studies. I also set forth the conclusions drawn from the findings. Implications and recommendations for future studies also are presented.

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## **CHAPTER II**

### **REVIEW OF THE LITERATURE**

### **Introduction**

The goal of this study was to examine the learning strategies of second-year medical students who were under the PBL curriculum to determine how they adapted to a PBL curriculum from a large-lecture-based curriculum. To understand and fulfill the goal of this study, this chapter includes a review of literature based on three purposes.

The first purpose of this chapter is to discuss the definitions of learning strategies adopted in previous studies to derive the definition used in this study. Previous studies of general learning strategies also are reviewed.

The second purpose of this chapter is to describe the types of medical contexts in which medical students need to adapt their learning strategies. I compare the medical context at MSU to that of other medical schools, and discuss in detail the PBL context in order to understand students' responses to interviews carried out for this research. In doing this, the first-year and second-year medical contexts in general and at MSU are described and compared.

The third purpose of this chapter is to provide the rationale for this study, and also to formulate the research questions and working hypotheses. Thus, previous PBL studies

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#### **Definitions of Learning Strategies**

Researchers have defined learning strategies in various ways. Weinstein and Mayer's (1986) definition of learning strategies is so broad that it includes all cognitive processes. They defined learning strategies as thoughts and behaviors that a learner engages in during learning and that are intended to influence the encoding process. Nisbet and Shucksmith (1986) distinguished learning strategies from learning skills. They defined strategies as "executive processes which choose, coordinate, and apply skills and sequence of activities" (p. 1). In this definition, strategies are rather broad, general, and goal-oriented, whereas skills are more specific or reflective. For example, strategies include monitoring, revising, and checking, whereas skills include note-taking, underlining, and summarizing. According to Nisbet and Shucksmith, strategies improve with age and experience, even without specific instruction; skills are more task-specific and can be taught easily.

Kirby (1984) postulated a division of learning strategies into micro-strategies and macro-strategies. Micro-strategies, such as underlining and summarizing, are more taskspecific and thus are closer to performance and more responsive to instruction. On the other hand, macro strategies, such as monitoring and effort managing, are more pervasive and often are entwined with emotional and motivational factors. Whatever term researchers choose, it seems that learning strategies are executive processes such as

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monitoring, planning, and regulating and are related to metacognition. They are at a more general level than observable performances such as skimming, note-taking, or outlining.

In the present research, strategies were defined as purposeful mental and physical processes that underlie performance. Learning was defined as changes in either thinking or behavior, including both quantitative and qualitative changes. This definition of learning includes changes in one's thinking process of which one is unaware, and that are potentially available to consciousness. People may be able to infer their use of a strategy after being queried, even if they were unaware of their processing while performing the task. Therefore, learning strategies are tactics that increase the likelihood of effective and efficient learning, such as helping the learner encode the information, memorize, and learn easily. More specifically, following the definition of Weinstein and Mayer (1986), learning strategies can be considered as thoughts and behaviors that a learner engages in during learning and that are intended to influence the information processing. Learning strategies include basic memory processes as well as general problem solving, and they encompass almost all cognitive processes.

#### General Learning-Strategy Research

Many researchers in the late 1970s and 1980s were interested in results or outcomes such as student achievement or grade changes brought about by using certain learning strategies, rather than the process by which learning strategies resulted in improved student achievement. For example, specific learning strategies such as notetaking (Norton & Hartley, 1986) and underlining in text (Blanchard, 1986) have been found to influence students' ability to recall information.

Many researchers have found that learning strategies can be taught (Chipman, Segal, & Glaser, 1985; Weinstein & Mayer, 1986). Also, it has been found that metacognition can be promoted through direct instruction in classrooms and that increased awareness can lead to better use of learning strategies (Paris, Cross, & Lipson, 1984). Paris (1988) indicated that effective learners know when they need to be strategic and when they do not. Lodico, Ghatala, Levin, Pressley, and Bell (1983) supported the relationship between metacognitive knowledge and subsequent strategy use. In their study, they found that instruction in general memory-monitoring principles was sufficient to effect a change in strategy usage. Investigators have established strong relationships between learning/metacognitive strategies and students' academic achievement (Brown et al., 1983; Garner, 1990; Paris, 1988).

Recently, scholars have begun to investigate the critical effect of college students' independent use of learning strategies on their academic achievement (McKeachie, Pintrich, & Lin, 1985; Pintrich, 1989). Pintrich argued that learning strategies facilitate the storage and retrieval of information and, as a result, lead to an increase in students' academic achievement. These studies were predicated on the assumption that academic achievement can be improved by students' examining the strategies they use while learning.

McKeachie, Pintrich, Lin, Smith, and Sharma (1990) suggested that use of learning strategies can vary depending on the situation, and that these strategies can be brought under students' control. For example, students may choose to study differently for a simple factual recall test than they would for a test that requires application and transfer of

the course material. In addition, research on student motivation and personality has indicated that motivational orientation can vary in different situations and significantly affect learning (McKeachie et al., 1990).

Most of the studies of learning strategies reviewed in this section focused on the relationships between learning strategies and achievement, and most of them centered on children and college students. The present study was based on the assumptions that learning strategies are changeable and that these strategies can be controlled by the learner. In contrast to previous studies of learning strategies, the present study concerned learning strategies of medical students who are graduate professional students. Further, I examined how students changed their learning strategies in two different contexts (lecture versus problem-based learning) instead of focusing on the relationship between learning strategies and academic achievement as most previous researchers have done.

### Medical Context

### Michigan State University Medical School

Michigan State University (MSU) has two medical schools: The College of Human Medicine (CHM), whose graduates become MDs (medical doctors) and The College of Osteopathic Medicine, whose graduates become DOs (doctors of osteopathy). This study was focused on students who were pursuing an MD degree, who were enrolled in the College of Human Medicine. Thus, the description of the medical school structure pertains to that for MD degree students. Information on the MSU CHM structure was taken from the <u>Handbook for Premedical Students</u> (1996), which is published by CHM,

and from an interview with a professor in MSU CHM who is in charge of the year one curriculum.

As with most other medical schools in the United States, students who are applying to the medical school at MSU need to have completed the baccalaureate degree requirements. Usually, students who are applying to the medical school have science backgrounds in their undergraduate education, although this is not always the case. Students need to take the Medical College Admission Test (MCAT) before applying to medical school. They also need to submit an American Medical College Application Service (AMCAS) application with transcripts of all their academic work. Then, AMCAS forwards a copy of the student's application and MCAT scores to the College of Human Medicine. MSU CHM also recommends that students work or volunteer in medically related areas and volunteer in community service areas. After the admissions committee reviews the students' AMCAS application, grades, and MCAT scores, qualified applicants are asked to continue the application process by submitting a CHM secondary application, in which students relate medically relevant professional experiences, a statement of past or pending disciplinary actions, and plans for completing the CHM's premedical requirements. After these admission requirements are reviewed, students are interviewed. At that time, students need to have three letters of evaluation from professionals. Following the interview, the student's entire application, including letters of evaluation, is carefully reviewed by the Committee on Admissions.

Students who are admitted to MSU CHM receive four years of medical education. In the first year, called Block I, medical students learn fundamental biological,

psycho lecture amicu medica experie ambula campus Penins awarde taining special the mec take pa atvance consists Problem basis. B contexts second y psychological, and sociological science concepts. Block I consists mainly of large lectures. The second year of medical school, called Block II, consists primarily of a PBL curriculum, which is explained in detail later in this section. The third and fourth years of medical school are called Block III. Block III clerkships are physician-supervised learning experiences in which students work with patients at community hospitals and in ambulatory settings. These clerkships are completed at one of six Michigan community campuses, including Flint, Grand Rapids, Kalamazoo, Lansing, Saginaw, and the Upper Peninsula. Students who successfully complete the four years of medical school are awarded the MD degree. However, to become practicing physicians, they need further training, including a residency program in their choice of one of several medical specialties. Students spend three to seven years in the residency program, depending on the medical specialty they choose. After the residency program, physicians sometimes take part in a one- to three-year fellowship program, doing research and receiving advanced clinical training.

This study focused on students in the second year of medical school, which consists mainly of a PBL curriculum. PBL is described in detail in the following section.

#### Problem-Based Learning (PBL)

In this section, I discuss problem-based learning including its goals and theoretical basis. Because the adaptation of students' learning strategies in different instructional contexts was the focus of this study, I also discuss the differences between the first and second year of medical school, including curriculum and intellectual tasks.

What is PBL in general? The PBL approach has its roots in the discovery method of teaching promoted by John Dewey in the 1930s. The approach reappeared in the 1960s as the inquiry method of teaching science, heavily influenced by the work of Bruner and Piaget (Wilkerson & Feletti, 1989). Recently, PBL has been the subject of much attention in medical education. PBL was developed at McMaster University Medical School in the early 1970s (Barrows & Mitchell, 1975; Neufeld & Barrows, 1974). Currently, more than 70 medical schools worldwide employ PBL (Ravitch, Golub, Altman, & McGaghie, 1994). The crucial components of PBL curricula are the ideas that problems 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 problems are not viewed as mere supplements to lectures, but are regarded as a major part of the educational experience.

PBL can be defined as learning that results from a process of working toward the understanding or resolution of a problem (Alguire & Werner, 1992). PBL uses problems-in this instance, patient cases--as a stimulus for learning, provides an opportunity for problem solving, and allows for student-initiated searching for information.

PBL curricula are student centered to the extent that, during the course of discussing a problem, students can identify knowledge deficiencies on their own and, outside class, study to address those deficiencies. Coulson (1983) considered this the process of self-directed learning. As he described the process, students working through a problem will hit obstacles to their progress due to lack of knowledge. Each time they hit an obstacle they make note of what they need to learn and continue with the problem until

progress ceases. At this point, students develop a learning "prescription" with help from their tutor, access learning resources to acquire the knowledge they need, and then return to the problem either to start over or to pick up where they left off. In working with the problems, students are expected to draw on previous learning and experience, to pose questions concerning new issues, to set personal learning goals, to take responsibility for their own learning through independent reading and study, and to teach one another through student-to-student discussion.

However, although the term "problem-based learning" identifies a general approach to learning, there are variations among PBL curricula at different schools. Some medical schools such as McMaster, Maastricht, Newcastle, Hawaii, and Sherbrooke, or "tracks" in such schools as New Mexico, Bowman-Gray, Rush, and Ohio State, have no lectures and have only PBL curricula. Other schools such as Tufts, Harvard, New Jersey, Northwestern, Michigan State, and Medical College of Wisconsin employ PBL as one learning modality within a curriculum that may also include lectures, large-group discussion, and other learning formats. Schools also may differ in their conceptualization of curriculum, structure, expectations of students in PBL, preparation of cases, roles of faculty, and assessment of students (Ravitch et al., 1994). Blumberg, Michael, and Zeitz (1990) in their structured interviews with faculty representing seven North American problem-based learning curricula found that the examination development process varies from school to school. For example, at MSU, Harvard, and Mercer, the faculty-generated learning objectives determine the content of examinations. On the other hand, at Rush and Bowman Gary, student-generated learning issues are collected and used in preparing

examinations. Further, Blumberg et al. (1990) found that at Bowman Gary, McMaster, New Mexico, and Rush, students are evaluated on their ability to generate learning issues. For instance, on the first attempt on some evaluations, students in these schools generate learning issues and study from learning issues for oral exams, which follow. However, at MSU and Mercer, the examinations are closed book and students' ability to generate and resolve learning issues is not evaluated.

At MSU CHM, students and a faculty tutor/preceptor meet for two hours, three times a week. The preceptor facilitates problem-based learning discussion. Preceptors are faculty in medical school, both Ph.D.'s and M.D.'s. The principal responsibility of the preceptors is to facilitate the discussion and learning of the small groups in PBL class. They also evaluate the performance of each student in the group and provide feedback to them. At MSU CHM, there is a balance between teacher- and student-centered PBL curricula. For example, MSU PBL classes are very structured in that the learning objectives are defined by faculty and not by students. Also, students focus on specific reading assignments provided by faculty. However, students are expected to participate actively in class discussions. Because each school has unique characteristics within PBL programs, it is important to keep these characteristics in mind when studying a particular school.

<u>General goals of PBL.</u> In general, PBL is supposed to let students take responsibility for their own learning. Students develop learning strategies and habits that will serve them well for a lifetime of learning, particularly when they encounter unfamiliar problems. Glaser (1984) labeled these strategies and habits self-regulatory or

metacognitive skills. They include knowing what one knows and does not know, predicting outcomes, planning ahead, efficiently apportioning time and cognitive resources, and monitoring one's efforts to solve a problem or learn.

This approach also is supposed to enhance students' motivation to learn. Active participation in defining, resolving, or managing a problem points up the need to acquire new information, attitudes, and skills. When PBL is implemented across an entire institution, students develop learning styles commensurate with that approach and different from the learning styles demonstrated by students in a more traditional curriculum (Newble & Clarke, 1986).

PBL also restructures previous learning in an attempt to accommodate new information; new learning is organized for assimilation into existing knowledge structures (Schmidt, 1983). Further, teachers can use PBL to encourage students to assess their own learning. Discussion among peers allows learners to compare their answers to those of other students, to discover errors in their thinking, and to hear how correct solutions were derived.

PBL is supposed to promote self-directed learning skills, and the practice of selfdirected learning in the context of PBL thus enhances the probability and quality of continued learning once the student has graduated and throughout his or her career. Hence one might assume that the PBL experience allows students to enhance their independent-study strategies. Also, through small-group work, PBL can promote team efforts and the ability to work with others. This led me to believe that second-year medical students improve their small-group skills through the PBL experience.

Goals of the MSU model of PBL. The goals of PBL at MSU include:

- 1. To provide a clinical context for learning which will both anchor the learning and motivate the student.
- 2. To encourage active learning: If students are in a small group and working with a problem, they should be engaged actively in learning, not passive bystanders.
- 3. To provide a model of problem solving: What is learned will depend upon where the focus is: the student may learn skills in identifying learning needs, or skills for acquiring new information, or some other clinically relevant problem-solving skills.
- 4. To develop small-group skills: Since students work in a small group, they acquire some effective small-group skills. The PBL group provides a "human laboratory" in which group process can be examined and one's own group behavior can serve as a focus for learning as well. (Block II Preceptor Training, 1993, p. 1)

Theoretical basis of PBL. PBL has a cognitive-psychology perspective as its

theoretical base. As Schmidt (1983) and Norman and Schmidt (1992) suggested, three major principles derived from the cognitive-psychology orientation support the rationale and process of PBL: (a) the role of prior knowledge, (b) learning transfer, and (c) elaboration of knowledge.

The first principle of PBL is acknowledgment of the role of prior knowledge.

Learning, by its very nature, has a restructuring character. It presupposes earlier knowledge that is used in understanding new information. Current learning is affected by past learning. Well-written problems will activate students' prior knowledge of high school or undergraduate science. As such, a second-year medical student, while reading and interpreting an article, will probably make use of his or her secondary-school or firstyear medical school knowledge of biology. Thus, one of the goals of learning is to activate a student's year-one knowledge. Instructional methods, however, differ in their capacity to activate relevant prior knowledge (Mayer & Greeno, 1972). To be successful, the instructional method must activate the prior knowledge. PBL, by encouraging students' discussion, questions, and problem solving, is intended to activate students' prior knowledge for the current learning. Thus, it can be predicted that PBL allows secondyear medical students to activate their prior knowledge and hence connect their current learning to their existing knowledge more easily than first-year students.

The second principle of PBL is related to learning transfer, which Schmidt (1983) called "encoding specificity." This principle suggests that the closer the resemblance between the situation in which something is learned and the situation in which it will be applied, the more likely it is that transfer of learning will occur. PBL problems use real-life situations. Well-written problems present situations most commonly seen in practice. Barrows (1985) contended that medical students do not remember or cannot use the knowledge they learned in traditional basic-science courses because that knowledge was structured into mental organizations that are not useful in a clinical setting. That knowledge was structured around taxonomies and hierarchies, but not symptoms, signs, or courses of illnesses. Barrows proposed that learning basic science in a PBL format will structure the knowledge in such a way that students will remember it better and will be able to retrieve it when they need it in clinical practice.

The third theoretical principle of PBL is the importance of the elaboration of knowledge. Information will be better understood and remembered if there is opportunity for elaboration (Anderson & Reder, 1979). Examples include engaging in active discussion, answering questions, teaching peers, writing summaries, and formulating and criticizing hypotheses about a given problem (Schmidt, 1983). Providing opportunities for

elaboration is one of the main activities of PBL. Elaboration creates redundancy in the memory structure. Redundancy can be viewed as a safeguard against forgetting and an aid to rapid retrieval.

Overall, by encouraging students' active participation in discussion and problem solving, PBL facilitates students' learning, emphasizing the active role of the learner, in comparison with the more traditional curriculum.

#### Contents of the CHM curriculum.

### 1. First-Year Medical School

First-year medical students take biological-science courses including anatomy, physiology, biochemistry, histology, pathology, neuroscience, pharmacology, genetics, microbiology, and radiology. The instruction is discipline-based and is conducted in a large-class lecture mode.

In addition to these basic-science courses, students learn basic clinical science, which is taught in a series of clinical skills courses spanning Blocks I and II (three hours per week). From these courses, students learn the dynamics of the doctor-patient relationship, how to interview patients, and how to conduct physical examinations. Also, they take human development courses, which are taught in the summer semester. These courses provide a foundation for domains related to behavioral sciences such as psychology or sociology.

## 2. Second-Year Medical School

The second year of medical school (Block II) features a required PBL curriculum designed to facilitate the integration of basic sciences with clinically relevant cases. The

content domains of the second year include infectious disease, disorders of development and behavior, neurological and musculoskeletal, major mental disorders, cardiovascular, pulmonary, renal, metabolic, endocrine and reproductive, digestive, dermatology/allergy, and hematopoietic/neoplasia. At the beginning of each of these domains, students are given an "unpacked content list," which defines for them all of the content they are expected to know and understand at the end of that domain. The lists are organized by basic science disciplines, as is the first-year curriculum, although they contain more advanced and sophisticated knowledge. An effort has been made to relate the content lists to the cases as much as possible in terms of domain content. Each case is designed so that there are pieces of the content list that naturally elaborate from that case.

In addition to the PBL curriculum, students in Block II participate in a year-long seminar on medical ethics, health policy, and epidemiology, and learn advanced clinical skills. They also take part in the mentor program, which focuses on the personal development of the physician.

#### Process (task description) of case analysis in the MSU PBL classroom.

Cases are usually discussed and analyzed in two or more successive sessions. As the cases are analyzed, students define learning issues. Learning issues provide the bridge from one session to the next. They are the agenda for learning that the students define for themselves, the homework that students create. They determine what the students will be prepared to discuss and examine at the next meeting. All members of the group then focus on the learning issues in their study between sessions. Preceptors help students to define learning issues in ways that will make it productive for them, and not overwhelming.

The analysis of the cases proceeds in three general steps:

- 1. Define cues: What data are in the case that might be clues about what is going on?
- 2. Create hypotheses: ideas about what's happening, what the underlying mechanisms or principles that might be at work in this case. The hypotheses should be in terms of the underlying basic sciences, and not be possible diagnoses.

3. Generate learning issues: areas that will be emphasized during independent study, in order to better understand the case. This is a dynamic process. Rather than moving in a linear fashion from cues to hypotheses to learning issues, the preceptor helps the group move back and forth between cues, hypotheses, and learning issues. (Block II Preceptor Training, 1993, p. 7)

An example of each step of the PBL process is shown in Appendix D.

Intellectual tasks.

### 1. First-Year Medical Students

First-year medical students' intellectual tasks include (from discussions with the

director of Block I curriculum and the pilot study (Lee et al., 1994)):

- Mainly reading books, notes, and scribe notes. Scribe notes are notes which other

students have taken in the class and are distributed to those students who want them.

They are widely used among medical-school students.

- Solving assignments to understand the concepts, principles, and diagrams in preparation

for classes and exams.

- Taking notes during class.
- Memorizing the facts, concepts, principles, and so on (using various strategies such as mnemonics, diagrams, and connecting to experiences) for exams.
- Discussing and asking questions during review sessions or Supplemental Instruction (SI) sessions (optional).
- Studying with tutors (mostly for understanding the concepts)-optional.
- Interacting with patients (interviewing skills).

# 2. Second-Year Medical Students

Second-year medical students' intellectual tasks include (from *Block II Preceptor Training*, 1993):

Task Description	<u>Tasks (Skills, Ideas)</u>
1. Present the initial case	Listen to or look for the pertinent cues
2. Find cues	Find and organize cues
3. List hypotheses	List hypotheses in terms of principles
4. Receive additional information	Reduce the number of hypotheses, seek additional cues
5. Summarize facts	Summarize facts, change hypotheses
6. Generate learning issues	Identify knowledge deficiencies
7. Discuss resources	Look for the resources, research skills
8. Learn independently	Independently study the learning issues
9. Revise hypotheses based on independent study	Apply knowledge to the case
10. Review what has been learned	Review knowledge, connect new knowledge to previous knowledge

In addition to these tasks, second-year medical students' intellectual tasks include:

- Learning basic-science concepts in clinical context.
- Actively participating in discussions.
- Thinking and identifying the learning issues (identifying their knowledge deficiencies).
- Doing independent study for the next session, looking for resources.
- Integrating concepts and principles for problem solving.
- Improving small group skills.

- Asking questions.
- Interviewing patients.
- Studying for exams (multiple choice exams).

A comparison of learning tasks of first- and second-year MSU CHM medical students is shown in Table 2.1. A comparison of general PBL and MSU PBL is presented in Table 2.2.

Table 2.1: Comparisons of learning tasks between first-year and second-year MSU CHM medical students.

	First Year	Second Year
Assessment	Multiple-choice exams	Multiple-choice exams; essays occasionally
Learning Activities (Tasks) in Class	Mostly memorization of what will be on the exams; selecting main information; lectures; taking notes, interviewing skills, etc.	<u>To be studied</u> Problem solving - discussion of the case; generating learning issues for the next session, solving stimulus questions provided by faculty members, asking questions, etc. (It is hypothesized that they also focus on memorization for exams, thus doing different things for the class and the exams.)
Outside Activities	Solving stimulus questions that are at the end of the course packet; attending Supplemental Instruction (optional), participating in study group, tutoring, etc.	To be studied Independent study for learning issues, research, etc. (It is hypothesized that students use more learning resources such as library facilities.)
Content	Basic sciences	Basic sciences
Methods (Curriculum)	Mainly large lectures	PBL (mainly small-group discussion), large lectures (optional), etc.; balanced in that PBL has both teacher and student centered; teachers generate testing agendas

Note: First-year data are primarily from a pilot study of MSU students (Lee et al., 1994). MSU second-year data come from internal documents of the MSU medical school and from interviews with faculty members in the medical school.

	MSU PBL	General PBL
Assessment	Multiple choice; essays occasionally	Usually both essays and multiple choice are required
Learning Activities (Tasks) in Class	<u>To be studied</u> Problem solving - discussion of the case; generating learning issues for the next session, solving stimulus questions provided by faculty members, asking questions, etc.	Understanding oriented, problem solving, information gathering, reasoning, etc.
Outside Activities	To be studied Independent study for learning issues, research, etc.	More library use (information seeking), self-directed learning, doing research of their own, etc.
Content	Basic sciences	Basic sciences
Methods (Curriculum)	PBL (mainly small-group discussion), large lectures (optional), etc.; balanced in that PBL is both teacher and student centered; teachers generate testing agendas	PBL; most other programs have PBL curriculum for both first and second years, varied depending on program, but mostly student centered in that students generate learning agendas

Table 2.2: Comparisons between general PBL and MSU PBL

Note: General second-year data are from literature on various PBL programs.

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### **Research on Problem-Based Learning**

Vernon and Blake (1993) conducted a meta-analysis of PBL as compared with traditional methods of teaching. Their study included 25 studies carried out from 1970 through 1992. Albanese and Mitchell (1993) also did a comprehensive review of writings on PBL. They reviewed literature from 1972 to 1992 on the effectiveness of PBL. The diversity of the original studies reviewed, particularly with respect to outcome measures and research designs, enhances the tentative nature of the conclusions they reached. The results of both review studies were similar. Based on their research, the present researcher tried to provide a more comprehensive and detailed review of studies in the various areas of PBL.

Although students' approaches to learning were the focus of this study, knowing the effects of PBL on other areas helps in understanding PBL and how students may respond to it. Thus, the review of PBL research focused on several areas.

### Academic Achievement

Researchers evaluating PBL have explored academic achievement by using several outcome variables, including the National Board Medical Examination (NBME) Part I, "other knowledge tests," and the incidence of academic failure or attrition. Vernon and Blake (1993) analyzed data on the NBME from eight research reports. They found that effect size (ES) data suggested a significant trend favoring the traditional teaching method. Also, they found that traditional programs had an advantage with respect to other knowledge tests that required factual information. However, analyses of homogeneity among the ES measures have raised questions about the generalizability of the obtained

mean ES. For example, Albanese and Mitchell (1993) reported that, although the University of New Mexico program has shown consistently negative ES (favoring the traditional program), Michigan State University's earlier PBL curriculum showed consistently positive ES favoring PBL (Farquhar, Haf, & Kotabe, 1986). The University of Colorado (Nolte, Eller, & Ringel, 1988) and Mercer (Bickley, Donner, Walker, & Tift, 1990) also showed a positive effect for PBL. Such variations might be the result of different emphases in program goals at different schools. For example, the PBL curriculum at McMaster and New Mexico is more student centered, which exposes students to narrower content. Thus, they develop inadequate knowledge scaffoldings, which results in inferior performance on basic science examinations as compared to students in a traditional curriculum (Albanese & Mitchell, 1993).

Another possibility is that schools may have recruited different types of students into their PBL and traditional programs. For example, the MSU PBL program, at the time the research was done, may have recruited students with stronger basic-science backgrounds or interests, as compared with their traditional counterparts because the students self-selected the PBL curriculum track, whereas the opposite pattern may have prevailed at New Mexico (Martinez-Burrola, Klepper, & Kaufman, 1985).

### **Clinical Performance**

In their meta-analysis, Vernon and Blake (1993) found that PBL increased students' abilities in clinical reasoning, integration of clinical and basic science knowledge, and the independent study of clinical problems. Also, in contrast to results on NBME I, these data showed a slight, but nonsignificant, trend in favor of students in PBL programs.

For example, PBL graduates viewed the quality of their training in humanistic areas and clinical reasoning more positively than did conventional students. Conventional students tended to rate their training in biomedical science more positively (Post & Drop, 1990). Albanese and Mitchell (1993) found that, in all seven studies they reviewed, clinical ratings by faculty supervisors were either more positive for students in the PBL curriculum or nonsignificantly different from the ratings for the conventional group.

#### **Program Evaluation**

In their meta-analysis, Vernon and Blake (1993) found that PBL was significantly superior to the conventional approach with respect to students' program evaluation (students' and faculty's attitudes and opinions about their programs). In addition, distress (including depression, anxiety, hostility, and somatic complaints) was found to be lower among PBL students than their traditional counterparts (ES = +.51) (Moore-West, Harrington, Mennin, Kaufman, & Skipper, 1989). For example, Moore, Block, and Mitchell (1990), using interviews of students in PBL and conventional curricula at Harvard, found that the PBL students were more likely than conventional students to describe their preclinical years in medical school as being engaging, difficult, and useful (p < .05). The conventional students, on the other hand, were more likely to describe their preclinical experience as irrelevant, passive, and boring. Students seem to consistently enjoy the small-group interactions and atmosphere created by PBL. I expected that, through the experience of small-group interactions, students in MSU PBL classes would develop their small-group working skills.

Wetzel, Ramois, Armstrong, and Neill (1989), Feletti and Carver (1989), and Anderson (1989) studied faculty satisfaction with the PBL program at Harvard Medical School. Their findings strongly suggested that faculty found PBL a satisfying way to teach. The personal contact promoted by the small-group format was one of the most commonly perceived benefits of PBL.

Moore-West and O'Donnell (1985) reported on the stress levels of second-year medical students. The results indicated that PBL students were substantially less stressed than their conventional counterparts. Moore-West et al. (1989) also surveyed students in the two tracks about their perceptions of other aspects of the environment. The PBL students rated their experience higher in terms of meaningfulness, flexibility, emotional climate, nurturance, and student interactions. However, Moore et al. (1990) found that PBL students at Harvard thought their preclinical experiences were more stressful than did students in the conventional curriculum. Blumberg and Eckenfels (1988) studied students' levels of satisfaction with the environment in a PBL and a conventional curriculum. The most satisfying aspects identified by PBL students were problem solving, applicability, group discussions, and clinical relevancy. Conventional students identified the balance between individual excellence and group competence as being the most satisfying aspect. PBL students identified the least satisfying aspects of the experience as tendencies to encourage competition and essay examinations, whereas conventional students identified memorization of facts, lectures, and multiple-choice tests as least satisfying.

The results of these studies, suggesting that both students and faculty generally perceived the PBL environment as a positive one, are important because perceptions of

the curriculum could be a crucial factor to medical schools in deciding to make curriculum changes.

#### The Study Process (Study Habits)

Very few studies have been conducted on the academic processes associated with PBL. However, some research has been done on the process of learning in PBL, including students' approaches to learning and their use of various learning resources (e.g., the library). This research is discussed in the following pages.

Research on general approaches to studying. Marton and Saljo (1976a) studied Swedish university students' approaches to studying. They found that there were qualitative differences in the processing of learning--deep-level processing versus surfacelevel processing. Because the following research on students' approaches to learning focused on this framework, a detailed explanation of what Marton and Saljo meant by deep- and surface-level processing will be helpful. They defined deep-level processing as when students are directed toward the intentional content of the learning material (what is signified); that is, they are directed toward comprehending what the author is saying about, for instance, a certain scientific problem or principle. The authors defined surfacelevel processing as when students direct their attention toward learning the text itself (the sign); they have a "reproductive" conception of learning, which means that they are more or less forced to keep to a rote-learning strategy.

Following this framework, Coles (1985) and Newble and Clarke (1986) compared the study approaches of PBL and conventional medical students, using versions of the Approaches to Studying Inventory developed by Entwistle (1981). Both studies indicated

that students in PBL programs placed more emphasis on "meaning" (understanding) than on "reproducing" (rote learning and memorization), and that the opposite pattern prevailed among students in traditional programs. The researchers found that PBL students were more likely to use versatile approaches (p < .01) and meaning-related approaches (p < .001), and less likely to use reproduction (p < .001). They defined the surface approach as being motivated by a concern to complete the course or by a fear of failure, and intention to reproduce factual material, which promotes rote learning. Students using the deep approach, motivated by an interest in the subject matter, tend to reach an understanding. Those using the strategic approach, motivated by the need to achieve high marks and to compete with others, tend to be successful by whatever means are necessary. Coles (1985) argued that PBL may be creating an educational climate that enables students to learn in what seems to be a desirable manner. In contrast, a conventional curriculum appears to constrain students to adopt poorer approaches to studying, not only in comparison with PBL students but also as compared with their own approaches on entry.

Also, in their study of Harvard medical students, Moore et al. (1990) found that PBL students were less likely to engage in memorization and more likely to rely on conceptualization as a learning method as compared to conventional students. Similarly, Mitchell (1992) found that PBL medical students were much less oriented toward memorization, were much more oriented toward studying by reflection on material, and showed a trend toward conceptualization in their studies.

Van Langenberghe (1988) carried out research on a physical therapy PBL curriculum. Using the Short Inventory of Approaches to Studying developed by Entwistle (1981), he found that physical-therapy students in PBL in The Hague had more desirable studying approaches than did normative students. More specifically, he found that PBL students showed more drive to achieve, relied less on memorizing, and put more effort into understanding the subject matter. Thus, based on the PBL studies reviewed above, one might expect that students in PBL curricula develop skill in integrating the materials and focus more on understanding than on rote memorization.

Learning resources. Nolte et al. (1988), Rankin (1992), and Saunders, Northup, and Mennin (1985) studied the effect of introducing a PBL course on neurobiology into the medical curriculum. They found that library use increased 20-fold and that student attendance at formal instructional sessions increased from 65% to 90%. The researchers found that the PBL group and the traditional group differed in their use of learning resources in ways that were plausible and that favored PBL. Specifically, PBL students (a) placed more emphasis on journals and on-line searches as resources; (b) made greater use of the library; (c) made greater use of self-selected, as opposed to faculty-selected, reading materials; and (d) more frequently felt competent in information-seeking skills. These findings led me to believe that students in PBL classes would evidence increased use of learning resources such as the library and self-selected reading materials.

Blumberg and Michael (1992) studied PBL as related to self-directed learning. They did not find differences between groups in terms of study time, but they did find that the PBL group and the traditional group relied on different resources for studying.

Compared with their conventional peers, the PBL students reported greater use of textbooks, journals and other books, and informal discussions with faculty or peers. They reported significantly less use of cooperative lecture notes (p < .001).

In general, the findings from these reports suggest that there is a greater degree of independent study in PBL programs than in traditional programs, as well as greater emphasis on depth of understanding rather than on rote learning and memorization. Most of the studies done in this area had static-group research designs (traditional students' ratings of their courses were compared with the ratings of nonequivalent PBL students) or relied on questionnaires.

### Summary of PBL Research

Most of the PBL research in this area favored PBL over traditional programs. However, there are drawbacks in how the outcomes were measured. For instance, most researchers have used the standardized achievement tests of the NBME, but standardized examinations measure only the examinees' ability to recognize the correct answer from a limited list of potentially correct answers and are heavily oriented toward recall. PBL proponents have argued that such measures do not assess study approaches aimed at the deep learning that PBL promotes (Albanese & Mitchell, 1993).

Further, not all of the views of PBL are favorable. For instance, in her review of PBL research, Berkson (1993) expressed a pessimistic view of PBL. Although many researchers have suggested that PBL promotes deep approaches to study, which enhance understanding, Berkson argued that most students are flexible in their choice of learning strategy, and PBL can provoke highly strategic rote, or reproductive, learning behavior.

She argued that tasks that require comprehension for a successful conclusion, whether they occur in PBL or traditional curricula, will encourage the use of a comprehensiondirected, or deep, cognitive learning approach. Concerning motivation, Berkson argued that interest (motivation) is important to learning behaviors because it focuses students' attention, stimulates deep processing, sustains persistent study, and increases tolerance of frustration. However, PBL is not unique in its capacity to stimulate curiosity in students or to create satisfying learning environments. Berkson argued that students who feel insecure in guiding their personal learning experiences may lose interest in the subject matter as a result of frustration or peer performance pressure.

### Summary of the Literature Review

My purpose in this study was to examine the learning strategies of second-year medical students who were under the PBL curriculum to determine how they adapted to the PBL curriculum from a large-lecture-based curriculum. To understand and fulfill this goal, the review of literature and research was based on three purposes--understand learning strategies, which was the focus of the study; understand different instructional contexts--lecture versus PBL; and review previous PBL research on study approaches--in order to derive the rationale, research questions, and working hypotheses.

In this study, learning strategies were defined as tactics that increase the likelihood of effective and efficient learning, such as helping the learner encode the information, memorize, and learn easily. More specifically, following the definition of Weinstein and Mayer (1986), learning strategies can be considered as thoughts and behaviors that a learner engages in during learning and that are intended to influence information

processing. Learning strategies include basic memory processes as well as general problem solving, and they encompass almost all cognitive processes.

The review of the instructional contexts revealed that medical students in MSU CHM experience varied curricula, mainly large lectures delivered by professors during their first year, and small-group discussion of cases or problems in PBL classes during their second year. Further, the review of the nature of PBL in general and in MSU CHM specifically indicated that MSU CHM has a unique structure for its PBL classes. For example, it was found that MSU CHM focuses mainly on multiple-choice exams as assessment and is more structured in the sense that professors, not students, generate testing agendas and formulate objectives, although they also allow active student participation in small-group discussion.

The review of the PBL research in academic achievement area indicated that there is a significant trend favoring the traditional curriculum. However, researchers have found that PBL students evaluated their curriculum more favorably than did conventional students and that PBL increased students' abilities in clinical reasoning and integration of clinical and basic science knowledge. Further, PBL research indicated that PBL students tended to study differently from conventional students. They are less likely to study for short-term recall and more likely to study for understanding, or to analyze what they need to know for a given task and study accordingly. PBL students also control substantially more of their learning efforts than do conventional students. In addition, PBL students are substantially more likely to use the library and library resources to study. However, the

results of the PBL research have not been consistent, so further study is needed to understand how students in PBL curricula approach studying.

The research questions and working hypotheses for this study were derived by reviewing previous studies on PBL and different instructional contexts at medical schools. Although hypotheses should not constrain what is understood from the data collected in a qualitative study, having working hypotheses derived from previous studies not only guided the analysis of data from a vast number of interview protocols but also helped in comparing the findings with those from previous studies. The research questions of this study and working hypotheses derived from the review of the literature are stated in the following section.

#### **Research Questions and Working Hypotheses**

- 1) What learning strategies do students use in preparation for the problem-based learning classroom, and why?
  - a) Students will study differently for PBL classes than for examinations.
  - b) Students will focus more on understanding than on rote memorization in preparing for PBL classes.
  - c) Students will use many learning resources, such as library facilities, for PBL classes.
- 2) What learning strategies do students use in preparation for examinations (both class exams and the licensing exam), and why?
  - a) Students will use strategies for integrating the materials for exam preparation as a result of their PBL experience.
  - b) Students will use many memorization strategies in preparing for exams.

- c) Second-year students will use many strategies for selecting main information because of the large study load.
- 3) What do students think influences their learning strategies (such as goals, assessment of learning, student activity, teaching method, and course content)?
  - a) Students will think that the PBL curriculum affects their use of learning strategies.
  - b) Students will develop their communication strategies influenced by the PBL experience.
- 4) Do second-year medical students at MSU CHM report that they study differently than they did in their first year? If so, how and why?
  - a) Second-year students will develop skills in integrating the materials and focus more on understanding the materials as a result of their PBL experience as compared to their first year.
  - b) Second-year students will have improved their strategies for selecting main information because of the large study load as compared to their first year.
  - c) Students will develop research skills and do more independent study as a result of the PBL experience as compared to their first year.
  - d) Students will use more learning resources, such as library facilities, self-selected reading materials, or textbooks than they did in the traditional curriculum.

### СНАРТЕК Ш

### METHODOLOGY

#### Introduction

This chapter contains a discussion of the methodology used in conducting the study. The population and sample for the study are described first. Next, the instruments used to gather data for the study are discussed. Two data-collection methods were used, personal interviews and the Learning and Study Strategy Inventory (LASSI). Dataanalysis procedures are explained last.

### Subjects of the Study

## **Population**

The population of this study comprised all medical students who experienced PBL curricula. Because the samples were chosen from medical students in the College of Human Medicine at Michigan State University, the accessible population comprised second-year medical students at MSU CHM (during the 1994-95 academic year). Each year, approximately 106 students enter the CHM at MSU. About 15% are underrepresented minority students, and almost 50% are women. During their first two years, students study the basic sciences such as physiology, anatomy, biochemistry, and

pharmacology. This research focused on education during the second year of this twoyear preclinical period, which consists primarily of PBL classes.

Medical students were chosen for this research because studying their learning strategies in lecture-based year one and their learning strategies in PBL based year two was consistent with the purpose of this study. That purpose was to examine how secondyear medical students adapt their learning strategies to changes in the instructional context.

### <u>Sample</u>

Interview sample. Of the second-year medical students, eight students who participated in the pilot study during the 1993-94 academic year and four other secondyear medical students participated in interviews about learning strategies for this research. Because two of the original eight students were not taking PBL classes at all during 1994-95, the additional four medical students were interviewed to match the responses of the original students who participated in the pilot study. The eight students who had been interviewed the preceding year were matched based on their entrance exam scores (MCAT) to account for preexisting differences among students in two different groups--students in Supplemental Instruction (SI) and students who were not in SI. Supplemental Instruction is an academic support intervention designed not only to help students master course content but also to develop their learning strategies (Martin, Black, & DeBuhr, 1983). Of these eight students, two represented high, five represented middle, and one represented low to middle academic performance levels. Six of the students were females and two were males. To select four additional students for the interviews, I determined second-year medical students' academic performance and gender so that the total group of interviewees would represent various performance levels and both genders. However, because only those students who agreed to participate in the interviews were selected for the study, the interviewees did not represent various levels of academic performance as expected. For example, most students in the low group did not agree to participate in the study; as a result, only one interviewee represented the low performance level. In sum, of the 12 interviewees (excluding two pilot interviewees) who participated in this study, seven were female and five were male. Six of them represented the middle level of academic performance, whereas five represented the high level of academic performance. Only one student represented the low academic performance level. Thus, although I attempted to match the interviewees by academic performance and gender, in order to represent the population more accurately, the effort did not succeed as planned.

LASSI sample. Most second-year medical students were administered the Learning And Study Strategy Inventory (LASSI), which measures students' affective and cognitive processes. However, only those who agreed to participate in the study were included in the sample. Most of these students were the same ones who had taken the LASSI in the 1993-94 pilot study, in which the LASSI was administered to all students. By administering the LASSI to second-year medical students, I could compare students' first-year learning strategies at the time of the 1993-94 pilot study with their learning strategies during 1994-95.

#### Instrumentation

#### **Interviews**

Development of interview questions. I developed the questions for the interviews after consulting with several professors about the appropriateness of the questions for drawing out students' use of learning strategies during their PBL classes. The interview questions were intended to gather information to answer the research questions and therefore to discover the students' learning strategies under PBL curricula, how they had changed their learning strategies from what they had used during their first year, and their perceptions of PBL. The final version of the interview questions is included in Appendix B. Some of the questions used in the 1993-94 pilot study concerning learning strategies of first-year medical students were used because they had been successful in gathering information on students' learning strategies. For example, interview question 3--"How did you study for a PBL exam you have taken recently?"--was adapted from the previous year's questions (except that the word "exam" was changed to "PBL exam") because this question had elicited the desired information on how students used their learning strategies in studying for exams.

Several consultations with professors, as well as pilot interviews with two medical students, were conducted to refine the interview questions. The two medical students were selected through the recommendation of a medical professor, and they agreed to participate in the pilot interviews. As a result of the pilot interviews, I made minor changes in the interview questions and changed the order of some questions to draw more appropriate information from the students and to avoid repetition. For example, from the

pilot study, I discovered that students did not necessarily study differently for PBL classes and for exams, as expected. Thus, before asking their approaches to preparing for PBL classes and for exams, I asked "Do you prepare differently for PBL classes and PBL exams?" Further, I determined the approximate time needed for the final interview from the pilot interviews.

I used open-ended questions in the interviews to elicit detailed and clear explanations of students' use of learning strategies. For example, I asked such questions as "Would you describe what you do during the PBL classes?" in order to learn what students did during the PBL classes. Also, after listening to the interviewees' answers, I asked follow-up questions to ensure that the topics interviewees discussed pertained to the focus of the study.

Interview procedure. In February and March 1995, I interviewed the same eight students who had been interviewed the preceding year. Interviewing the same students was important because their learning strategies for the first and second years could be compared, and changes in their learning strategies shown more clearly.

I explained to each participating student the purpose of the study, the types of data to be collected, the estimated time their participation might require, and any potential risks and benefits of participating in the interviews. Only those students who signed a consent form (Appendix A) were interviewed.

Interviews were scheduled at times and places convenient to the students, such as before or after the class time and in the place where their class met. The interviews were conducted during spring semester 1995. At this time, as a result of their first-semester
experience with PBL, the students knew the learning strategies that they used under PBL. Before the interviews, I informed the students that there were no right or wrong answers to the questions, but that I was interested in their approaches to learning under the PBL curriculum. I tape recorded with the permission of the interviewees, and I also took notes.

The first interviews took approximately an hour each. After the first interviews, I analyzed the interview content and tried to find some patterns with regard to students' learning strategies. To obtain more knowledge regarding interviewees' learning strategies, to answer the research questions, and to clarify responses from the first interviews, I conducted a second interview with each participant. The interview questions for each interviewee were not identical at the second interview. The second interviews took approximately 20 to 30 minutes each. Two students had not taken PBL classes at all that semester; hence, they were not interviewed a second time. Also, two interviewees could not take the time for another interview, so e-mail was used to clarify certain points.

## Learning And Study Strategy Inventory (LASSI)

<u>What is the LASSI?</u> Weinstein, Palmer, and Schulte (1987) developed a standardized self-report measure, the Learning And Study Strategies Inventory (LASSI), to measure college students' affective and cognitive processes. Nine years in the making, the LASSI appears to be soundly constructed. Weinstein et al. conducted two pilot tests and a number of field tests on the LASSI.

According to the LASSI User's Manual (Weinstein et al., 1987), the inventory is designed to measure college students' use of learning and study strategies (p. 2). The authors ensured that the LASSI could be used (a) for diagnosis and remediation of

studying weaknesses, (b) as a pre- or posttest to measure student achievement and to evaluate the success of study-strategies courses, and (c) as a counseling instrument in college orientation courses. The LASSI measures "both overt and covert thoughts and behaviors related to successful learning . . . that can be altered through educational interventions" (p. 2).

The LASSI takes 15 to 20 minutes to complete and 10 minutes to score. It is a self-report instrument; students respond to items on a 5-point Likert-type scale ranging from "not at all typical of me" to "very much typical of me." Approximately half of the items are numbered from 1 to 5 whereas the other half are numbered from 5 to 1. This is because some items are stated in a positive direction, such as "I use special study helps, such as italics and headings, that are in my textbook," whereas the others are stated in a negative direction, such as "I have difficulty identifying the important points in my reading." Overall, higher scores on each scale meant that students have better learning strategies on that specific scale. The LASSI has 77 items in 10 scales measuring different clusters of learning strategies and study attitudes. The 10 scales of the LASSI include Anxiety, Attitude, Concentration, Information Processing, Motivation, Scheduling, Selecting Main Ideas, Self-Testing, Study Aids, and Test Strategies. The evidence for reliability is strong. Coefficient alpha and test-retest correlations (3-week intervals), calculated for each of the 10 scales, range from .68 to .86 and .72 to .85, respectively.

The validity of the LASSI has been examined using several different approaches. The scale scores have been compared, where possible, to other tests or subscales measuring similar factors. For example, Weinstein, Zimmermann, and Palmer (1988)

correlated scores on the Information Processing scale of the LASSI with scores on the Elaborate Processing scale of Schmeck, Ribich, and Ramanaiah's (1977) Inventory of Learning Processes ( $\mathbf{r} = .60$ ). Several of the scales have been validated against performance measures. For example, scores on the Selecting Main Ideas scale have been compared to students' scores on selecting main ideas from texts and other readings ( $\mathbf{r} = .40$  and above) (Weinstein et al., 1988). A brief description of each LASSI scale and sample items are included in Appendix C.

The LASSI was used as an assessment instrument in this study on learning strategies because (a) by using this instrument, comparisons could be made with the same students' LASSI scores from the previous year; and (b) some scales, especially the Information Processing, Selecting Main Ideas, Study Aids, Self-Testing, and Test Strategy scales, were assumed to be related to the PBL curriculum, as shown in the literature on learning processes under the PBL situation.

Selection of the LASSI. The main reason for selecting the LASSI for use in this study was that subjects' scores could be compared with their scores from the previous year. The previous year, the CHM had used the LASSI for administrative purposes for the entry medical students, so it was convenient for the researcher to use this inventory. By having LASSI scores for the same students in two different contexts, I could examine whether and how students' use of learning strategies had changed in relation to the PBL experience.

Because the LASSI originally was developed for undergraduate students, to ensure that the LASSI was appropriate for use with graduate professional students in PBL

curricula, I inspected each question on each scale in the LASSI with two medical professors who are experts in the PBL curriculum. From the analysis of each question, it was found that the affective-domain questions, including the Attitude, Motivation, Time Management, Anxiety, and Concentration scales, for the most part included general questions that were not necessarily related to learning strategies that are encouraged in a PBL class. However, the items on the Information Processing scale reflected learning strategies encouraged in a PBL class.

I and two medical professors who were experts on PBL curriculum rated the individual items of the LASSI as being PBL sensitive or not. The professors and I examined each LASSI item and divided the 77 items into two scales--termed the PBLsensitive scale and the PBL-nonsensitive scale. Only those items that all three of us agreed were PBL related were included in the PBL-sensitive scale. Because the analysis of the LASSI using the individual items could not be done with all three LASSIs because of missing data on the second LASSI, I created another set of subscores from the original LASSI scales, so that one subscore represented PBL-related scales and the other did not. The authors of the LASSI suggested that five scales (Motivation, Anxiety, Attitude, Concentration, and Time Management) represented the affective domain, whereas the other five scales (Information Processing, Self-Testing, Studying Aids, Test Strategy, and Selecting Main Ideas) represented the cognitive domain. By carefully discussing the individual items in consultation with the medical professors who were experts on PBL, I noticed that the cognitive domain of the LASSI had items related to PBL participation, whereas the affective domain of the LASSI did not.

Thus, I conducted a MANOVA repeated measures analysis using two subscales (named the PBL-related scale and the PBL-unrelated scale) derived from the original LASSI scales. The PBL-related scale included the Information Processing, Self-Testing, Study Aids, Test Strategy, and Selecting Main Ideas scales from the original LASSI scales. The PBL-unrelated scale included the Motivation, Anxiety, Attitude, Concentration, and Time Management scales.

Overall, most of the scales in the LASSI exemplify the general nature of learning strategies and were designed to reflect large-lecture instruction. However, because the second-year medical students also took large lectures in addition to PBL, the LASSI could show whether students changed on any of the scales from the first to the second year. Further, the Information Processing scale might reveal students' change in learning strategies in relation to their experience with PBL. However, it is possible that students' scores on the LASSI would not reveal significant changes from the first to the second year, even on the Information Processing and Self-Testing scales, which the PBL literature supports, because it was found from the pilot study that the first-year medical students already had very high scores on these two scales (Lee et al., 1994).

LASSI administration procedure. The LASSI was administered to most of the second-year medical students in early February 1995. Because it was hard to have every second-year medical student at one place at one time, the LASSI was administered after a class that most of the students were required to take. The LASSI was administered for research purposes only. At my request, a medical professor administered the instrument. I notified students of when the LASSI would be administered, the time needed to

complete the instrument, and the purposes of the research. I also assured them that their responses and identities would be kept confidential. Only those students who agreed to participate in the study and signed the consent form giving permission to use their scores for research purposes took the LASSI. Because only 45 out of 109 students took the LASSI when it was first administered, the medical professor contacted students who were not in class that day through e-mail. Ten more students took the LASSI the following week; thus, a total of 55 students completed the LASSI for this study in February 1995.

#### Data Analysis

#### Interview Data

Most learning-strategy studies have included variables that were theoretical constructions imposed on the phenomenon (Svensson, 1977). If one's understanding is to be close to the phenomenon, then the terms used to describe and understand the phenomenon should emerge from analyzing instances observed in people in different situations or contexts. It is essential to recognize that a student's perception of a situation is as important as the situation itself. Thus, in this study, I analyzed the transcribed interview responses to gain an understanding of the phenomenon (in this case, learning strategies under PBL), rather than using preexisting learning-strategy domains, such as the ones that emerged from the 1993-94 pilot study.

Qualitative research is, by its nature, flexible so that the researcher's original frameworks or assumptions do not constrain what can be understood from the data collected. Rather, the intention is to discover patterns during the data analysis. As Tesch (1989) pointed out, "analysis is not the last phase in the research process, rather it is concurrent with data collection" (p. 95). Thus, the analysis of the interview responses was continually modified to fit the verbal data rather than fitting the verbal data to the theoretical framework or the categories that emerged from the 1993-94 interviews.

The overall approach to analyzing the interview responses was drawn largely from the work of Bogdan and Biklen (1992) and Tesch (1989). First, after collecting the interview data, I transcribed all of the interview responses. Then I read the transcriptions, trying to be flexible in finding a new framework of learning strategies rather than being constrained by a preexisting conceptual framework.

I then read the interview transcripts several times to discover possible learningstrategy categories. For example, I looked for similar attributes from each protocol, such as "look at the starred objectives to find what is important information," and gave names to those attributes, such as "selecting main information strategies." I coded every learning strategy the students mentioned in the interviews and formulated tentative categories of strategies. I then applied these initial categories to the individual interview responses, and modified classifications that did not seem to fit during the process of matching the merging categories with the data set.

While doing this, I reviewed any verbal report that was confusing so that it could be placed in any number of categories to which it was related. For example, solving practice quizzes at the end of the coursepack could belong to either checking knowledge or selecting main information for tests, according to how the student used the technique. A coursepack contains articles from the medical literature and material prepared by the

faculty. Students purchase a coursepack for each PBL domain, and it includes some of the content that they are expected to learn.

I repeated this coding process several times to clarify the definition of each category and to ensure the comprehensiveness of each learning-strategy category. While doing this, I consulted with professors including my advisor several times regarding the names of the learning-strategy categories and individual learning strategies that belonged in these categories to increase the validity of the categories.

Next, I described each interviewee's response regarding each learning-strategy category that emerged, based on each interview question, in the form of a case study. I recorded evidence I found in the transcripts for each case description. Then, I reviewed each individual case to check the tentative findings in order to find the pattern of learning strategies that ran through each case. For example, I tried to clarify common patterns by making charts and counting the numbers of interviewees who mentioned a certain learning strategy. In doing so, I also recorded typical examples from the protocols for each learning strategy. However, because most of the findings were based on the interviewees' own reports, there is a possibility that some students did not report using a certain learning strategy even though they did use it.

Because not all of the vast amount of data found through this process could be used for this study, I tried to make key points in each interviewee's case that essentially answered the research questions of this study. While doing this, I enumerated students' reported learning strategies whenever possible. Thus, the interview responses were

analyzed "according to the organizing system that is predominantly derived from the data themselves" (Tesch, 1989, p. 96).

### The LASSI Data

Scores were available from three administrations of the LASSI, two from 1993-94 (Year 1, time 1 and time 2) and one for the present study (Year 2, time 3). To compare year one to year two using the entrance LASSI scores (time 1) as a baseline, I used the data from all three LASSIs. I used multivariate analysis of variance (MANOVA) with repeated measures because there were 10 dependent variables (10 scales from the LASSI inventory), and I was interested in seeing the changes at three times. Because there were no between-subjects variables for the research, I used only within-subject MANOVA repeated measures; the within-subject factor was "time." Further, using MANOVA instead of 10 single t tests reduced the alpha (the type I error rate).

In addition to the MANOVA using three time points, I also analyzed the data from time 1 and time 2, and from time 2 and time 3, in order to determine where the differences, if any, existed. This also allowed me to use more data in each analysis because only data completed for two time points is needed. Further, to reflect the effect of PBL on students' learning strategies more clearly, I analyzed the LASSI data using scales I derived (called PBL-sensitive versus PBL-nonsensitive scales), in addition to analyzing the original scales of the LASSI.

The schedule and the numbers of subjects who were interviewed and who completed the LASSI for this study are shown in Table 3.1.

	Time 1 (Entry)	Time 2 (Lecture)	Time 3 (PBL)
Interview	August 1993	January 1994	February 1995
	( <u>n</u> = 8)	( <u>n</u> = 8)	( <u>n</u> = 12) *
LASSI	August 1993	January 1994	February 1995
	( <u>n</u> = 109)	( <u>n</u> = 91)	( <u>n</u> = 55)

Table 3.1: Schedule and number of subjects for interviews and LASSI administrations

a:  $\underline{n} = 14$ , including pilot interviewees

### **CHAPTER IV**

#### RESULTS

#### **Introduction**

There are two sections in this chapter. First, I analyzed each interviewee's responses and described those responses in the form of a case study corresponding to each interview question. Two examples of case studies are featured in the first section of this chapter. The case studies for other interviewees are included in Appendix F.

In the second section, I describe the common patterns that emerged from the students' responses to each interview question. In presenting the findings for the research questions, I evaluated the working hypotheses whenever evidence was available. I drew the findings regarding Research Questions 1, 2, and 3 primarily from the interview data. I drew the findings for Research Question 4 from the interview and LASSI data.

#### **Examples of Two Case Studies**

In this section I feature two case studies, Jim and Laura, corresponding to each research question. At the end of each case study, I present a summary of key features. I look closely at and comment on these two cases because Jim and Laura are representative of the 14 interviewees (including the pilot\_interviewees) in terms of gender and race (Jimmale and white, Laura-female and black). Further, because these two students

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participated in the previous years' study, I could find rich data from their cases regarding their strategies the first and second years in medical school. Further, Jim took Supplemental Instruction the previous year, whereas Laura did not. Although I chose these two cases as examples from the 14 case studies, readers can refer to the other interviewees' learning strategies in Appendix F.

<u>Jim</u>

# <u>Research Ouestion 1</u>: What learning strategies do students use in preparation for the problem-based learning classroom, and why?

It is important to mention that, to Jim, studying for PBL classes was not different

from studying for exams. The only difference Jim mentioned was that he studied

integratively for the materials in a PBL group, whereas he tried to pick out the information

for exams, as shown in his statement:

PBL helps me to integrate concepts. For example, we did pulmonary, we did cardiovascular before Christmas break. And then we just did renal. And a great number of the diseases will affect more than one system. So that certainly helps. A lot of cardiovascular pathology can affect the renal system, for example, or the renal system's involved. So learning it in systems helps to integrate the body as a whole. However, the exams are multiple choice, and I always remember that. When you get down to the week before, I'm picking out facts and I'm picking out the information that will be on the exam. Yes, I'm learning the information, but I'm also focused on doing my best on that exam. So there's sort of a twofold purpose to preparing. You could have a very good understanding of the content and know a lot of it, and still not have the facts to succeed on a multiple choice test. You know, it's narrowing down the edges and really picking out the key concepts that could be tested.

<u>During class</u>: As described in the PBL curriculum section, Jim mentioned that his PBL group attempted to find cues from the cases that were provided. He said that his group tried to look at "abnormal things" from the case or use their past knowledge in order to find cues or to form hypotheses. His PBL group also questioned what they did not understand in order to probe for more information, list hypotheses from that information, and finally raise learning issues. Thus, the learning strategies that Jim used during the PBL class involved drawing information from his past knowledge and trying to find abnormal features from the provided cases.

The main learning strategy that Jim used in order to combine PBL class preparation and exam preparation was matching objectives with learning issues. Learning issues are the agenda for learning in PBL classes that the students define for themselves, the homework that students create in their PBL classes. They are the areas that are emphasized during independent study, in order to better understand the case provided during PBL class.

Jim mentioned that when his group raised learning issues, they asked, "Does it fit the objectives?" If it did not, they did not spend time on it. He also mentioned that objectives helped to direct learning issues. For example, if a learning issue was very broad, he tried to narrow it down, based on the objectives.

We had recently tried in my group to try to police the objectives. Like for instance, they can throw in a piece of information about a case and we say, "OK, we're going to write a learning issue about this. Does it fit the objectives?" If it doesn't, we won't write a learning objective about it, we won't spend any time on it.

Learning issue study: Jim's main motivation in looking for learning issues was to participate in class. To study learning issues to prepare for the next PBL class, he usually found books at home and did not go to the library. Jim also used computer programs to find learning issues. He said that faculty in the department wrote computer programs, and those programs provided "very good insight into what's critical to know." Jim mentioned that PBL classes helped to achieve objectives that were mainly on the exams because the group process ensured that learning issues directly responded to the objectives. Also, his PBL small group discussed, questioned, debated, and pointed out the points they thought were important during the PBL class.

## <u>Research Ouestion 2</u>: What learning strategies do students use in preparation for examinations (both class exams and the licensing exam), and why?

Reading: The basic study mode that Jim mentioned was reading materials more than twice. The first time, he read everything critically, looking at pictures, diagrams, and references. He also highlighted about three-fourths of the materials because doing this made him keep track of his reading. When he read the materials a second time, he looked at what he had highlighted and tried to correlate the coursepack and lectures. Then, he highlighted with different colors, narrowing down the facts to what he needed to learn. To explain his reading strategy, Jim mentioned,

I'll read the first time through completely. I don't mind taking that time. Then I've got a big picture in my mind. Then when I come back I've got a constant reference in my mind. I can come back to the content list and say, "OK, what are the details that I missed?" Or "What is important that I didn't get out of the reading that I need to search for?"

Jim also took notes from everything he read. According to him, taking notes and writing them down in the margins made him build up speed in the next reading and helped him gain mastery of the material.

<u>Group study</u>: Jim studied with two other students. He said he used group study more the second year than the first year. His group study was like a small PBL class

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except that they did not raise learning issues. Members of his group studied on their own before getting together; when they met, they read the objectives and talked through them. For example, when they studied for drug x, they talked about how it acted and where it acted. Then they quizzed each other, correcting their misunderstandings. Jim mentioned that group study pushed him to go through the material one more time when he was bored with his own reading.

Integration strategies: Jim said that integration was a broader overview, an overall picture of what's happening. For example, he said if one explains how the system operates and happens, it is integration. For studying concepts he needed to understand, Jim usually drew flow charts or diagrams of what happened. Also, he used computer programs that contained information he needed to integrate different topics, and this helped him see the whole picture.

Memorizing strategies: Jim thought rote memorization was knowing symptoms of something without knowing in what system it was occurring. For example, if one knows the heart has two sounds and gets valve closure and memorizes these facts using mnemonics without knowing how the heart actually operates, it is rote memorization. To study facts, Jim mainly read materials, talked about facts, and made charts and tables showing similarities and differences. He mentioned that he did less memorization the second year than the first year.

<u>Selecting main information</u>: Jim looked for overlapping information in the objective lists, coursepack, and textbook in order to find the main information he needed to know. For example, electronic and mechanical coupling of heart contractions runs

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through all information sources because it is the ground level, and he knew this was important information to know. Also, he gained insight into what was important to know through lectures.

On the objective lists, Jim knew which objectives were the most important by the number of stars in each objective. For some domains, faculty prioritized the importance of the objectives by providing stars. If no stars were given to the objectives provided in a certain domain, Jim looked for quiz questions in a coursepack because they were formulated by those who wrote the exam questions. This also indicated that Jim cared about information that might be covered on the exam.

<u>Computer programs</u>: Jim mentioned that when faculty developed computer programs, these programs provided good insight into what it was critical to know. Thus, he used computer programs as a way of selecting the main information to learn. Also, computer programs are interactive because they give immediate feedback on quiz questions, as illustrated by his comment:

They [computer programs] provide another source of information from the textbook. That doesn't make them different from the textbook, but it's another source. They're a little more interactive in that they often have quiz questions. Because what will happen is you'll go through a particular topic and they'll break it down in outline form. And then they'll give you the details and they'll show you a few pictures. And then they'll ask you, "What is this?" And then they give you the correct answer and feedback. Not all of them do that, but some do. But generally, they're very similar to the textbook because they have the same material in them.

Jim mentioned that pictures in the computer program are better than those in the textbook because they are not restricted by the headings, as those in a textbook are. Also, computer programs integrate things from different disciplines, such as physiology, pathology, and biochemistry.

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<u>Checking knowledge strategies</u>: When Jim read materials a second time, he asked himself questions. For example, he asked, "Okay, what is important, what did I learn, what are the main ideas I need to take away from this, what will make me happy if I get a 'Now, I know.'" Also, his study group used practice quizzes to check their knowledge.

Lecture attendance: Jim went to lectures regularly. Rather than using scribe notes, he took his own notes in the lectures. He thought that lectures were another way of getting a focus on the important information as seen by experts. Lectures provided what the lecturer thought was essential to know and also allowed Jim to ask questions. Also, Jim was paying for his education, which included lectures, so he felt a responsibility to attend them, as shown by this statement:

Why I go ... I go because those people have spent their time to put together a lecture to try to give you insight to what's important, what they think is essential to know. It's another source of information. It provides yet another means of getting the information. It points me to what's important in their perspective. It allows me to ask questions. And I feel like I'm paying for my education, and that includes lectures. I feel a responsibility to do it.

Additional strategies: In addition to the strategies mentioned above, Jim also checked his coverage of the objectives. For example, he took major headings in pharmacology from the objectives and read the textbook. Then he looked at the objective lists again to see whether he had covered all of the detailed objectives or important things in his reading.

Also, Jim used organization strategies. For example, he said that he wrote down critical points while reading. He categorized things in his mind as he read, and if something fit one of his categories, he wrote it down or highlighted it. For example, for

tumors in pathology, he needed to know the incidence, gender, and age group in which they occur. Then he wrote those things in the margins while reading.

Board preparation: Jim said he planned to take the ArcVentures program, which is a board review course. He also thought that PBL classes would help him study for the board.

## <u>Research Question 3</u>: What do students think influences their learning strategies (such as goals, assessment of learning, student activity, teaching method, and course content)?

Jim thought that his old study habits influenced the way he used his learning strategies. He also said the PBL process "directed" his learning. For example, when he had a case involving a patient with diabetes, instead of reading someone else's notes, he learned about the disease by looking at related materials and researching the disease.

Jim's goal was "learning the material" rather than passing the exams. He mentioned that he would like to achieve good interaction with the group and prepare for the exam through the PBL classes. In general, he said that he liked PBL, but he did not forget to mention that careful selection of a preceptor is important.

The only thing I would like to see is, and I know this is difficult, a more careful selection of the preceptors. I think they can make or break the group. It can be a destructive role if there's a difference between the instructor. Right now, I think we've had our share of good preceptors and some that were mediocre and some that were excellent.

Jim also mentioned that PBL helped in the following areas:

1. <u>Small-group working skills</u>: Jim commented that being in a PBL group helped him improve his small-group skills, as illustrated by the following statement: I think naturally in a group there are people who talk and people who don't talk and then somewhere in the middle. I think it makes us very aware and responsible for each other's learning. I monitor how much I speak. If there's someone who's a more quiet person who wants to speak, I'll hold back. I think that everybody has good points; it teaches us to listen to others. It also teaches me that everyone doesn't look at things the way I look at them. So when I say things, sometimes it may help.

2. Independent study: Jim mentioned that PBL classes allowed him to study more

than just those topics in the content lists, as shown by the following statement:

For instance, now I go and learn, in my group, we learn about diseases' pathology and physiology for the sake of learning it, for the desire to have the knowledge. And then when we look at the content list, we find that we've covered a lot of those things.

3. <u>Integrating materials</u>: Jim noted that, because cases they discussed during the

PBL classes required students to integrate different diseases they learned, being in PBL

classes helped him integrate concepts and helped him use his knowledge, as he pointed out

in the following comment:

PBL helps me to integrate concepts. Given the case, we have an individual who has problems, for the renal domain. But we also notice that they have a cardiovascular problem or that they have some type of infection. And that helps us to use our previous knowledge.

4. Preparing for exams: Jim said that being in PBL classes helped him prepare for

exams because the cases provided during the PBL classes were related to the exams. He

stated, "I know that a lot of the information is recurrent in the cases and in the exams and

in my textbooks."

## <u>Research Ouestion 4</u>: Do second-year medical students at MSU CHM report that they study differently than they did in their first year? If so, how and why?

Jim said that first year, he had more facts to learn and thus used more rote memorization strategies. He stated, "I think last year, we could have gotten away with a lot more rote memorization. Last year, realistically, you could have spent a few days just piling information into your head and then just regurgitating it on the exam." The content was more conceptual and integrative in second year.

Last year, it [objective list] was very specific, very factual. If we were to learn anything about diabetes, it was to approach it from a micro level, rather than starting at the macro level and coming down. There wasn't the integration that there is. Everything was a separate science last year. This year, I start reading about the disease and cover all the sciences, all the disciplines.

Thus, according to Jim, he used a more "macro-level approach" the second year, which meant starting with broad issues and getting an overview first before narrowing the focus. He mentioned that part of the reason he felt this way was that he had accumulated knowledge. Also, the way the test questions were asked the second year involved more integrative knowledge, according to him. Thus, he used more group study the second year. He also used computer programs as a learning resource in his second year because they were visual and presented redundant information without being boring.

Another difference between Jim's first and second years was that he had more confidence the second year. He described the second year of medical school as a "sink or swim atmosphere." Also, because of the independent studying necessitated by the school environment, he was more confident about his learning strategies in his second year.

Table 4.1 contains a summary of the key features of Jim's learning strategies.

 Table 4.1: Key features of Jim's learning strategies

Q1	- Studying for PBL class and exams is the same
	- Matching learning issues with objectives
	- Using books or computers to find learning issues, no use of library
Q2	<ul> <li>Reading twice: taking notes, writing down</li> <li>1. Get a framework, highlighting</li> <li>2. Narrow down facts, speed up</li> <li>Group study: check his understanding through quizzing and talking to each other, make him keep studying when he is bored</li> <li>Integration strategies: draw flow charts and diagrams, use computer programs</li> <li>Memorization strategies: reading, talking, using mnemonics, making charts &amp; tables, drawing similarities &amp; differences</li> <li>Selecting main information: corresponding information, lectures, stars in the objective lists, quiz questions in the coursepack, computer programs</li> <li>Use computer programs: as a way of selecting main information, good picture, interactive</li> </ul>
	<ul> <li>Checking knowledge strategies: quiz in a group study and self-questions</li> <li>Lecture attendance: way of knowing what's important information, opportunity to ask questions</li> <li>Additional strategies: checking coverage of the objectives, organize materials - categorize what he reads and then write down or highlight</li> </ul>
Q3	<ul> <li>Influences: Old study habits and PBL process</li> <li>Goals: Learning materials</li> <li>PBL helps <ol> <li>Small-group working skills</li> <li>Independent study</li> <li>Integration of the materials</li> <li>Preparation for the exam</li> </ol> </li> </ul>
Q4	<ul> <li>More group study in second year: because of the integrative contents</li> <li>More use of computer programs in second year</li> <li>Macro-level approach: getting overview first: because of the existed knowledge</li> <li>More confidence about his learning strategies : because of the second-year curriculum</li> </ul>

### Laura

# <u>Research Ouestion 1</u>: What learning strategies do students use in preparation for the problem-based learning classroom, and why?

Studying for PBL classes and preparing for the exams were not two separate things to Laura. She primarily prepared for exams, and while doing that, she prepared for the PBL classes.

During class: Laura mentioned that her PBL group read a case, picked out the main information, formulated hypotheses, raised learning issues, and solved stimulus questions. To pick out the main information, she tried to find symptoms that were significant to patients and sometimes highlighted the important facts in the provided cases. To raise learning issues that she needed to know for the next session, Laura used her past knowledge and objective lists. Also, stimulus questions included in the coursepack guided what she needed to study for the next session.

Laura matched learning issues with objectives by looking at the learning issues and thinking, "Which objectives are related to learning issues?" Occasionally, some preceptors suggested learning issues to look for. Laura mentioned that her group spent time on every learning issue early in the semester, but they thought this was a waste of time. So later, if a learning issue was not matched with objectives, her PBL group did not spend time discussing that issue.

Learning issue study: Laura studied learning issues by looking at objectives and finding those in the first year's textbook. She never went to the library to study learning issues. Usually she read books and articles to study learning issues, trying to relate them to the exams. Laura mentioned that because PBL class did not cover every objective, she

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studied on her own for the exams. Thus, studying for PBL class was part of studying for

exams, as shown in her comment:

PBL picks certain topics that are listed in the objectives that we do have to know for the exams, but they don't cover...they don't nearly cover everything we have to know.

# <u>Research Ouestion 2</u>: What learning strategies do students use in preparation for examinations (both class exams and the licensing exam), and why?

Reading: Laura mentioned that she tried to read everything that was related to the

exams at least once because the second year she had a vast volume of materials to study in

a limited time. Further, because the exams came from very detailed materials, she thought

she should know every minute detail in the materials, as illustrated by the following

statement:

But you can't really say, "Well, maybe this is more important than that," because you don't know what's going on in the examiner's head, and so basically you try to know everything. And I know that sounds impossible, and sometimes it feels impossible, but they test details on the exam. General . . . you would think that if you have that volume of material they would focus on general concepts to see if you got the basic stuff. No. I had some of those questions, but most of them test minute details or minute differences between two different concepts. And so you have to know those, and since you don't know which are going to be tested on, you try to know everything.

If Laura read the material more than once, she read the first time to understand

the material. Laura mentioned understanding is "to get the main concepts or to get the broad picture." She also highlighted the materials when she read them. She used different colors for different diseases and wrote down notes when she read. By doing this, when she read the materials the second time, she could review and connect the materials better. When Laura read the second time, she flipped through the highlighted parts and focused on memorizing them. She realized that she needed a second reading when she could not explain what she had read the first time. To explain her reading strategy, Laura mentioned.

Thus, the first time is for understanding. Understanding means to me getting the main concepts or to get the broad picture, to figure out what they're trying to tell us. Second reading is for memorization. I mean, I know it doesn't work for me to just read it once because the first time I read I'm learning it. The second time I'm memorizing it. And, I mean, sometimes it works out that I'll just remember one key word. It's like, "Okay. That's that," just because I happen to remember seeing it that second time, so it's more of a memorization type thing for that second time around.

<u>Group study</u>: Laura studied with one other person whom she had worked with since her first year. They read through the charts that she had made and discussed any unclear points. They also asked questions and explained things to each other. Laura mentioned that studying with a friend clarified concepts, supported her emotionally, and made her stay awake.

Integration strategies: Laura made charts to integrate the materials she studied. For example, she made a flow chart on diabetes and one particular outcome. As she studied further, she found diabetes again with another outcome. She then integrated those findings and made another chart so that she could see the whole diabetes picture. Also, group study helped Laura clarify concepts by discussing the information with her partner and listening to her partner explain the materials she did not understand.

<u>Memorization strategies</u>: Laura typed summaries and charts that she made, using a computer. She said that doing this helped her memorize things because she actively thought about what she was typing. Also, reading the materials more than once provided repetition, which helped her memorize what she needed to learn.

<u>Selecting main information</u>: Laura said she tried to study every objective because even though professors said certain objectives were not important, they sometimes tested on them nevertheless. With regard to focusing, Laura mentioned that she tried to emphasize the objectives that had the most stars.

<u>Computers</u>: Laura usually did not use computer programs because she thought this was time consuming and she often got a headache. Only if she heard that a certain computer program was good for a certain domain and she had time did she look it up. For example, when Laura had trouble learning about bone disorders because they all sounded alike, the computer program provided a good way to differentiate them through pictures. Laura said that because she was a visual learner, pictures in a computer program sometimes helped her learn the material. Although she seldom used computer programs, she usually used a computer for typing her summaries and charts. She said it was easier to memorize micro things in this way because when she typed them, she could actively think about them.

<u>Checking knowledge strategies</u>: Through group study, Laura and her friend asked questions and explained things to each other. This helped her clarify concepts and ensure her grasp of the material.

<u>No lecture attendance</u>: Laura was not attending large-group lectures her second year. She said she had an attention-span problem and that sitting in a lecture made her mind wander. She liked the PBL class format better than lectures, as illustrated by the following statement:

I thought I was a lecture-oriented person, but about the middle of last year I started to realize that I wasn't getting as much out of lectures as I thought I was, you know. I would faithfully, you know, at the beginning of the year go every day and take notes, but then after a while I started to realize, okay, the first few hours I'm actively involved taking notes and whatever. The next two hours my mind is somewhere else. I'm like, okay, why am I sitting here if I'm having trouble focusing, concentrating. I'm wasting my time basically when I could either be reading something on my own or sleeping or something, you know ... and reading it later. And so I think this format [PBL] is a lot better because I'm not sitting in lecture and letting my mind just wander.

Additional strategies: At the beginning of the second year, Laura made her own agenda for studying. But she could not contribute to the PBL classes because she could not get to the material that would be discussed in class, based on her own schedule. Therefore, she structured what she was going to review herself, based on the cases provided in class, and she combined those cases with objectives.

Also, Laura wrote important words or concepts down in the margins of the textbook or coursepack. For example, if she found pages of uniform text without pictures when she read, she wrote down subheadings of her own so that when she looked at it again, she could readily see what the page was about. Also, she used highlights, circles, or underlines as means of organization. For example, she used different colors for main headings, subheadings, and subsequent information. To distinguish between males and females when studying general somatic-formation disorders, Laura circled the words "women" and "men" and underlined the concepts related to each gender.

Board preparation: Laura said she planned to take a review course for the board exam. At the time of the interview, she said there was no time to study for the board exam separately from the class exams. But she thought that studying for the domains covered in class now would help her in studying for the board exam later.

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## <u>Research Ouestion 3</u>: What do students think influences their learning strategies (such as goals, assessment of learning, student activity, teaching method, and course content)?

Laura mentioned that time constraints influenced her learning strategies the most. Also, the PBL experience had changed her study approach in that she had changed her scheduling. She made her own schedule at the beginning of the semester but now combined studying for exams and preparing for the PBL class.

Laura mentioned that she had two goals: (a) having a good knowledge base for the future and (b) passing the exams. She said she was giving more emphasis to her first goal during her second year. PBL classes helped her have a good knowledge base because they necessitated independent study and integration of the materials through cases. However, Laura was not sure of the role PBL played in achieving her goal of passing the exams, as shown in the following comment:

I think what I can confidently say is it's helping me get a good knowledge base, which is my ultimate goal. I can't really say it's helping me pass the domain exams ... because a lot of times I think the exams come down to how much can you remember within a short period of time and how many little details can you remember, you know, for the exams.

Laura mentioned that although having such different PBL group members was stressful, PBL classes also helped in the following ways:

1. <u>Small-group working skills</u>: PBL helped in terms of group interaction; it made Laura monitor her talking and try to contribute equally with other group members.

2. <u>Independent study</u>: According to Laura, being in a PBL group helped her study independently. Because PBL classes did not cover the majority of the material, she needed to study on her own, look up material, and search for it by herself.

th R lec if s tha yea She her the Mai ber con also ofth 3. <u>Integrating concepts</u>: During PBL classes, it was easier for Laura to connect the different disciplines because students discussed all of the related materials.

## <u>Research Question 4</u>: Do second-year medical students at MSU CHM report that they study differently than they did in their first year? If so, how and why?

Laura mentioned that, during her first year, she learned most information from lectures or scribe notes. Thus, she did not have to do much reading. She read books only if she needed clarification. Laura used more charts, tables, and flashcards her first year than her second year because she had more time and less material to study. This second year, she self-checked her knowledge less because of the vast volume of study materials. She said it was important to go through everything at least once and to read more during her second year, as illustrated by her comment:

It's just too much work to try to get through. And I figure it's best to get through everything once rather than to get through some things and not the others and really screw up on the exam because I didn't get to the other material.

Laura also thought that she was a more effective learner her second year. Part of the reason for this was that she had previous knowledge and hence could connect the materials better.

Another change is that Laura quit going to the lectures her second year because of her lack of time. She obtained scribe notes to study, however, because sometimes they contained information for the exams that was not in her textbook or coursepack. Laura also mentioned that the cases provided in the PBL classes helped her do more integration of the materials. Also, Laura made her own schedule at the beginning of the semester but now combined studying for exams and preparing for the PBL class. She started with her firstyear approach to studying and then changed her scheduling during the second year to adapt to the changed instructional context.

Well, I found it to be better than what I tried to do the first domain, which was have my own schedule, say, "Okay. I'm going to do all the micro first, and then I'm going to do all the path next and all the phys next." That just seemed to be in conflict with what I was expected to do with the group. And I'd say, "Well, rather than fight this, let me work with this," and because I found it to be really frustrating to come to group and not be able to contribute or feel stupid because I hadn't gotten to that portion of the material that we were discussing.

A summary of the key features gleaned from the interviews with Laura is presented

in Table 4.2.
Table 4.2: Key features of Laura's learning strategies

Q1	<ul> <li>Raise learning issues: use objective lists, past knowledge and stimulus questions</li> <li>Match learning issues with objectives: studying for PBL learning issue is part of studying for exams</li> <li>To find learning issues: use the previous year's textbooks, no library use</li> </ul>
Q2	<ul> <li>Reading more than once:</li> <li>1. For understanding - highlight with different colors; review better, connect better</li> <li>2. For memorization</li> <li>Group study: ask questions, clarify concepts, support emotionally, stay awake</li> <li>Integration strategies: make charts, group study (clarify concepts)</li> <li>Memorization strategies: read more than once (repetition), type into computer</li> <li>Selecting main information: stars in the objective lists</li> <li>Computer programs: seldom use computer programs; good picture</li> <li>Checking knowledge strategies: group study (ask questions)</li> <li>Additional strategies: scheduling, organizing materials; writing down her own headings, underlining, highlighting, circling</li> <li>No lecture attendance; get scribe notes</li> </ul>
Q3	<ul> <li>Influences: time and PBL experience</li> <li>Goals: having good knowledge base and passing exams</li> <li>PBL helps</li> <li>1. Small-group working skills</li> <li>2. Independent study</li> <li>3. Integration of the materials</li> </ul>
Q4	<ul> <li>More reading in second year</li> <li>No lecture attendance in second year; use scribe notes, however</li> <li>Less use of flashcards, charts, tables the second year; lack of time</li> <li>Less self-checking, more study time the second year: because of vast volume</li> <li>More integration the second year: cases help</li> <li>Feels she is a more effective learner the second year: because of previous knowledge</li> </ul>

#### Findings Pertaining to the Research Questions

The common patterns that emerged from analyzing each case study, corresponding to each research question are discussed in the following pages. I do not present the results of the common patterns for two subjects, Susan and Cindy, who were not taking\_any PBL classes the semester the study was conducted, although I do present their brief case studies in Appendix F.

# <u>Research Ouestion 1</u>: What learning strategies do students use in preparation for the problem-based learning classroom, and why?

The 12 interviewees who took PBL the second year, including the pilot interviewees, all claimed that they studied by focusing on exams rather than on PBL classes. They said that they studied for exams, and in the process of preparing for exams, they could contribute to class discussions.

During the PBL classes, most of the interviewees looked for odd symptoms or symptoms that were significant to the patient that they were studying in order to find cues about the provided case. Also, they used previous knowledge to generate hypotheses during the PBL classes. Eleven out of the 12 interviewees mentioned that they used objectives for raising learning issues. They also tried to gear their PBL group discussions toward the objective lists so that they could focus their study on exams. Kelly, who was a pilot interviewee, did not mention specifically that she used objectives for raising learning issues. She tried to connect all of the information in the case, and if she could not see the connections, she studied the missing parts after class. However, Kelly also studied for exam preparation and not for PBL classes per se. Interestingly, Ann tried to determine what teachers would think were important as learning issues. Ann also relied on percentages of the exam content for raising learning issues. Ann mentioned,

I try to psyche out the teachers and sort of say, "Given this case, which of the objectives do you think they were trying to get us to learn from this case." And then we try to make learning issues. Like this time, 45% of the exam is going to be pathology. So when a case comes up, one of the learning issues will be the pathology of whatever the case is or the pathology of similar cases.

All of these processes that students were using to raise learning issues were geared

to exam preparation. However, Jane mentioned that she studied information for the

learning issues even though they were not on the objective lists. Further, Ann said that

she studied learning issues that were not among the objectives if they were interesting and

easy to find, but her focus was primarily on exams and not on preparing for classes.

Table 4.3 shows students' use of learning resources to find learning issues.

Table 4.3: Resources students used to st	tudy learning issues (n = 12)
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Name	Books	Coursepacks	Computer Programs	Learning Resource Center	Library
Jim	x		x		
Laura	x				
Mark	x	x	x	x	
Tom	x		x	x	
Ann	x	x			
Mary	x	x			
Andrew	x	x			
Roger	x	x	x		
Nancy	x	x	x		
Janet	x				
Kelly	x				
Jane	x	x		x	x
Total (12)	12	7	5	3	1

Key: x = students' use of the strategy.

As shown in Table 4.3, all 12 interviewees reported that they read books--either textbooks or board review books--to study learning issues. Also, many of them used coursepack notes and computer programs to study learning issues. However, only Jane went to the library to look for information for the learning issues, and three students went to the learning resource center to find information to study learning issues. In addition to the resources mentioned above, Roger said he read old objectives he obtained from the previous second-year medical students to find pertinent information for the learning issues.

Most interviewees said they found information for the learning issues because studying them covered objectives that would be on the exams. However, Jim and Janet mentioned that they studied learning issues for participating in group discussion and asking questions. Interestingly, Ann mentioned that she studied learning issues and made charts or summaries for relating them to the group, in order to impress the group and to get "brownie points."

I tried to enumerate resources that the interviewees reported that they used. However, it was difficult to make a clear-cut separation between the resources they used in studying the learning issues for class and those they used to study for the exams because students said they did not necessarily separate their study for PBL classes and exams. Thus, although the interviewees did not report resources for the question of where they found information for the learning issues, it is likely that they found information for the learning issues from the resources they used in studying for exams.

# <u>Research Ouestion 2</u>: What learning strategies do students use in preparation for examinations (both class exams and the licensing exam), and why?

The second year, students focused their learning strategy mainly on reading although there were individual differences in their use of learning strategies. Also, 10 of the 12 interviewees who attended PBL classes said they studied with a partner or in a group. Interviewees used various strategies for memorizing, integrating, and organizing information. As in their first year of medical school, all of the interviewees used many strategies for selecting important information. Because of the vast volume of materials they had to cover in a limited time, students focused on selecting important information. Other than this, all of the students except Jane who took PBL classes used computer programs, although they relied on those programs to varying degrees. All of the students said they checked the knowledge they acquired, using such strategies as solving practice quizzes or asking questions. The students went to lectures less the second year than the first year, and 5 of the 12 interviewees had quit going to lectures entirely; however, other interviewees attended lectures as a means of preparing for exams.

The data collected regarding how students studied for exams were the richest of all the information elicited through the interviews. Hence, in the following pages, I present the findings for each category of learning strategy that students used during their second year of medical school.

<u>Reading</u>: The basic studying approach of most students the second year was reading books, coursepacks, and objectives. The interviewees' reading patterns are shown in Table 4.4.

Name	How and What They Read
Jim	<ul> <li>First reading: to get a framework, reads everything in the book, critically highlighting things</li> <li>Second reading: goes faster because he reads highlighted things</li> </ul>
Laura	- First reading: to understand materials, highlighting things - Second reading: flips through highlighted things for memorization
Mark	- First reading: to get a general idea, reads with highlighting - Second reading: reads highlighted ones, makes marginal notes
Tom	<ul> <li>Reads coursepack, highlighting important points</li> <li>Reads textbook, looking for overlapping information with coursepack</li> <li>Reads coursepack again with added information in the margins</li> </ul>
Ann	<ul> <li>First reading: to get an overall framework</li> <li>Second reading: goes faster, comprehends better</li> <li>Reads old objectives, coursepack, scribe notes, then does computer programs, reads board review books</li> </ul>
Mary	<ul> <li>Reads objectives, books, and coursepack, making charts</li> <li>Memorizes those charts</li> </ul>
Andrew	<ul> <li>First reading: to understand, highlights testable questions</li> <li>Second reading: skims materials by making connections of concepts</li> </ul>
Roger	- Reads books sometimes, uses computer programs and group study
Nancy	- Reads books and coursepack for understanding: writing, underlining - If she has time, reviews underlined things or writing in the margins
Janet	- First reading: slowly to understand materials and answer objectives - Second reading: reads highlighted things at a faster pace
Kelly	<ul> <li>First reading: slowly to get the general concept</li> <li>Second reading: to memorize better</li> </ul>
Jane	<ul> <li>Reads old objectives to get an idea of test information</li> <li>First reading: to get a general overview</li> <li>Second reading: to memorize things</li> </ul>

# Table 4.4 : How and what students read

As shown in Table 4.4, most students read the material more than once during the second year. In their first reading, most of them focused on understanding the materials, usually highlighting important information or facts. In their second reading, most students skimmed the materials or read only the highlighted parts for memorization purposes. It seems that, by reading slowly and carefully the first time, they had an overall framework on which to hang specific facts in their second reading. Because of the vast volume of materials, they tried to understand the materials by reading the same information several times.

<u>Group study</u>: Of the 12 interviewees who were taking PBL classes, 10 mentioned that they studied in a group or with a partner to prepare for the exams. The most frequently mentioned reasons for doing group study are shown in Table 4.5.

Name	Check Knowledge	Help Understanding	Keep Studying	Pick Up Important Information
Jim	x		x	
Laura	x	x	x	
Mark	x	x		x
Tom	x	x		
Ann	x		x	
Mary	x	x		
Roger	x	x		
Nancy	x		x	x
Kelly			x	
Jane	x	x		
Total (10)	9	6	5	2

Table 4.5: Reasons for doing group study (n = 10)

Note: Because Janet and Andrew did not use group study to prepare for the exams, they are excluded from the table.

As shown in Table 4.5, 9 of the 10 students who used group study did so to check their knowledge. Through discussing the materials in a group, they could ascertain the state of their knowledge. They checked whether they had stored knowledge by asking questions or quizzing each other. Roger mentioned, "We do that [group study] because we test each other and see if we know the facts."

Also, discussing the materials in a group helped students integrate the materials and understand the concepts. Students said that group study helped more with conceptual materials than with factual materials because discussing the materials with each other made students see different points of view or points related to other materials, which sometimes clarified the material they were studying. In explaining how he used group study for integration purposes, Tom said,

I think that the conceptual material, an understanding of the conceptual material, comes with discussing it by studying in a group of people. The facts I learn when I'm sitting there studying by myself. I also learn the facts when I'm in a group and I hear things. But the conceptual material is the material that really seems to come together when I study in a group with other people. Because it's hearing somebody else explain it, and hearing them looking at it from a different angle, that helps bring things together.

Further, group study forced group members to study more when they were bored or tired of reading the materials by themselves. Group study also provided an opportunity to exchange information, which enabled students to discover what information was important during discussion. In addition to the aforementioned reasons, a few students said that group study provided repetition of their study, made them see different points of view, and helped them memorize the materials.

Most of the interviewees said they went through the objectives or coursepack notes together by discussing, teaching or quizzing each other, and sometimes summarizing important points during the group study. Tom said he met with the group after studying the material by himself because "If you can come to the group and understand things a little bit then we get through the material faster, and we're able to get through it more times."

<u>Integration strategies</u>: Most interviewees said they thought understanding meant to know how things work, to know how a certain system operates.

If they [group members] make a statement and if I can guess what is coming next, just because of the logical progression, and I know when this happens then this should happen, you kind of fit it together that way. You start predicting, if this happens then this is going to happen, and this and this and this is going to result from it, then you start to feel like you're understanding it. (Andrew)

They added that connecting various pieces of information and seeing the overall picture helped them understand how things work. Thus, integration and understanding of the materials were not two separate things to most of the interviewees.

To integrate materials for better understanding, most interviewees used a "careful reading" strategy. They said they read materials slowly, trying to make connections with previous subjects they had studied. For example, Kelly tried to compare and connect texts with pictures, or texts with PBL cases, through reading. Also, reading the materials more than once seemed to help students comprehend. Other than reading materials carefully, students used the strategies shown in Table 4.6 to integrate materials or to help them understand the materials.

Name	PBL Experience	Study in Group	Make Charts/ Diagrams	Use Computer Programs
Jim	x		x	x
Laura	x	x	x	
Mark	x	x		
Tom	x	x		
Ann	x		x	
Mary		x	x	
Andrew	x			x
Roger		x		
Nancy	x			
Janet	x			x
Kelly	x			x
Jane	x	x		
Total (12)	10	6	4	4

Table 4.6: Integration strategies (n = 12)

Although being in a PBL class was not in itself a purposeful strategy for better understanding of the materials, as shown in Table 4.6, 10 of the 12 students reported that the PBL experience helped their understanding by clarifying concepts and providing contexts with the cases. Also, half of interviewees mentioned that they used group study for better understanding. As in PBL class, group study helped their understanding of the materials through discussing things with and explaining them to each other. Discussing the materials with each other made them see different points of view or points related to other materials that sometimes clarified the material they were studying.

Four students reported that they made charts or diagrams to integrate the materials. For example, Ann said that drawing charts helped her classify similarities and differences and also showed patterns that aided her understanding. Computer programs also helped students understand the materials by providing visual examples associated with a certain disease, and also by integrating different topics. In addition to using the strategies in Table 4.6, a few students reported that they wrote down a certain process or an explanation of unclear points in order to help them understand the materials.

Memorization strategies: Most interviewees reported that they used fewer memorization strategies in their second year as compared to their first year. Students had more materials to study the second year as compared to the first year, so they could not spend their time memorizing minute details. Further, the interviewees reported that, because they spent more effort on understanding the materials the second year, memorization followed naturally. Whereas students thought understanding meant knowing how things worked and being able to connect various information, they thought rote memorization was learning things that had no connection with others without knowing the process. Nancy called rote memorization "learning random facts." Roger gave examples of understanding and rote memorization. He said that knowing that "aspirin decreases swelling" is rote memorization. Understanding would be "If one knows the reason that that happens is because you block something called the central oxygenic pathway chemically, and that produces prostaglandins, which increase swelling. So if you don't have proxyglandins, you don't have swelling."

To memorize the materials, most students used repetition strategies such as reading the same materials several times, reading different materials for the same information, or talking with friends several times. Other than repetition of information, students reported using the strategies shown in Table 4.7 to memorize materials.

Name	Writing Down	Mnemonics	Charts/ Organization	Imagery
Jim		x	x	
Laura	x			
Mark				
Tom	x			
Ann	x			
Mary			x	
Andrew		x		x
Roger		x		
Nancy	x			
Janet				
Kelly	x	x		x
Jane	x		x	
<b>Total</b> (12)	6	4	3	2

Table 4.7: Memorization strategies ( $\underline{n} = 12$ )

Half of the interviewees reported that writing down facts, important points, and similar things to differentiate them helped their memorization. They mentioned that writing is a more active process than just reading the materials and thus helps in remembering. Sometimes students recorded information in several places, such as writing it on flashcards or on charts, typing it into a computer, and taking notes of the information they needed to remember; this repetition aided memorization. Four students mentioned that they made up mnemonics or acronyms using stupid and silly stories or songs to aid in memorization. They also reported that drawing charts not only helped understanding, but also aided memorization. Organizing materials into charts enabled students to see clearly the similarities and differences of particular topics and thus helped memorization. Andrew and Kelly mentioned that they used imagery for memorization. They reported that using imagery gave context to things, which aided their memorization, as illustrated by the following statement:

I guess you'd call me a visual learner. If I could kind of . . . put in your mind what somebody presents with . . . and you can kind of attach things onto that, and that seems to solidify it in my mind a little better... I think it would really help me remember things a lot better just to actually put it with . . . putting a certain problem with a certain face, and that way . . . and the certain ramifications of that person's problem, it would really stick with me, I think, more. (Andrew)

Other than the above-mentioned strategies, students highlighted important facts, talked in groups, and used computer programs with visual pictures. These strategies helped them understand and remember the materials.

Selecting main information: All of the interviewees mentioned that selecting important information was very important for them because they had to cover a vast volume of materials the second year. They used various strategies to select important information. By "main or important information" they meant material that would be on the exam. Students reported that they relied on objective lists in preparing for exams and PBL classes because the contents of objective lists were what would be on the exams. Other than using objective lists as their study guide, students used the strategies shown in Table 4.8 to sort out important information.

The most frequently used strategy for selecting important information was using the relative percentages of contents on the exams provided in their coursepacks by professors. Students focused their study on material constituting a large percentage of the exams. Some interviewees said they used percentages of contents of the exams as their scheduling guide. For example, they studied the largest percentage content first; then, if they had time, they studied subjects making up a lower percentage of the exam.

Name	% of Exam	Stars in Objectives	Practice Quizzes	Computer Programs	Lectures	Old Objectives *
Jim		x	x	x	x	
Laura		x				
Mark	x			x	x	
Tom	x	x	x		x	
Ann	x		x	x		
Mary	x	x		x	x	
Andrew	x	x	x	x		x
Roger	x	x		x	x	
Nancy						
Janet	x		x			x
Kelly	x					x
Jane			x		x	x
<b>Total (12)</b>	8	6	6	6	6	4

Table 4.8: Strategies for selecting main information ( $\underline{n} = 12$ )

a. Old objectives are objectives from the previous second year, which current medical students obtained from former second-year students.

In some domains, topics in the objective lists were starred. Topics that were given more stars were more important than those with fewer stars. Thus, students reported that they looked at the number of stars in the objective lists and focused their study on topics with more stars. Students also used practice quizzes as a way of seeing which materials the exam providers thought important, as well as a way of checking their knowledge. Six students said they used computer programs as a way of sorting out important information. When department faculty wrote computer programs, students could see what formation faculty thought was important by using these programs. Further, computer programs contained more condensed and concise information than textbooks, which helped students select important information. Students also used lectures as a strategy for gaining information that might be covered on exams. Laura and Andrew reported that they obtained scribe notes from lectures even though they did not attend lectures, because scribe notes provided them with test information.

Other than the strategies shown in Table 4.8, four students, Ann, Nancy, Andrew, and Tom, mentioned that they could tell what were "testable questions" from their "gut feeling." According to them, the common diseases or characteristics of a certain disease were likely exam questions. To explain testable questions, Tom said,

It's kind of hard to explain. It's just kind of a gut feeling when you're studying. When I'm reading over something I just say to myself, that really sounds like a test question. Some questions are just really hard to test on, and so, if I think something is really hard to test on I won't emphasize it as much as the things that I think are more testable . . . They like to ask questions like, "Does this predispose to cancer?" So when we're studying, whenever we see something like, "This predisposes you to an adenoma," you try to remember that because that seems to come up on exams a lot.

Andrew, Jane, and Janet mentioned that PBL classes helped them sort out

important information because either the preceptor or classmates mentioned what was important to know during discussions. Along the same lines, a few students mentioned that group study helped them select main information. Three of the 12 students also said they realized certain information was important to know if it was repeated in various places. For example, Jane mentioned her approach to detecting importance as follows:

What I try to do is just read through that other source and then see how it matches the objectives that they give us and then all the other sources. Like I say, the overlap between all the sources, I figure that's got to be pretty important. If all three sources mention it, it's got to be pretty important.

Other than these strategies, many students mentioned that they highlighted, underlined, circled, or wrote things down while reading the materials. Doing these things helped students focus their attention on information they needed to know. <u>Computer programs</u>: Of the 12 students who were taking PBL classes, all but Jane used computer programs. Among them, Janet and Laura used computer programs only when they heard the computer programs were good or followed the coursepack closely, because using computer programs took time. Other interviewees reported that they used computer programs very much their second year. Students' reasons for using computer programs are shown in Table 4.9.

Name	Provide Good Pictures	Provide Main Information	Provide Interaction
Jim		X ·	x
Laura	x		
Mark		x	x
Tom	x		
Ann	x	x	
Mary	x	x	
Andrew	x	x	
Roger		x	
Nancy	x		
Janet	x		
Kelly	x		
<b>Total (11)</b>	8	6	2

Table 4.9: Reasons for using computer programs (n = 11)

Eight interviewees reported that they used computer programs because the pictures in the programs were bigger and better than those in textbooks, and thus they enhanced understanding. Also, looking at pictures illustrating various diseases made it easier to remember them. For example, although Laura did not use computer programs very much, she thought they helped her in that they provided a good way of differentiating

among similar diseases by providing good pictures. Six students said they used computer programs as a way of selecting important information. Computer programs were condensed and concise, hence saving time and giving only the necessary information, whereas textbooks were too wordy. Also, quiz questions in the computer programs sometimes helped students find important information.

Other than these frequently mentioned reasons, a few students reported that computer programs provided interaction. For example, students could have immediate feedback when answering quiz questions on computer programs. Also, computer programs were another source of information, which repeated the same content, so students used them when they were tired of reading textbooks or coursepacks. For example, Mary said, "Usually when I'll do it [computer program] is when I'm sick of reading. And I'll go in there and I'll be like, aha, changes." The programs provided stimulation and a change of pace when students were bored with reading other materials.

<u>Checking knowledge strategies</u>: As they did in their first year of medical school, the interviewees used certain strategies to check their knowledge or understanding of the materials. As shown in Table 4.10, nine interviewees said that group study provided an opportunity for them to determine the state of their knowledge by asking questions and quizzing each other. For example, Roger said, "We do that [group study] because we test each other and see if we know the facts." To explain his approach to checking knowledge, Jim commented,

Yeah, it's similar to PBL. For instance, we'll take a drug, and we'll say, "OK, here's the drug." And we'll say, "Drug x, how does it act, where does it act, what does it act like?" And then we quiz each other, and we talk through it and then if somebody says the wrong answer, or maybe they got something wrong, maybe they misunderstood the

concept . . . where I think it went up, where maybe it went down, in reverse feedback or something. And we talk about those things.

Five students said they solved practice quizzes included at the end of the coursepack or in

the computer programs to see how well they understand the material.

Table 4.10: Strategies for checking knowledge ( $\underline{n} = 12$ )

Name	Group Study	Practice Quizzes
Jim	x	x
Laura	x	
Mark	x	
Tom	x	
Ann	x	x
Mary	x	
Andrew		
Roger	x	
Nancy	x	
Janet		x
Kelly		x
Jane	x	x
Total (12)	9	5

In addition to these strategies, Jim asked himself questions when he read the material a second time to see whether he understood it. Andrew said he knew he understood the material if he could restate what he had read and if he could tell the next stage of something because most systems in the medical area have a logical progression.

Lecture attendance: Of the 12 interviewees who were taking PBL classes, 5 reported that they had quit going to lectures because they could spend the lecture time more effectively studying by themselves. Most of students who attended lectures said they did so only if the lecturer was good and let them know what to emphasize in studying for exams. Even those five students who did not attend lectures obtained scribe notes and studied them to see what the lecturer had emphasized. Students who attended lectures gave various reasons for doing so. Lectures gave them an opportunity to ask questions and reinforced what they knew. Also, students thought they should attend the lectures because they had paid for them.

Additional strategies: Some interviewees reported that they used certain strategies to organize materials, check their coverage of the objectives, or schedule their study. (See Appendix F for additional strategies mentioned by interviewees.) Further, a few students mentioned that their motivation and confidence had changed because of their experience in medical school. For example, Roger said that doing well on exams gave him confidence. He noted, "Getting good scores always helps because you feel like you are doing the right thing, and you feel like you can trust your judgment about what to study and what not to study."

<u>Board preparation</u>: Except for Susan and Cindy, who were not taking the board exam soon because of their extension, all of the interviewees said they would be taking a board review course to prepare for the board exam. Because of their busy study schedule the second year, the students were not yet thinking about starting to prepare for the board exam. However, most interviewees believed that studying for exams and discussing the materials during PBL classes would help them pass the board exam. Mary noted, "Michigan State students do well above the national average on the boards."

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### <u>Research Ouestion 3</u>: What do students think influences their learning strategies (such as goals, assessment of learning, student activity, teaching method, and course content) ?

In the following discussion of the findings for Research Question 3, Susan and Cindy, who were not taking PBL classes when the interviews were conducted, are included because influences on their learning strategies were not related solely to PBL classes. Table 4.11 shows what interviewees said influenced their learning strategies.

Table 4.11: Influences on students	' learning strategies ( $\underline{n} = 14$ )
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Name	Passing Exams	Previous Study Habits	Time	Being a Good Doctor *	PBL Process
Jim		x			x
Laura			x		x
Mark				x	
Tom	x				
Ann		x			
Магу		x			
Andrew			x		
Roger	x				
Nancy	x				
Janet	x				
Cindy			x		
Susan				x	
Kelly		x			
Jane				x	
Total (14)	4	4	3	3	2

a. Students who mentioned having a good knowledge base and understanding of materials were included in this category.

As shown in Table 4.11, interviewees mentioned various factors that influenced their studying approach. Having limited time with a vast volume of materials to cover in

the second year, the pressure to pass exams, their old study approaches, and the desire to have a good knowledge base and thus be a good doctor were the greatest influence on the ways students studied. Jim and Laura said that having the PBL experience in their second year also influenced the way they studied because it gave them the opportunity to integrate materials and made them more independent learners. Andrew thought his previous knowledge also directed how he studied.

I also asked the interviewees about their current goals because those are integral to what they study and how they study. Most students said that their goals were passing class exams and the board exam, as well as having a good knowledge base and understanding the materials. Some of them mentioned that they would like to balance their studying for exams, their personal life, and having clinical experience for the future. Although most students recognized the importance of having a good knowledge base in the long run, they thought that passing exams was a more immediate goal in order to move to the next step.

Table 4.12 shows the ways in which students thought PBL classes helped them. Susan and Cindy are not included in the table because they were not taking PBL classes at the time the interviews were conducted.

Name	Understanding (Integration)	Small-Group Working Skills	Indep. Study	Get Info. (SMI) *	Exam	Checking Knowledge
Jim	x	x	x		x	
Laura	x	x	x			
Mark	x	x	x			
Tom	x	x				
Ann	x	x				
Mary		x	x		x	
Andrew	x	x	x	x		x
Roger		x				
Nancy	x	x			x	
Janet	x	x		x		x
Kelly	x					
Jane	x		x	x		
Total (12)	10	10	6	3	3	2

Table 4.12: The ways in which PBL classes helped the students (n = 12)

a. SMI = Selecting main information

As shown in Table 4.12, most interviewees thought the PBL class experience helped them integrate and understand the materials by providing a context with a case and thus giving a clinical experience. Also, as hypothesized, most students thought that because PBL classes were small, they developed skill in talking and listening to others. Students said they monitored what they talked about and listened to others more carefully. Also, they were more tolerant as a result of dealing with a wide variety of personalities in PBL classes.

About half of interviewees said that PBL classes encouraged their independent study by letting them search for information on their own instead of giving them all the information, as the previous year's lectures had done. Some students also mentioned that they could obtain information from classmates, such as what material was important to know, and they could get different points of view. Also, the PBL class experience helped them check their knowledge through discussion. Whereas most students said PBL classes helped them understand and integrate the materials, four students said that PBL class helped them prepare for exams through discussion of relevant information. In addition, Janet said that PBL classes gave her an opportunity to ask questions. Ann liked PBL classes because she could form friendships through them. On the whole, students thought PBL classes helped more with their long-term goal, which was integration or understanding of the materials, than with their current goal, which was passing exams.

## <u>Research Question 4</u>: Do second-year medical students at MSU CHM report that they study differently than they did in their first year? If so, how and why?

In the presentation of findings for Research Question 4, both interview and LASSI data are used. Susan and Cindy were not taking PBL classes when the interviews were conducted because of the extension of their programs; thus, they are excluded from the discussion of interview findings.

Interview findings: One notable change that students reported was that, whereas they focused primarily on lectures and lecture notes their first year, they did more textbook reading and focused on understanding their second year. They mentioned that the knowledge they accumulated during their first year in medical school helped them to see more of the overall picture. Also, whereas year one lecturers gave students the necessary information with which to prepare for exams, in the second year they needed to find resources on their own and study them. For example, whereas students thought that

studying scribe notes or lecture notes meant doing well on tests their first year, the second year, they believed they should look for study resources outside of the lectures, such as doing computer programs or reading recommended books. Thus, they focused more on reading the materials, as exemplified by Ann's comment:

Just because there's so much that memorizing one particular thing is a waste of energy usually. Usually your better to immerse yourself in as much volume of material and hope you absorb enough of it to speak to the questions as they come up. So you're better off spending time reading it, trying to read more of it, or all of it hopefully, once. It'd be nice to read it twice.

Having a greater volume of materials to study the second year in a limited time

also made students use fewer memorization strategies because that took time. Instead,

they tried to focus on understanding as a goal rather than memorizing the details.

Another notable change related to the above fact was that, whereas only Ann had quit going to lectures the first year, more students stopped going to lectures their second year, and those who attended lectures did so less frequently than their first year. Janet stopped going to lectures the second year; she commented,

I don't go to lectures, but I read scribes, but I only read them after I've done my own studying. I read them the day before the exam. So lecture is totally useless to me. I don't even go to the labs. All my time is my own personal time that I spend studying and reading. So I just take the objectives list and I go down the objectives and check them off as I do them. Sometimes I do the computer programs.

Students attended lectures only when the lecturer was good. The reason students either attended only good lectures or quit going to lectures was lack of time. They thought they could spend time more effectively studying by themselves. However, even those students who did not attend lectures obtained scribe notes from the lectures so they would know what information the lecturer emphasized, for exam preparation. Whereas second-year students said they used computer programs, no interviewees imentioned using computer programs their first year. Students used computer programs more the second year because they contained more condensed information and better pictures than textbooks. Also, when students were tired of reading, doing computer programs provided a fresh approach to their study. As they did the first year, most students in their second year used group study either to check their knowledge or to understand the concepts.

In addition, some students commented on the pressure they had felt the first year as compared to the second year. For example, whereas Ann felt more pressure the second year because of greater study loads, Roger and Nancy said they felt less pressure but more confidence the second year because of their experience in taking exams and receiving good scores on them. This is illustrated by Roger's comment:

Yeah, I just tell myself that I've taken probably a hundred tests since I've been here, and I haven't failed yet, so what I'm doing is probably good. And if I want a break I just take a break and I've started to value my free time a lot more. I felt scared to take free time last year just because I was afraid I might fail. But I have more confidence this year.

LASSI findings: The LASSI findings are divided into three parts. The first part contains findings from the LASSI analysis over three time points (August 1993, January 1994, and February 1995), using the original LASSI scales. The second part contains findings from analyses of individual items of the LASSI, which I and two medical faculty categorized as PBL-sensitive and PBL-nonsensitive. In the third section, findings from the PBL-related scale versus the PBL-unrelated scale, which I and two medical faculty made from the original LASSI scales, are reported.

#### 1. Findings from the original LASSI scale analysis

#### Overall analysis (using three time points).

I first used repeated measures MANOVA(Norusis, 1993, p.132), using results from the LASSI administered to medical students at three times (August 1993, January 1994, and February 1995). Forty-four students completed the LASSI at all three time points. Thus, the repeated measures MANOVA was applied to those 44 cases to see the changes for those students who completed the LASSI over two years.

Because there were no between-subjects variables in the research, I used only within-subject MANOVA repeated measures. The within-subject factor was time. Table 4.13 shows the means and standard deviations for each scale of the LASSI over time for the 44 students included in the analysis.

Scale	Mean ( <u>SD</u> )			
	Time1	Time2	Time3	
Attention	35.9(2.93)	35.4(3.05)	35.3(2.96)	
Motivation	32.0(3.83)	30.3(4.51)	30.1(4.58)	
Time Management	26.4(6.35)	26.0(6.28)	24.3(7.06)	
Anxiety	29.3(6.21)	30.0(6.20)	28.7(6.10)	
Concentration	29.0(4.80)	28.7(4.77)	26.7(4.99)	
Information Processing	30.4(4.43)	31.5(5.23)	30.9(5.16)	
Selecting Main Information	19.7(3.00)	20.2(2.95)	20.0(2.35)	
Study Aids	26.9(4.99)	27.4(4.27)	27.2(4.30)	
Self Testing	27.7(4.02)	27.5(4.13)	26.4(3.91)	
Test Strategy	33.2(3.74)	33.2(3.62)	32.7(2.92)	

Table 4.13: Means and standard deviations on each LASSI scale for students who completed the LASSI at times 1, 2, and 3 ( $\underline{n} = 44$ )



Figure 4.1: Means on each LASSI scale for times 1, 2, and 3.

Note: This graph is presented to compare the means of time 1,2, and 3 within each scale. Comparisons among scales in this graph may be misleading because the Selecting Main Ideas scale includes five items, whereas the other scales include eight items each.

Results of the overall multivariate test of significance using the .05 significance level indicated that the null hypothesis of no change over three time periods was rejected (p = .004). In other words, there was a significant change over the three time periods. Thus, univariate tests were conducted on the 10 scales to gain insight into which scales changed significantly over time. The results are shown in Table 4.14. The .05 significance level was used to test the significance of the changes. The univariate tests showed statistically significant changes in 3 of the 10 scales over time. These were the Motivation, Time Management, and Concentration scales.

Scale	Hypoth.	Error	Hypoth.	Error	<u>F</u>	Sig. of <u>F</u> *
	<u>SS</u>	<u>SS</u>	<u>MS</u>	<u>MS</u>	, 1 1 1	
Attention	9.65	539.02	4.83	6.27	.77	.466
Motivation	90.24	711.76	45.12	8.27	5.45	.006*
Time Management	109.74	1140.26	54.87	13.26	4.14	.019*
Anxiety	38.23	1123.77	19.11	13.07	1.46	.237
Concentration	137.23	795.44	68.61	9.25	7.42	.001*
Information Processing	29.60	827.74	1 <b>4</b> . <b>8</b> 0	9.62	1.54	.221
Selecting Main Ideas	6.11	312.56	3.05	3.63	.84	.435
Study Aids	6.79	846.55	3.40	9.84	.34	.709
self Testing	41.56	669.11	<b>20.78</b>	7.78	2.67	.075
Test Strategy	5.47	578.53	2.73	6.73	.41	.667

Table 4.14: Univariate <u>F</u>-Tests of significance of all three LASSIs using the 10 LASSI scales

\* Significant at the .05 level.

The means for all three scales decreased significantly over time in a linear fashion as shown in Figure 4.1. These results indicated that students' use of strategies for maintaining their motivation, their strategies to create and use schedules, and their focus on school-related activities such as studying and listening in class decreased from year one through year two.

#### Findings using time 1 and time 2 LASSL

Looking at the LASSI results at three times resulted in a significant amount of missing data. Hence, I ran the repeated measures MANOVA using only two time points

to reduce the missing data problem. Another reason for considering only two times was that I wanted to look for changes within the first academic year, when the students had a lecture-based standard curriculum.

For this analysis, the MANOVA with repeated measures was run using two time points as the within-subject factor to determine whether there was a significant change from time 1 to time 2. Eighty-seven students were included in this analysis. The multivariate test of significance using time 1 and time 2 data showed that there were significant changes from time 1 to time 2 (p = .000). The results of the univariate tests showed that students' scores on the Motivation, Information Processing, and Selecting Main Ideas scales of the LASSI changed significantly from time 1 to time 2, as seen in Table 4.15.

Scale	Hypoth.	Error	Hypoth.	Error	<u>F</u>	Sig. of <u>F</u> *
	<u>SS</u> -	<u>SS</u>	<u>MS</u>	<u>MS</u>		
Attention	1.39	1075.60	1.39	12.51	0.11	.740
Motivation	157.34	1333.65	157.34	15.51	10.15	.002*
Time Management	0.93	2018.07	0.93	23.47	0.04	.843
Anxiety	57.94	2213.06	57.94	25.73	2.25	.137
Concentration	0.00	1614.00	0.00	18.77	0.00	1.000
Information Processing	469.01	1556.99	469.01	18.10	25.96	.000*
Selecting Main Ideas	48.56	618.44	48.56	7.19	6.75	.011*
Study Aids	36.04	1963.95	36.05	22.84	1.58	.212
Self Testing	1.39	1751.61	1.39	20.37	0.07	.794
Test Strategy	47.08	1242.92	47.08	14.45	3.26	.075

 Table 4.15: Univariate F-tests of significance at time 1 and time 2 using the 10 LASSI scales

\* Significant at the .05 level.

Means on the Motivation scale decreased significantly from time 1 to time 2 (see table 4.16). On the other hand, means on the Information Processing and Selecting Main Ideas scales increased significantly from time 1 to time 2. The results indicated that students' use of strategies for maintaining their motivation decreased from the beginning to the end of the first semester of medical school. Also, the results indicated that students' use of strategies for information processing, such as using elaboration and organizational strategies to foster understanding and recall, increased as they experienced medical school. Further, increases in means on the Selecting Main Ideas scale indicated that students improved in selecting important information to concentrate on in their study from the beginning to the end of the first semester of medical school.

Scale	Mean ( <u>SD</u> )			
	Time1	Time2		
Attention	35.7(2.97)	35.8(2.83)		
Motivation	31.6(4.10)	30.3(4.45)		
Time Management	25.8(6.55)	25.7(6.31)		
Anxiety	29.1(5.33)	30.0(5.97)		
Concentration	28.5(4.48)	28.5(4.76)		
Information Processing	29.7(4.91)	32.0(5.12)		
Selecting Main Ideas	19.7(2.94)	20.5(2.97)		
Study Aids	26.6(5.19)	27.2(5.70)		
Self Testing	27.6(4.70)	27.5(4.52)		
Test Strategy	32.6(3.86)	33.3(3.79)		

Table 4.16: Means and standard deviations on each LASSI scale for students who completed the LASSI at time 1 and time 2 ( $\underline{n} = 87$ )

#### Findings using time 2 and time 3 LASSL

The time 2 and time 3 LASSI data were analyzed to determine whether there was a significant change from time 2 to time 3 (from January 1994 to February 1995)--in other words, from one academic year to the next. The instructional methods these students experienced changed from time 2 to time 3 (lecture-based to PBL). Repeated measures MANOVA was run using two time points as the within-subject factor. Forty-five students who completed LASSIs at both time 2 and time 3 were included in this analysis. Means and standard deviations are shown in Table 4.17. Results of the omnibus test of significance for time 2 and time 3 are shown in Table 4.18.

Table 4.17: Means and standard deviations on each LASSI scale for students who completed the LASSI at time 2 and time 3 ( $\underline{n} = 45$ )

Scale	Mean ( <u>SD</u> )			
	Time2	Time3		
Attention	35.3(3.02)	35.3(2.93)		
Motivation	30.2(4.46)	30.1(4.53)		
Time Management	25.8(6.35)	24.2(7.01)		
Anxiety	30.0(6.11)	28.6(6.05)		
Concentration	28.7(4.72)	26.8(4.95)		
Information Processing	31.5(5.17)	31.0(5.11)		
Selecting Main Ideas	20.1(2.95)	20.0(2.33)		
Study Aids	27.3(4.29)	27.2(4.26)		
Self Testing	27.4(4.14)	26.3(3.90)		
Test Taking	33.2(3.58)	32.8(2.91)		

Test Name	Value	Exact F	Hypoth. <u>df</u>	Error <u>df</u>	Sig. of <u>F</u> *
Hotelling's	0.47323	1.65629	10	35	.131

# Table 4.18: Omnibus test of significance at time 2 and time 3 using<br/>the 10 LASSI scales

\* Significant at the .05 level.

No overall significant change was found from time 2 to time 3. Because the omnibus test results were not significant, the univariate test results are not reported here.

#### 2. Findings from individual items on the LASSI

As discussed in Chapter III, I and two medical professors who were experts on PBL curricula rated the individual items of the LASSI as being PBL sensitive or not. We examined each LASSI item and divided the 77 items into two scales, termed the PBLsensitive scale and the PBL-nonsensitive scale. Only those items that all three of us agreed were PBL related were included in the PBL-sensitive scale. Thus, 25 of the 77 LASSI items were included in the PBL-sensitive scale, and 52 items were included in the PBLnonsensitive scale. Items in each scale are shown in Appendix E.

I computed subscale scores for time 1 LASSI and time 3 LASSI. However, I could not compute subscale scores for time 2 LASSI because only overall LASSI scale scores were available, and individual item scores were missing. Thus, repeated measures MANOVA was applied only for time 1 and time 3 PBL-sensitive and PBL-nonsensitive LASSIs. The multivariate test of significance using time 1 and time 3 data showed that there were significant changes from time 1 to time 3 (p = .000).

Thus, univariate E-tests for each scale were conducted for the 50 students who took the LASSI at both time 1 and time 3. The results showed that, whereas PBL-sensitive scale means did not change significantly from time 1 to time 3 (p = .045), means on the PBL-nonsensitive scale did change significantly from time 1 to time 3 (p = .007). Looking at the means of the 50 students who were included in the analysis, one can see that means on the PBL-nonsensitive scale decreased significantly from time 1 to time 3 (198.2 to 187.6). Figure 4.2 shows this trend from time 1 to time 3.





Note: This graph is presented to compare the means of time 1 and time 3 within each scale. Comparison of two scales in this graph may be misleading because the number of items included in each scale is different (PBL-sensitive scale with 25 items and PBL-nonsensitive scale with 52 items). These results indicated that students' use of learning strategies that were not necessarily related to the experience of PBL classes decreased from the beginning of medical school to the second year (see Appendix E for PBL-nonsensitive items). Although the means on the PBL-sensitive scale did not change significantly from time 1 to time 3, the means (94.7 and 97.1 for time 1 and time 3) indicated that students improved on the PBL-related items over time.

### 3. <u>Findings from the PBL-related scale and the PBL-unrelated scale</u>, <u>derived from the original LASSI scales</u>

Because the analysis of the LASSI using the individual items could not be conducted with all three LASSIs because of missing data at time two, I created another set of subscores from the original LASSI scales, so that one subscore represented PBLrelated scales and the other did not. The authors of the LASSI suggested that five scales (Motivation, Anxiety, Attitude, Concentration, and Time Management) represented the affective domain, whereas the other five scales (Information Processing, Self-Testing, Studying Aids, Test Strategy, and Selecting Main Ideas) represented the cognitive domain. By discussing the individual items in consultation with medical professors who were experts on PBL, I noticed that the cognitive domain of the LASSI had items related to PBL participation, whereas the affective domain of the LASSI did not.

Thus, I conducted a repeated measures MANOVA using two subscales (named the PBL-related scale and the PBL-unrelated scale) derived from the original LASSI scales. The PBL-related scale included the Information Processing, Self-Testing, Study Aids, Test Strategy, and Selecting Main Ideas scales from the original LASSI scales. The PBL- unrelated scale included the Motivation, Anxiety, Attitude, Concentration, and Time

Management scales.

Table 4.19 and Figure 4.3 show the means and standard deviations on these

subscales for the 44 students who completed the LASSI at all three times.

Table 4.19: Means and standard deviations on the PBL-related scale and the PBL-unrelated scale for students who completed the LASSI at all three times (n = 44)

Scale	Mean (SD)				
	Time1	Time2	Time3		
PBL-related scale	137.8(14.50)	139.8(15.63)	137.3(13.91)		
PBL-unrelated scale	146.1(19.68)	150.3(19.03)	145.1(17.17)		





Note: This graph is presented to compare the means of time 1, 2, and 3 within each scale. Comparison of two scales in this graph may be misleading because the number of items included in each scale is different (PBL-related scale with 37 items and PBLunrelated scale with 40 items).
Although students' means on both the PBL-related and the PBL-unrelated scales increased from time 1 to time 2, their means decreased from time 2 to time 3. To determine whether this change was statistically significant, I conducted multivariate tests of significance. No significant change was found from time 1 to time 3 (p = .368). Thus, the univariate <u>F</u>-test results are not reported here.

To determine whether there was a significant change from time 1 to time 2 and/or from time 2 to time 3, an analysis was conducted for each time period as was done with the original scale described in the first section. Table 4.20 shows the means and standard deviations for the 87 students who completed the LASSI at time 1 and time 2.

Table 4.20: Means and standard deviations on the PBL-related scale and the PBL-unrelated scale for students who completed the LASSI at time 1 and time 2 ( $\underline{n} = 87$ )

Scale	Mean ( <u>SD</u> )		
	Time 1	Time 2	
PBL-related scale	136.2(15.27)	140.5(15.52)	
PBL-unrelated scale	144.2(17.02)	150.2(17.24)	

As shown in Table 4.20, means on both scales increased from time 1 to time 2. To determine whether this change was statistically significant, multivariate tests of significance were conducted using time 1 and time 2. The result indicated that there was a significant change from time 1 to time 2 (p = .002). This result was consistent with the result of the analysis on the original LASSI scales. Because the omnibus test showed a significant change, I conducted univariate tests on the PBL-related and the PBL-unrelated

scales. Means on both scales changed significantly from time 1 to time 2 (p = .003 for the PBL-related scale, p = .002 for the PBL-unrelated scale). On both scales, the means of the 87 students included in the analysis improved from time 1 to time 2, as shown in Table 4.20. These results indicated that students' use of strategies, whether they were related to the PBL experience or not, increased from the beginning to the end of first semester of medical school.

I conducted MANOVA tests for time 2 and time 3 to determine whether there was a significant change during this time period. Table 4.21 shows the means and standard deviations of the 45 students who completed the LASSI at time 2 and time 3.

As shown in Table 4.21, means on both scales decreased from time 2 to time 3. To determine whether this change was statistically significant, a multivariate test of significance was performed, using time 2 and time 3. The result (p = 0.85) indicated that there was no significant change from time 2 to time 3. Thus, the results of the univariate tests are not reported here.

Table 4.21: Means and standard deviations on the PBL-related scale and the PBL-unrelated scale for students who completed the LASSI at time 2 and time 3 ( $\underline{n} = 45$ )

Scale	Mean ( <u>SD</u> )		
	Time 2	Time 3	
PBL-related scale	139.5(15.55)	137.2(13.75)	
PBL-unrelated scale	150.0(18.92)	145.0(17.00)	

## Summary

In Chapter IV, I first featured two case studies from the interview findings. Then, I presented the common findings prevailing for all of the interviewees according to each research question of this study. Also, to report the differences in learning strategies between first- and second-year medical students, I presented the LASSI data in addition to the interview findings.

Chapter V contains the limitations of the study, findings pertaining to each research question, conclusions drawn from the findings, implications for medical education, and recommendations for future study.

# **CHAPTER V**

# **DISCUSSION AND CONCLUSIONS**

## Introduction

Educators construct instruction so their students will learn effectively and efficiently. In response, students employ learning strategies of their own to learn what is needed in the provided instructional environment. Thus, it would be ideal if the instruction that is provided and the learning strategies students employ complement each other.

In most situations, students must adapt to the instructional context. Thus, understanding how students adapt their learning strategies in different instructional contexts would benefit educators, especially those who are interested in curriculum design, those who advise students about the most effective learning strategies for the instructional system, and those who build courses to encourage effective and efficient learning strategies.

This study explored MSU medical students' adaptation of their learning strategies. Medical students are a useful group to study in regard to adaptation because they experience different instructional contexts during their preclinical years. Thus, the main question of this study was how medical students adapt their leaning strategies to different

educational contexts. During their first year, students at MSU have a lecture-based curriculum, whereas during their second year, they have problem-based learning. Problem-based learning is learning that results from a process of working toward the understanding or resolution of a problem (Alguire & Werner, 1992). PBL uses cases as a stimulus for learning, provides an opportunity for problem solving, and allows for studentinitiated searching for information.

This chapter contains a discussion of how medical students adapted their learning strategies to a changed instructional context--from lecture-based to problem-based learning--and provides preliminary answers to how students in general may cope with changes in the curriculum. Specifically, the discussion includes how CHM medical students studied during their second-year curriculum, what influenced the learning strategies of second-year medical students, and how students changed their learning strategies from the first year to the second year.

Limitations of the study are presented before the discussion of results. Conclusions drawn from the findings are presented after the discussion of findings for each research question. Implications and recommendations also are made for future research.

### Limitations of the Study

There were a few limitations in this study as discussed below.

<u>The LASSI was not the ideal assessment instrument for the study</u>: In this study, I
compared students' learning strategies from the first year of medical school and the
second year by using the LASSI in addition to interview data. The LASSI originally
was developed for undergraduate students who are under the large-lecture format of

instruction. Although doing several analyses, including item analysis, might compensate for the shortcomings of using the LASSI, results from the LASSI might still be biased because the instrument originally was developed for undergraduate students and because it is based on large-lecture classes. Thus, the LASSI was not the ideal assessment tool to see the changes in the learning strategies of medical students who are professional graduate students and who also experience different curriculum during their preclinical years.

- 2. Not all students completed the LASSI all three times: Another limitation is that not all students completed the inventory all three times from year 1 through year 2. Actually, the number of students who took the LASSI decreased from time 1 to time 3. Thus, there could be some differences between students who completed the LASSI three times and those who did not.
- 3. <u>Interviewer's subconscious bias</u>: Although I tried to be objective in interviewing students, I could have had a biased opinion about learning strategies based either on the literature and/or on the pilot study conducted during the 1993-94 academic year. Thus, subconsciously, I could have influenced students to respond in a particular way.
- 4. <u>Self-reporting instruments</u>: Because both the interviews and the LASSI were self-report instruments, there is a possibility that students concealed their true use of learning strategies. Observation of the PBL classes or use of videotape during the informal group study sessions could compensate for the subjectiveness of self-reporting devices.
- 5. <u>Interviewees nature</u>: Medical students have successfully finished their undergraduate program and have the academic ability to compete in medical school. Thus, they are

relatively bright students. Further, the interviewees in this study did not represent every academic performance level among medical students. There was only one lowacademic-performance student, whereas others represented middle to high academic performance in medical school. Thus, there is a limitation for generalizing the results of this study to other students. However, this research can be generalized to relatively successful medical students.

#### **Research Question 1**

## What learning strategies do students use in preparation for the problem-based learning classroom, and why?

Based on the PBL literature, I expected that students would study differently for PBL classes and for exams. However, most of students mentioned that they did not prepare for PBL classes per se, but focused mainly on exam preparation. Thus, the hypothesis that students would focus more on understanding than rote memorization in preparing for PBL classes could not be evaluated. Most of the interviewees said that they studied for exams, and that process indirectly helped them prepare for PBL classes. They believed that PBL classes did not directly help in their exam preparation, although they thought PBL was a valuable experience.

During the PBL classes at MSU, students are expected to discuss a case, formulate hypotheses, and generate their own learning issues with the help of preceptors so that they can learn relevant information. I found that the learning issues generated during PBL classes were geared primarily toward studying for exams. That is, what students did during the PBL classes was influenced by the objectives that faculty provided for the exam. The reason students monitored their PBL activities based on the objectives was that they needed to study those objectives to pass the exams, and they did not have time to study learning issues that were not relevant to the exams. And when students looked for the learning issues, instead of going to the library and researching necessary materials as hypothesized, they relied on their own textbooks or coursepacks recommended by faculty. Further, when PBL classes were geared toward the exams, students were more motivated to participate eagerly. Some students reported that they felt frustrated when the group discussed something irrelevant to the objectives.

This trend in PBL classes can be compared to K-12 education. In both contexts, exams drive learning. However, whereas in K-12 education, exams drive teachers' evaluation and teaching, in medical school, exams drive students' learning. In medical school, students have taken over the instructor's role in their studying. They decide what information is relevant and how to practice for mastery. For example, medical students gear discussion in PBL classes toward objectives which are the focus of their exams. They also decide how they will practice for the test.

In sum, students did not prepare for PBL classes but studied mainly for exams. Through studying for exams, they could contribute to PBL class discussion. Further, students used the PBL class as an arena to study for exams by making the learning issues match the objectives that drove the exam questions. Thus, it can be concluded that no matter what curriculum is used, students study for exams.

## **Research Question 2**

# What learning strategies do students use in preparation for examinations (both class exams and the licensing exam), and why?

From the interviews I found that students used various strategies to prepare for examinations. First, I found that second-year medical students relied extensively on reading materials, used many integration strategies and group study, and used only a few memorization strategies. Students' use of these strategies will be discussed together because the reasons for using these strategies were similar. Second, I found that second year medical students used many strategies for selecting the main information for exam preparation.

One of the notable things I found from the students' interviews was that their basic study mode in the second year was reading textbooks, whereas they relied heavily on lecture notes and lectures the first year. They attempted to get the overall picture and general ideas during their first reading and studied details through their following readings. Thus, reading the materials several times seemed to help them understand the vast amount of material. By reading books and/or coursepacks, students tried to expose themselves to as much information as possible, as shown in Laura's comment:

It's just too much work to try to get through. And I figure it's best to get through everything once rather than to get through some things and not the others and really screw up on the exam because I didn't get to the other material.

Further, consistent with Blumberg and Mitchell's (1992) finding that students in PBL relied more on reading textbooks or other materials and informal discussion with peers than did conventional students, students in this study relied more on textbooks than they did their first year, and they engaged more in discussions with peers during group study.

Although various factors might have influenced students' use of reading strategies and group study, students reported they were more effective learners their second year, either because they had the first-year medical knowledge or because they had experience taking exams. Also, they felt more confident about studying alone for exams as a result of their experience of studying the first year of medical school. Thus, rather than relying on lectures, they focused on reading materials for understanding and group study, mainly because this helped them integrate and understand the materials. Group study enabled students to talk to each other and clarify concepts, check their knowledge, and pick up important information. Further, by providing students the opportunity to discuss, question, and teach the materials to each other, group study seemed to activate and elaborate students' prior knowledge and connect it to new knowledge. For example, Jim mentioned that when the members of his informal group studied for drug x, they talked about how it acted and where it acted. Then they quizzed each other, correcting their misunderstandings. Thus, what Schmidt (1983) argued as the theoretical basis of the PBL was achieved through students' PBL group discussion or informal group study in preparing for the exams.

Medical students' use of learning strategies and influences on their use of learning strategies can be connected to Palincsar and Brown's (1988) reciprocal teaching. Although reciprocal teaching is designed to help children comprehend what they read, it shares many features with learning strategies that medical students used in this study, even

though PBL class has a student-centered instructional format and reciprocal teaching has teacher-guided instructional format. For example, reciprocal teaching involves four study activities--summarizing, questioning, clarifying, and predicting--that enhance comprehension and also afford children an opportunity to check whether comprehension is occurring in the same way that medical students check their knowledge through discussion and questioning during PBL classes and informal group study. Reciprocal teaching also assumes that comprehension is influenced by the extent of overlap between the reader's prior knowledge and the content of the texts. As medical students reported in this study, they also connected their prior knowledge with what they learned during their second year to help their understanding. Hence, some of the features of the PBL classes and informal group study that students said they used could also be found in the reciprocal teaching instructional format.

When asked their reasons for using group study and readings, students said that, in their second year, they focused on conceptualization and understanding more than on memorization. Most interviewees mentioned that they thought understanding meant knowing how things work, knowing how a certain system operates. They added that connecting various pieces of information and seeing the overall picture helped them understand how things work. Thus, integration and understanding of the materials were not two separate things to most of the interviewees.

This finding is consistent with those of previous PBL researchers. For example, following Marton and Saljo's (1976a) framework of deep versus surface processing of learning as discussed in Chapter II, researchers such as Coles (1985) and Newble and

Entwistle (1986) found that PBL students placed more emphasis on understanding than on rote memorization, as compared to conventional students. Newble and Entwistle (1986) defined rote memorization as "memorization of pieces of information and ideas largely in isolation from the wider context" (p.165), whereas understanding means "interconnections with other ideas and previous knowledge" (p.167).

Students' use of computer programs with visual examples connected to texts, group study, readings, and making charts also seemed to reflect their purpose of understanding rather than memorizing the materials. Thus, the hypothesis that students will use many strategies integrating materials in their second year was supported. However, the hypothesis that students will use many memorization strategies in preparing for exams was not supported in this study. It may be hypothesized that students had knowledge gained from their first year of medical school, which allowed them to connect the information more easily and hence increase their understanding. Further, as discussed earlier, having a vast amount of material seemed to make students focus on understanding the materials rather than spending time on memorizing details.

As hypothesized, another notable learning strategy that students used the second year was selecting important information. Interestingly, however, the most frequently mentioned strategies for selecting the main information reflected the exam makers' or professors' views of important materials rather than what students themselves selected through reading. For example, percentages of the exam content, starred objectives, practice quizzes, and computer programs are all strategies that professors provided to students. Students just used those resources in order to select the main information.

Students also used computer programs extensively the second year to select the main information. Computer programs contained more concise information than textbooks. Thus, students used such programs extensively to obtain important information efficiently.

The vast number of strategies students used to select the main information that was likely to be on the exams was also reflected in students' use of resources. Based on previous PBL research (Nolte et al., 1988; Rankin, 1992; Saunders et al., 1985), it was hypothesized that students in PBL classes would increase their use of library facilities for information seeking. However, the findings of this study indicated that students did not use the library at all in preparing for their PBL classes or exams. Rather, students looked for those materials that were closely related to the exams, and focused on materials recommended or provided by faculty instead of looking for materials on their own. This may be explained, in part, by the fact that MSU has a faculty-centered PBL program as compared to other PBL schools, so students do not have to select their own materials to study but are given lists of recommended materials. Also, limited time for study and the pressure of passing class exams and board exams prevented students from making greater use of the library.

In sum, as discussed above, second-year medical students focused on understanding or integrating the materials as a goal instead of memorizing details. Thus, they used various strategies for this purpose, such as reading, integration strategies, computer programs, and group study. The use of these learning strategies in their second year was partly influenced by their knowledge from the first year. Also, second-year medical students used many strategies for selecting the main information. This was partly

a result of their need to study vast amounts of material in a limited time to pass the exams. Thus, they geared their study toward the objectives and used various strategies to learn information for the exams. The strategies that students mentioned reflected how they adapted their use of learning strategies to the changing demands and conditions of the context during their second year.

### **Research Questions 3**

# What do students think influences their learning strategies (such as goals, assessment of learning, student activity, teaching method, and course content)?

Most interviewees said they wanted to pass the domain exams and board exams. Also, many students said they wanted to have a good knowledge base. Although having a good knowledge base and thus being a good doctor was their long-term goal, their immediate goal was passing the exams. Thus, the pressure of passing the exams and having a limited time to study influenced their choice of learning strategies. Also, 4 of the 14 students said it was hard to change their previous study habits; thus, they still used those methods in their study. Only 2 of the 12 interviewees mentioned that the PBL process made them change their learning strategies. Thus, in this study it was hard to validate the hypothesis that the PBL experience affected students' use of learning strategies. Rather, time constraints and pressure to pass the exams seemed to influence their strategies the most.

Because. students' perception of the educational context influences their selections of learning approaches (Arnold & Feighny, 1995), it was important to explore how students in this study perceived the PBL context. Although most students said that PBL classes did not help in their preparation for exams, they found the experience in the PBL curricula to be valuable in some ways.

Ten of the 12 interviewees reported that PBL classes helped them integrate the materials and hence increased their understanding. Students also thought that PBL classes provided a valuable context for their clinical years' learning. As Vernon and Blake's (1993) meta-analysis suggested, students in this study thought that PBL increased their integration of clinical and basic science knowledge. They thought PBL classes provided cases with contexts and thus helped them assimilate information easily into their existing knowledge. This corresponded to one of the main goals of PBL, which is for students to assimilate new information into the existing knowledge structures and thus integrate the materials (Schmidt, 1983).

Conforming what Norman and Schmidt (1992) and Schmidt (1983) argued, the PBL format may foster increased retention of knowledge over time by stimulating the activation and elaboration of prior knowledge through discussion, answering questions, and teaching peers in a small group. Norman et al. also argued that these activities in PBL in turn can facilitate students' comprehension of the materials. This claim matches students' reports that PBL helped their integration of the materials and hence will help their long-term goal, which is having a good knowledge base and understanding the materials.

Further, 10 of the 12 interviewees reported that being in PBL classes increased their communication skills through small-group discussion, as hypothesized. This result confirmed one of Moore-West et al.'s (1989) findings, which was that PBL students rated

their experience higher with respect to student interactions. Also, this result was consistent with that of Blumberg and Eckenfels (1988) who found that students identified group discussions as one of the most satisfying aspects of the PBL experience. Students in this study reported that they learned how to convey their ideas and how to question others critically without causing offense. As reported in Chapter IV, students thought that PBL promoted the ability to work with others and listen to others' opinions. Thus, one goal of MSU PBL, which is to develop effective small-group skills, seems to have been achieved (*Block II Preceptor Training*, 1993). Maybe this development of communication skills through small-group discussion in PBL classes contributed to students' use of informal group study as a learning strategy the second year. Students reported that they relied more on group study their second year as compared to their first year. For example 10 of the 12 interviewees who attended PBL classes said they studied with a partner or in a group.

About half of the interviewees said that PBL classes improved their independent study habits, which is also one of the purposes of the PBL model. However, what students termed "independent study" meant finding and reading books for the exams and studying for exams by themselves instead of relying on lectures to provide all of the necessary information for exams, as they did the first year. Thus, what students meant by increasing independent study did not mean using the library or doing research for their own learning, as hypothesized. Again, because they had so much material to study in a given time, there was no time to do research for their own learning. This may have been a result of the unique MSU PBL structure. For example, the MSU PBL curriculum is

faculty-centered in the sense that students use faculty-generated objectives and reading lists to guide their learning of basic science concepts. Having more structured problems and faculty-centered PBL classes, students might gear themselves toward studying those learning objectives for the exams, rather than developing individual research skills, like students who are in an entirely student-centered PBL environment. However, this structure could benefit students by giving them more direct guidance for their studying and thus saving them time by focusing their study, which they thought was very important in light of their content overload.

In addition to these advantages, students also mentioned that PBL classes provided an opportunity for self-checking through small-group discussion sessions. By discussing the material with peers, students could compare their knowledge with others', discover whether they had misunderstood something, get information about what they needed to know, and determine how well they had learned the material.

Previous researchers have found that students and faculty are more favorable toward PBL than the traditional instruction format (Vernon & Blake, 1993). For example, Moore-West et al.'s (1989) survey of medical students showed that the PBL students rated their experience higher in terms of meaningfulness, flexibility, emotional climate, nurturance, and student interactions. Although most of the interviewees in the present study knew that PBL would be useful in their clinical years, some of them felt insecure in the PBL experience and were frustrated and stressed with the unguided structure of the classes compared to the lectures they had during their first year. This result is similar to that of Moore et al. (1990), who found that PBL students at Harvard thought their

preclinical experiences were more stressful than did students in the conventional curriculum. However, this result contrasted with the findings of Moore-West and O'Donnell (1985), who found that PBL students were substantially less stressed than their conventional counterparts.

Further, interviewees in this study did not seem to think that PBL was necessarily more valuable than lectures in preparing for the exams, which was their current goal. Some students said they could study more effectively by themselves than by spending time in PBL classes. Perhaps, by their second year, students established their own learning strategies and knew how to study to pass the exams and thus did not feel the need for PBL classes for that purpose.

Overall, consistent with the other findings, I found that students thought passing exams and time constraints influenced their choice of learning strategies. Interviewees thought PBL was not necessarily better than lectures for achieving their immediate goal, which was passing exams. However, interviewees believed that the PBL experience allowed them to achieve their long-term goals which were to develop a good knowledge base by providing a clinical context for learning, to develop small-group working skills, and to encourage active learning such as discussing materials with peers, comparing their knowledge, checking their understanding, and getting information about what they need, which are the goals of the MSU PBL model.

## **Research Question 4**

# Do second-year medical students at MSU CHM report that they study differently than they did in their first year? If so, how and why?

### Interview Results

From this study, I found that second-year medical students used more integration strategies and reading than they did the first year. Also, second-year students used fewer memorization strategies than they did their first year. I also found that students used more diverse strategies for selecting the main information during their second year than their first year. However, second-year medical students did not increase the use of learning resources, especially using library facilities, compared to their first year. Next I discuss these findings in detail.

Based on previous PBL research, it was hypothesized that second-year medical students would focus more on understanding the materials as a result of their experience, as compared to their first year. As expected, in their second year, students read textbooks more and focused more on understanding as compared to their first year, in which they had relied heavily on lectures and lecture notes. First, part of the reason for these changes stemmed from the fact that most information was not covered in lectures. Second, maybe this result was related to the source of exam questions. Whereas in the first year of medical school most of the test items came from lectures and lecture notes, in the second year students could not pinpoint only one source for exam questions. Third, experience in PBL classes may encourage students to use more integration strategies. Students mentioned that PBL classes helped them integrate materials. In discussing cases with

peers, they had to relate many separate ideas to find and solve the problems embedded in the case. Fourth, partly because of the knowledge they had from their first year, students were able to focus more on understanding the second year. Because students did not have to concern themselves with the vocabulary of the medical language, they may have been able to concentrate on the relationships among the ideas. Therefore, they were more able to use integration strategies which stressed the interrelationship of ideas. Students reported using more strategies for integrating and relating ideas, such as making charts, reading materials, group study, or using computer programs, the second year. In contrast, the first year, they had focused on numerous memorization strategies such as mnemonics, making flashcards, or repetitive reading or writing down materials.

Comparing the learning strategies that students used their first year, which consisted mainly of lectures, to those they used their second year, I found that most students used strategies for understanding and integration, and they focused less on memorization strategies as compared to their first year. This finding is consistent with those of Moore et al. (1990), Mitchell (1992), and Van Langenberghe (1988), who all found that students in PBL curricula relied more on understanding than on engaging in memorization. For example, students in this study used more informal group study their second year as compared to their first year because group study helped them understand the materials through discussion. Maybe the increased use of group study the second year was\_influenced by the experience of PBL classes. For example, Jim used the process of PBL in his informal group study, as evidenced in the following comment: " I have two

other people that's kind of our own PBL group. And we work much like a PBL group does except that we don't do learning issues."

Further, students' knowledge from the first year of medical school and their limited time with a vast study load made them develop more integration learning strategies, with the goal of passing the exams, rather than spending their time memorizing small details. That is, they connected a new idea to a concept or information they already knew, and this led to further conceptualization and understanding.

I also expected that second-year students would increase their use of strategies for selecting the main information because of the large study load as compared to their first year. As expected, students used strategies for selecting important information because of content overload. However, another reason students used these strategies so widely might be that students had multiple-choice exams and they tried to guess what types of questions would be on those exams. Thus, they used strategies for selecting information that was likely to be on the exams, such as using starred objectives, percentages of the exam content, objectives, quizzes, and computer programs. In addition, the main reason some students attended lectures the second year was to get information for the exam. In general, students focused on studying for exams and thus concentrated on selecting information that was likely to be on the exams.

I also hypothesized that, second-year medical students would use more learning resources, such as library facilities, self-selected reading materials, and/or textbooks than they did the first year. As discussed under Research Question 2, while students exclusively used lecture notes and relied on lectures their first year, students relied on

textbooks in addition to lectures the second year. However, unlike the hypothesis, students in this study did not seem to increase their library usage or self-selected reading materials as compared to their first year. This result was contrary to those of Nolte et al. (1988), Rankin (1992), and Saunders et al. (1985), who found that students in PBL curricula increased their library usage and self-selected, as opposed to faculty-selected, reading materials. It could be explained that the students in this study had been given the materials to study and had books recommended by MSU faculty. Thus, they might not have needed to make an effort to go to the library to find information or self-selected materials for their study. Further, having limited time with a vast amount of materials to cover may not have allowed students to spend their time on library searches. The hypothesis that students would increase their independent study and develop research skills their second year as compared to the first year can also be explained in a similar way. As discussed in detail under Research Question 3, students seemed to have no need to increase their research skills in an environment in which they found most of the information they needed in books or computer programs.

The above-mentioned changes reflect how students adapted their learning strategies to a different instructional context. Students knew what was expected in the new environment they confronted and changed their learning strategies accordingly. Further, what they had as previous knowledge seemed to affect their changing learning strategies, such as integrating materials more. Students did not seem to add many new strategies the second year because of the curriculum change, but rather they seemed to change the amount they used certain strategies. For example, although students used

informal group study as a learning strategy their first year, they used it more their second year.

Having a vast amount of material to study in a limited time and having previous knowledge seemed to make students focus on integration- and understanding-related strategies rather than rote-memorization strategies. However, this change in learning strategies did not necessarily reflect the two different curricula students experienced, as had been expected. Although the PBL experience helped students in various ways, as discussed under Research Question 3, whether this experience made students change their learning strategies was not evident from the interview data.

## LASSI Results

I used the LASSI in addition to interviews to determine whether medical students changed their learning strategies through their preclinical years. From the LASSI analysis, I found that students changed their learning strategies from time 1 to time 2, rather than from time 2 to time 3. During the first year of medical school, students adjusted their study habits more than they did from the end of the first year through the second year. During the first year, strategies to promote motivation decreased significantly, whereas strategies to aid information processing and strategies for selecting important ideas increased significantly. This could be interpreted to mean that although students were worried about succeeding at the beginning of medical school and thus used various strategies such as self-talking to increase motivation, they used fewer of these strategies as they gained experience in medical school, possibly as a result of reduced concern and more content overload with limited time. This does not mean that students became less

motivated. They simply used less strategies for enhancing their motivation. From this data, we cannot be sure if their motivation increased or decreased.

On the other hand, with the vast amount of information they had to study for the exams in a limited time, students needed to develop their strategies for selecting important information--what was mostly likely to be on the exams--and for information processing, such as elaborating or organizing information. Thus, the significant increases in students' mean scores on these two scales seemed to evidence a logical process.

However, there was no significant change in students' learning strategies between time 2 and time 3. This might be interpreted to mean that students had already adjusted their study strategies during their first year and did not have to change their strategies any more during the second year for the kind of assessment made. This was also shown in the interview data, in that some students said their previous study habits influenced their use of strategies the second year. Or this finding could be explained by the fact that the LASSI was developed mainly for undergraduate students, who primarily attend large lectures. Because medical students take large lectures during their first year, the LASSI could more properly represent the changes in their learning strategies, whereas the second year is composed mainly of PBL classes, which LASSI items do not represent well.

When I did the same analysis with the individual LASSI items divided into PBLsensitive and PBL-nonsensitive scales, means on the PBL-nonsensitive scale decreased significantly whereas means on the PBL-sensitive scale did not change significantly. No time 2 data were included in the analysis because no individual item answers were

available for time 2. Thus, the changes from time 1 to time 3 might have resulted mainly from the changes from time 1 to time 2, as found using the LASSI scales.

I analyzed the PBL-related scale versus the PBL-unrelated scale using the original LASSI scales; this was very similar to the individual item division. Five scales--Motivation, Concentration, Time Management, Attitude, and Anxiety--were coded as the PBL-unrelated scale, whereas the remaining five scales--Information Processing, Selecting Main Ideas, Self-Testing, Test Strategy, and Study Aids--were coded as the PBL-related scale. The results showed that means on both scales improved between time 1 and time 2, whereas means on the PBL-unrelated scale decreased significantly from time 2 to time 3. This finding is consistent with the results of the original analysis in that means on most of the PBL-unrelated scales in the original analysis decreased significantly. Thus, the decreases in means on the PBL-unrelated scale when there was no change in means on the PBL-related scale might indicate that PBL did something for the students' learning strategies or at least let the students keep the strategies they already had. Or it might just be that, during the second year, students keep the learning strategies they had developed during their first year of medical school in order to pass the exams.

The LASSI analysis showed significant changes from time 1 to time 2, which was during their first year of medical school, rather than from time 2 to time 3, which was from the first year to the second year. This result was found whether I ran the analysis with the LASSI scale or with researcher-made scales--the PBL-related and PBL-unrelated scales. This could be interpreted to mean that whereas students needed to adapt to a changed learning environment their first year of medical school (from their undergraduate education to medical school), they did not have to change their learning strategies as much during the second year as compared to the first year.

Consistent with the interview findings, the LASSI analysis indicated that the students' strategies for information processing and selecting the main information improved significantly during their first year. Students experiencing the first year of medical school may need to change their learning strategies to meet the demands of medical school—a large volume of study materials with limited time. Thus, it is logical for them to improve their strategies for selecting the main information and for information processing, such as elaborating and organizing information. However, although the interview data indicated that students\_modified their learning strategies to the changing demands or conditions of the context during their second year, these changes seemed to be less dramatic than those during their first year, as shown in the LASSI results.

This could mean that although students were already accustomed to the general medical school context, which required them to study a vast amount of material in a limited time to pass the exams, they were less influenced by the curriculum changes in using their learning strategies. This inference can also be drawn from the LASSI analysis results—that both means on the PBL-related and PBL-unrelated scales increased during the first year, whereas means on both scales decreased during the second year, indicating that the curriculum had relatively less effect on students' learning strategies.

### **Conclusions**

The overall question of this study was how second-year medical students adapted their learning strategies to a curriculum that had changed from their first year. The following are the major findings of this study.

# 1. Exams drove students' learning strategy choice more than the curriculum did: I

found that students did not prepare differently or use different learning strategies for PBL classes and for exams. Rather, they used PBL classes as an arena in which to discuss exam materials, and they prepared for classes in the process of studying for exams. Their use of learning strategies reflected the effect of the exams. For example, students matched their learning issues with objectives that would be the focus of the exams and thus used the PBL classes for studying exam-related issues. Also, students used many strategies for selecting information that was likely on the exams, such as percentages of the exam content, starred objectives, practice quizzes, and computer programs, which reflected the exam maker's views of important materials rather than what students themselves selected through reading.

# 2. Demands or conditions of the context also seemed to influence students' choice of

**learning strategies:** From this study, I found that exams drove students' learning strategies the most. However, demands or conditions of the instructional context also affected students' choice of learning strategies. For example, time constraints and the large amount of content they were required to study led students to use many strategies for selecting the main information, as shown in both contexts--lecture-based and problem-based learning. Availability of starred objectives or computer programs in an instructional

context also influenced the strategies that students chose for selecting the main information. Further, exam type--multiple-choice exams in both contexts--also seemed to play a role in students' extensive use of strategies for selecting exam-like information from the maker's point of view. Availability of faculty-made objectives and recommendation books, coupled with constraints of time, also seemed to explain students' nonuse of library or self-selected materials.

Having prerequisite knowledge gained through the first year of medical school allowed students to use more strategies for integration and understanding than they used during the first year. The curriculum also combined with prior knowledge to influence students' choice of learning strategies. For example, the PBL format allowed students to increase their communication skills through small-group discussions of cases and learning issues, and it also helped students integrate materials by providing context to a problem. Thus, students used more informal group study in preparing for exams, which provided an opportunity for them to activate their prior knowledge so it could be connected to new knowledge. Further, having existing knowledge, coupled with content overload and a limited time to study, seemed to lead second-year students to use fewer memorization strategies than they used their first year.

Of course, students' goals influenced their choice of learning strategies. Thus, the overall pattern of students' use of learning strategies in this study was geared toward passing the exams, which was their immediate goal. However, their use of strategies geared toward passing exams was made possible by other factors, such as availability of resources and demands that are required in a certain context.

Figure 5.1 shows various factors that influenced students' use of learning strategies found in this study.



Figure 5.1: Factors influencing students' choice of learning strategies.

Note: a = ex: objectives, computer programs, recommended books, peers, communication skills, class format, prerequisite knowledge

- b = ex: passing exams, understanding materials
- c = ex: time constraints, amount of content, exam type

3. <u>The PBL curriculum had mixed results in achieving its goals</u>: The four major goals

of PBL at MSU are (1) to provide a clinical context for learning, (2) to encourage active

learning, (3) to provide a model of problem solving, and (4) to develop small-group skills.

From the interviews with students, I found that PBL classes provided a clinical context for

learning so that students could integrate the materials easily. I also inferred from students'

reports that PBL encouraged active learning through discussing, questioning, and evaluating problems with each other during PBL classes. The use of informal group study to prepare for exams also indicated students' active learning. During the informal group study, students discussed, questioned, and evaluated issues with each other as they did in PBL classes. Further, students reported that PBL classes increased their small-group skills, such as how and when to talk and listen. These enhanced small-group skills may have encouraged students to use informal group study in preparing for exams their second year. However, whether the PBL curriculum achieved its goal of providing a model of problem solving, such as encouraging relevant problem-solving strategies through case studies, was not evident from this study.

In general, students reported some positive aspects of the PBL curriculum that they would use in the future and that would help them achieve future goals--understanding the materials well enough that they apply what they learned in the clinical situation. However, they did not think PBL was much help in achieving their immediate goal, which was to pass the exams.

4. <u>Students did not add many new strategies the second year because of changes in</u> <u>the instructional context, but rather they changed the amount they used certain</u> <u>strategies during the second year as compared to the first year</u>: The study findings suggested that second-year medical students studied somewhat differently than they did the first year. However, their adaptation of learning strategies to the changed instructional context was more a modification of strategies they had used rather than a dramatic change. The only learning strategy that students said they did not use their first year was

computer programs. Students said they used these faculty-made programs to select the main information because the programs contained more concise information than did textbooks. Other than using computer programs, students amplified their use of learning strategies from their first year. For example, students used strategies such as informal group study, integration, reading, selecting main information more the second year than the first year. On the other hand, they used fewer memorization strategies such as mnemonics or flashcards and relied less on lectures or lecture notes. Students also seemed to keep the checking-knowledge strategies they used during their first year but did not increase their use of library facilities.

5. From the LASSI analysis, I found that students changed their learning strategies more during their first year than during their second year: The LASSI analysis indicated that although students changed their learning strategies significantly during their first year, they did not change those strategies significantly during their second year. This could mean that students who are entering a different instructional context in which large amount of content must be learned in a limited time may need to adapt their learning strategies more than they needed to change their learning strategies for a different curriculum in medical school.

### **Implications**

In this section, I present implications for theory and practice. I include implications for general adaptation of learning strategy theory and PBL theory. In implications for practice, I present implications that can be used by both medical educators and general educational psychologists, including instructional designers.

Implications for Theory:

Recent studies have indicated that students' approaches to learning are attributable partly to their preferred learning style and partly to the context in which the leaning takes place (Newble & Entwistle, 1986). In this study, I found that medical students adapted their learning strategies to different educational contexts. Both the conditions that students perceived in a context and the demands required of students influenced their adaptation of learning strategies. For example, students' prior knowledge, the amount of content required, time constraints, and resources available in a context all influenced students' choice of learning strategies. However, the most powerful influence on students' learning strategies was the "assessment." Second-year medical students adapted their learning strategies so that they could pass the exams, which they must do in order to move to the next step. The immediate goal that students had, in this case "passing exams," seemed to make students gear their learning strategies toward the exams. As Marton and Saljo (1976) and Elton and Laurillard (1979) suggested, methods of assessment appear to have a great effect on students' use of learning strategies. For example, tests requiring only the recall of factual knowledge tend to induce a surface approach, even in those who prefer a deep approach to studying. On the other hand, anticipation that a test will require a greater degree of understanding encourages a deep approach (Marton & Saljo, 1976b). One of the interviewees in this study spoke about the effect of the assessment type on her way of thinking, as follows:

I feel that I'm losing a lot of my logical abilities by not having essay tests and not feeling that I'm studying for an essay test. And even things that I read now, even if it's pleasure reading or the newspaper, I tend to read the same way I study. I'm picking out important words instead of tying everything together into an idea. I have a problem with that. My whole way of thinking has changed with these multiple choice exams. So I have a problem with not having essay exams. (Nancy)

Most other students, including children and undergraduate students, also realize the importance of assessment because they need to pass exams in order to move to the next step in their education. Thus, researchers studying learning strategies should consider assessment as a powerful influence on students' choice and adaptation of learning strategies in different instructional contexts.

The study findings suggested that PBL curricula had some benefits on students' approaches to learning. For example, students reported that the PBL experience allowed them to improve their small-group skills and that discussion in PBL class facilitated integration and understanding of the materials by providing a context to a case. However, this study suggested that researchers studying PBL should also consider the role exams play in students' approaches to studying. Although PBL structure, compared to lectures, might be beneficial to certain uses of desirable strategies, one should account for the influence of assessment when considering PBL theory. Depending on the type of assessment, the influences of PBL might change. Further, PBL might be beneficial to differing degrees, depending on the structure of the curriculum. Whatever the structure of the PBL curriculum, the importance lies in the consistency among the method, outcomes, and measure of outcome. This is true of any instructional theory.

The MSU PBL has a basically student-centered instructional format in the sense that students, not faculty, raise learning issues and actively discuss a case, and preceptors only guide and do not direct students' class discussion. However, the evaluation format of MSU PBL is faculty centered. As long as the evaluation remains faculty centered, the students will do whatever they can to make the instruction format match what faculty expect in the evaluation. For example, the medical students in this study used the classes as a way of studying for exams, by matching objectives with learning issues. Thus, it is important to make the instruction (method), the goals or objectives of the instruction (outcome), and the evaluation (measure of outcome) consistent when designing a course or, more broadly, a curriculum.

#### Implications for Practice:

Students' use of learning strategies is a complex phenomenon that is influenced by many factors such as prior knowledge, content amount, and time. However, as suggested in this study, the most influential overall factor affecting students' approaches to studying seemed to be assessment. For example, students used PBL classes as an arena for studying for exams. When the assessment is so important, considering the type and quality of assessment is essential in facilitating students' desirable approaches to studying.

MSU has a different student assessment method than do other PBL programs, in that the main type of assessment is multiple-choice exams, as in a traditional curriculum. Although multiple-choice exams can induce deep processing of information, it is also true that such exams allow students to guess the answers more easily. For instance, multiple choice-exams might not reflect students' knowledge as precisely as essay exams because students can guess the answers. As Kelly stated,

I think that my test scores are not reflective of the information that I have. I think my test scores are generally higher than the information that I have. There are a lot of other people who think they know more than their test scores; I think I know less than my test scores. I'm one of those people who tests well, so when I guess, I generally guess better than other people.

Further, second-year medical students in this study used various strategies for selecting information that was likely to be on the exams, and they spent a great deal of time studying "testable" components of the course, rather than focusing on practical and clinical aspects. When the aim of medical school is to produce doctors with a wide range of skills and a great deal of relevant knowledge so that they can apply their knowledge to the field, it is essential for the instructional program to match closely the content of its assessments to its educational objectives. Otherwise, the examinations might lead to a mismatch between what students learn and what the school wants them to achieve.

For example, faculty intend to develop students' problem-solving skills through the PBL curriculum. Because the exams are the main thing for which students study, in order to achieve these objectives, the exams should include questions that increase students' problem-solving skills. The exams could include more questions that measure not only the acquisition of knowledge but also students' ability to apply that knowledge in problem solving, such as asking the justification or explanation of relevant underlying principles. Further, take-home exams, open-book exams, group projects, or brief oral interviews would be alternative choices of assessment methods. Of course, the important thing with the assessment is adequate feedback on performance rather than just an indication of scores, allowing students to discuss answers and giving them the opportunity to review each other's performance.

This implication applies to general educational psychologists who are especially interested in instructional design. When designing a curriculum, or more narrowly a course, the designers should make the assessment compatible with the objectives and goals of instruction so that the goals of instruction are what students want and need to study. Further, it is important to consider students' perceptions of instruction and what they think is important when designing instruction rather than focusing on teachers' point of view. For children, who need a more direct guide from teachers as compared to professional students, teachers' role is even more important in inducing students to glean the adequate knowledge that they are expected to learn.

From this study I also found that having previous knowledge helped students use more strategies for integrating materials. Thus, having solid previous knowledge so that students connect the new information more easily with what they had seemed important. For example, having a solid curriculum for year 1, which includes more activities that ensure students understand essential concepts and ideas, is important in medical school. Further, for those students who are at risk academically, providing extra support such as supplemental instruction, which encourages students not only to use appropriate learning strategies but also to learn basic science knowledge, seems very desirable so that students can adapt their learning strategies to a changed educational context more easily.

## **Recommendations for Future Research**

This study concerned how second-year medical students adapted their use of learning strategies to a changed educational context. I explored students' learning strategies under a PBL curriculum following their lectured-based curriculum the preceding
year. An important finding of this study was that students studied for exams no matter what the curriculum was. Exams influenced the most the way students studied and what they studied. To see the effect of assessment on students' use of learning strategies more clearly, more research should be undertaken on students' learning strategies and their perceptions of the PBL curriculum in various medical schools that have adopted a PBL curriculum, especially those schools that have different assessments from MSU CHM. Comparing the results of that research with those from this study would give an indication of how an individual school's structure and the characteristics of its PBL curriculum affect students' learning approaches.

This study showed how the same students who experienced large-lecture-format instruction adapted their learning strategies to a changed learning context- PBL. However, if one is interested in seeing the effect of curriculum on students' use of learning strategies more objectively, research should be conducted with second-year students in the College of Human Medicine, who are under the PBL curriculum, and those in the College of Osteopathic Medicine, who are under the traditional curriculum. One can ask research question such as "What is the effect of curriculum on second-year medical students' use of learning strategies?" Because both groups share their first-year experience as a large-lecture-instruction format, one can assume that they have a similar background regarding prior knowledge learned through the first year, and thus the effect of curriculum can be seen more clearly.

Further, to verify the roles of PBL classes and the usefulness of PBL, which I investigated based on students' self-reports, further research should be conducted during

146

students' clinical years, when they do not have the intense pressure of the basic science and board exams. Such a study could be done with the same students who participated in this study during their clinical years, with questions such as "How are your learning strategies changed from those that you used under PBL?" "What roles does the PBL curriculum play in your clinical years?" or "How has your perception of PBL changed, if at all, as you experience your clinical years?" Also, a study can be conducted, comparing students who experienced a PBL curriculum and those who did not during their preclinical years, to see whether students who had the PBL experience develop more clinicalreasoning skills and problem-solving ability during their clinical years.

# APPENDICES

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**APPENDIX A** 

#### **APPENDIX A**

#### **Consent Form**

I agree to permit the results of the LASSI administered 2/6/95 to be used for research on medical students' learning strategies in Problem Based Learning. I understand that this research is being done by the Office of Academic Programs in the College of Human Medicine and Inkyung Lee, a graduate student from the Department of Counseling, Educational Psychology, and Special Education at Michigan State University.

#### I understand that

- 1. My participation in this study is voluntary.
- 2. Data collected will be used for this learning strategy research and possible publication.
- 3. All data collected will be kept confidential and reported without individual identification.
- 4. I can choose not to answer any question or discontinue my participation in the study at any time.
- 5. This research project has been approved by the University Committee on Research Involving Human Subjects (UCRIHS).

Print Name _		
Signature	Date	

# **APPENDIX B**

### **APPENDIX B**

#### **Interview Questions**

### 1. Would you describe what you do during the PBL classes?

- sub) Tell me what and how you do (such as activities, tests etc.)
- \* Do you prepare differently for PBL classes and PBL exams?
- \* What is the approximate ratio of your study time for exams and for PBL classes?

#### 2. How do you prepare for your PBL classes ?

sub) How do you prepare for PBL class, can you describe or show me how?
Why do you prepare in that way?
How well do you think it works?
With whom do you prepare?
Where do you prepare?
When do you study?
Did you have Supplemental Instruction (SI) last year?
If yes, does it help you to prepare or adjust to PBL classes?

\* Has the way you prepare changed from last year?

#### 3. How did you study for a PBL exam you have taken recently?

sub) What was the specific content you had to learn?
How did you study; can you describe or show me how?
Why did you study in that way?
How well did it work that way?
With whom did you study?

What will you do for your next exam?

(For example, will you add, delete, change anything about your studying?) Why will you make that change?

\* How did your study for exams change from last year ?

Generally,

Are you satisfied with your approach, why? Do you use the same approach in all courses, why? Do you use the same approach for all tests, why? How do you intend to study for Board exam?

### 4. What is the biggest influence on the way you learn as a medical student? Why?

sub) What is your own goal in general?

What is your goal from PBL?

How does PBL help you to achieve your goal? (for your own understanding, for passing the NBME, for passing exams)

How does PBL help you to prepare for exams (both class exams and board exam)?

How does PBL make you feel?

\* How has it changed from last year?

\* How has the experience of PBL caused you to change the way you study?

# 5. What else do you think I should know that you think is important about your approaches to studying?

**APPENDIX C** 

# **APPENDIX C**

#### **Descriptions of LASSI Scales and Sample Items**

The following information is quoted from the LASSI user's manual (Weinstein,

Palmer, & Schulte, 1987).

#### Anxiety

Current conceptions of anxiety emphasize the effects of our own thought processes and how they affect school performance. Items on this scale address the degree to which students worry about their performance when confronted with academic tasks, such as exams. This scale shows whether students worry so much that it is hard for them to concentrate, and whether they are easily discouraged about grades.

Sample Items:

- 1. Worrying about doing poorly interferes with my concentration on tests.
- 2. I am very tense when I study.

#### **Attitude**

Students' general attitudes toward school and their general motivation for succeeding in school have a great impact on their diligence in study, particularly in autonomous situations in which they must study on their own. The items in this scale contain students' perceptions of the role and relevance of college in their lives. How clear are students about their own educational goals? Is school important or worthwhile to them?

Sample Items:

- 1. I feel confused and undecided as to what my educational goals should be.
- 2. I only study the subjects I like.

#### **Concentration**

Concentration helps students focus their attention on school-related activities, such as studying and listening in class. Items on this scale address students' abilities to concentrate and direct their attention to school and school-related tasks, including study activities. Are they easily distracted? Can they direct their attention to school tasks? Sample Items:

- 1. I concentrate fully when studying.
- 2. I find that during lectures I think of other things and don't really listen to what is being said.

### Information Processing

Meaningful learning is enhanced by the use of elaboration and organization strategies. These strategies help to build bridges between what a students knows and what he or she is trying to learn and remember. Items on this scale address how well students can create imaginal and verbal elaborations and organizations to foster understanding and recall. These methods range from simple paraphrasing and summarizing to creating analogies; using application; creating organizational schemes and outlining; and using inferential, analytical, and synthetic reasoning skills.

Sample Items:

- 1. I translate what I am studying into my own words.
- 2. I try to think through a topic and decide what I am supposed to learn from it, rather than just reading it over when studying.

### **Motivation**

Whereas the attitude scale measures students' general attitudes toward school and their general motivation for succeeding in school, the motivation scale addresses students' motivation to perform the specific tasks related to achievement. The items on this scale concern students' diligence, self-discipline, and willingness to work hard. Do they stay up to date in class assignments? Do students easily lose interest in their classes?

Sample Items:

- 1. When work is difficult I either give up or study only the easy parts.
- 2. I set high standards for myself in school.

### Selecting Main Ideas

Effective and efficient studying requires that students be able to select the important material for in-depth attention. Students' scores on this scale measure their ability to select important information to concentrate on for further study in either classroom lectures or autonomous learning situations.

Sample Items:

- 1. I have difficulty identifying the important points in my reading.
- 2. Often when studying I seem to get lost in details and can't remember the main ideas.

# Self-Testing

Reviewing and testing one's level of understanding are important for acquiring knowledge and monitoring comprehension. Items on this scale address students' awareness of the importance of self-testing and reviewing, and the degree to which they use these methods. Most of the items deal with some aspect of monitoring comprehension. Do the students review before a test? Do they stop periodically while reading to review the content?

Sample Items:

- 1. I stop often while reading and think over what has been said.
- 2. I try to identify potential test questions when reviewing my class material.

# Study Aids

Students need to know how to use study aids created by others and how to create their own, such as making diagrams, marking the text, creating charts or summary sheets, and underlining. There are other supplementary activities that also support and enhance meaningful learning. Items on this scale address the degree to which students create or use support techniques or materials to help them learn and remember new information.

Sample Items:

- 1. I use special study helps, such as italics and headings, that are in my textbooks.
- 2. When they are available, I attend group review sessions.

# **Test Strategies**

Effective test performance depends on both preparation strategies and test-taking strategies. A student needs to know how to prepare for the type of performance that will be required and how to maximize that performance. Items on this scale address students' use of test-preparation and test-taking strategies.

Sample Items:

- 1. I have difficulty adapting my studying to different types of courses.
- 2. In taking tests, writing themes, etc., I find I have misunderstood what is wanted and lose points because of it.

Managing time effectively is an important support strategy for learning. Most students have various demands on their time, and only by creating realistic schedules and sticking to them can they fit in everything. Creating and using schedules also encourage students to take more responsibility for their own behavior. Items on this scale address the degree to which students create and use schedules.

Sample Items:

- 1. I only study when there is the pressure of a test.
- 2. When I decide to study, I set aside a specific length of time and stick with it.

**APPENDIX D** 

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# **APPENDIX D**

# An example of the PBL Process

The following information is quoted from Part I of the Preceptor Guidebook for

the PBL groups (Alguire & Werner, 1992).

1. Initial Case Presentation: It is prepared by the curriculum development group. The patient will be presented within a biopsychosocial context.

"Mrs. M.E., a 28 year old school teacher, presents to the ambulatory clinic during one of your third year clerkships. She complains of a 2 year progressive difficulty in 'relaxing my grip,' after shaking hands, or grasping anything tightly. This problem has been a minor annoyance until the last 3 months, and its recent progressive nature has worried her. She wants to be reassured that this problem is nothing more serious than normal muscle cramps."

2. Students as a group will list "cues," or important facts, that may be useful in learning more about the case. "Cues" might be signs, symptoms, or significant historical and psychosocial data. The "cues" will be posted on the board by a member of the group for all students to review.

"28 year old female, school teacher, progressive problem relaxing grip over 2 years, problem recently progressive over last 3 months, worried, wants reassurance."

3. Students will be asked to list questions that the case raises. The questions may take many forms but most often should be in the form of "what is the significance," or "what is the relationship" or a request for more information. The question will be posted on the board by a member of the group for all students to review.

- Questions related to content

What is the significance of the inability to loosen the hand grip? What is the significance of her sex? What is the significance of her occupation? What is the significance of the recent progression of the problem? What is the significance of her concern?

 Questions asking for additional information about the patient Is she on any medications?
 What does her physical examination show?
 Are there other members of her family with this problem? 4. Students list hypotheses that might answer the posted questions. The form of the hypotheses will be in terms of altered biological, biochemical, physiological, and psychosocial mechanisms. The hypotheses should not be in the form of clinical diagnoses, since the main learning goals are biopsychosocial principles. The student-generated hypotheses will be posted on the board by a member of the group for all students to review. The early hypotheses may be unsophisticated, but the effort of thinking about the problem should be encouraged.

"She has a nerve problem. She has a muscle problem. She has muscle cramps due to overwork. She cannot release her grip because she has arthritis. The hand muscles lack sufficient energy substrate to relax. She is anxious, and has a psychosomatic disorder. Degeneration of the motor neurons of the spinal cord has produced the patient's symptoms."

- 5. Students will receive from the preceptor additional information about the case. This information will be used by the students to generate more questions, and to support or reject the listed hypotheses. In this way, the students will begin to focus more directly on the content to be covered in this case.
- 6. As sufficient facts accumulate, the preceptor will ask the students to create a summary of the facts. Based on these summarized facts, the original hypotheses can be reviewed and altered, deleted, and new hypotheses added to the posting on board.
- 7. In the process of generating hypotheses, knowledge deficiencies will become apparent. The process of identifying the knowledge deficiencies can be aided by the preceptor. These knowledge deficiencies, or LEARNING ISSUES, will be posted on the board by a member of the group for all students to review.

"How does muscle contract? How does muscle relax? What are muscle cramps? What muscle diseases are inherited? What does muscle use for energy? What is necessary for proper impulse generation in nerves?"

8. To respond to the learning issues, potential learning strategies and resources are discussed by the group. Learning strategies include, but are not limited to, lectures, recitations, labs, faculty, texts, journals, and computer-assisted instruction. Learning strategies and resources suggested by the curriculum development group are provided to the PBL group by the preceptor through the preceptor guidebook.

- 9. Self-directed, independent learning is initiated by the students outside of the PBL group. The goal of the individual learning sessions is to respond to the learning issues identified by the group.
- 10. Following the independent learning, the PBL group convenes again. The case and accumulated facts are reviewed. Based upon newly acquired knowledge, the hypotheses are revised. The iterative process will be continued until the basic sciences pertinent to the case are learned, the student-generated learning issues are addressed, or time runs out for the case.
- 11. By the end of the case, the students must review orally for the preceptor what was learned by studying the case, and integrate the new knowledge with learning from previous cases and domains.
- 12. For the students' interest and satisfaction, the preceptor may review how the patient was actually managed and the patient's progress or outcome.

**APPENDIX E** 

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# **APPENDIX E**

### **PBL-Sensitive Scale Items Versus PBL-Nonsensitive Scale Items**

\* Corresponding LASSI scales for each item is presented in the parenthesis: ATT: Attitude MOT: Motivation TMT: Time Management ANX: Anxiety CON: Concentration INP: Information Processing SMI: Selecting Main Ideas STA: Study Aids SFT: Self Testing TST: Test Strategies

#### PBL-Sensitive Scale

- 1. I use special study helps, such as italics and headings, that are in my textbook. (STA)
- 2. I try to think through a topic and decide what I am supposed to learn from it rather than just read it over when studying. (INP)
- 3. I learn new words or ideas by visualizing a situation in which they occur. (INP)
- 4. When preparing for an exam, I create questions that I think might be included. (SFT)
- 5. My underlining is helpful when I review text material. (STA)
- 6. I try to identify potential test questions when reviewing my class material. (SFT)
- 7. I translate what I am studying into my own words. (INP)
- 8. I am unable to summarize what I have just heard in a lecture or read in a textbook. (TST)
- 9. I stop periodically while reading and mentally go over or review what was said. (SFT)
- 10. When I am studying a topic I try to make everything fit together logically. (INP)
- 11. When I study, I have trouble figuring out just what to do to learn the material. (TST)
- 12. I try to find relationships between what I am learning and what I already know. (INP)

- 13. I key in on the first and/or last sentences of most paragraphs when reading my text. (STA)
- 14. I try to relate what I am studying to my own experiences. (INP)
- 15. I make drawings or sketches to help me understand what I am studying. (STA)
- 16. I make simple charts, diagrams, or tables to summarize material in my courses. (STA)
- 17. I read textbooks assigned for my classes. (MOT)
- 18. It is hard for me to decide what is important to underline in a text. (SMI)
- 19. I use the chapter headings as a guide to identify important points in my reading. (STA)
- 20. I memorize grammatical rules, technical terms, formulas, etc., without understanding them. (TST)
- 21. I test myself to be sure I know the material I have been studying. (SFT)
- 22. I have difficulty adapting my studying to different types of courses. (TST)
- 23. Often when studying I seem to get lost in details and "can't see the forest for the trees." (SMI)
- 24. I try to interrelate themes in what I am studying. (INP)
- 25. I have difficulty identifying the important points in my reading. (SMI)

#### PBL-Nonsensitive Scale Items

- 1. I worry that I will flunk out of school. (ANX)
- 2. I am able to distinguish between more important and less important information during a lecture. (SMI)
- 3. I find it hard to stick to a study schedule. (TMT)
- 4. After a class, I review my notes to help me understand the information. (SFT)
- 5. I don't care if I finish school as long as I find a husband/wife. (ATT)
- 6. I find that during lectures I think of other things and don't really listen to what is being said. (CON)

- 7. I try to identify the main points when I listen to lectures. (SMI)
- 8. I get discouraged because of low grades. (ANX)
- 9. I am up-to-date in my class assignments. (MOT)
- 10. Problems outside of school-being in love, financial difficulties, conflict with parents, etc.-cause me to neglect my school work. (CON)
- 11. Even when study materials are dull and uninteresting, I manage to keep working until I finish. (MOT)
- 12. I feel confused and undecided as to what my educational goals should be. (ATT)
- 13. I come to class unprepared. (MOT)
- 14. I would rather not be in school. (ATT)
- 15. I do poorly on tests because I find it hard to plan my work within a short period of time. (TST)
- 16. I only study when there is the pressure of a test. (TMT)
- 17. I compare class notes with other students to make sure my notes are complete. (STA)
- 18. I am very tense when I study. (ANX)
- 19. I review my notes before the next class. (SFT)
- 20. I work hard to get a good grade, even when I don't like a course. (MOT)
- 21. I often feel like I have little control over what happens to me in school. (ATT)
- 22. Even when I am well prepared for a test, I feel very anxious. (ANX)
- 23. I talk myself into believing some excuse for not doing a study assignment. (MOT)
- 24. When I begin an examination, I feel pretty confident that I will do well. (ANX)
- 25. When it comes to studying, procrastination is a problem for me. (TMT)
- 26. I check to see if I understand what the instructor is saying during the lecture. (SFT)

- 28. I am unable to concentrate well because of restlessness or moodiness. (CON)
- 29. I set high standards for myself in school. (MOT)
- 30. I end up "cramming" for almost every test. (TMT)
- 31. I find it hard to pay attention during lectures. (CON)
- 32. I only study the subjects I like. (ATT)
- 33. I am distracted from my studies very easily. (CON)
- 34. I make good use of daytime study hours between classes. (TMT)
- 35. When work is difficult I either give up or study only the easy parts. (MOT)
- 36. I dislike most of the work in my classes. (ATT)
- 37. I have trouble understanding just what a test question is asking. (TST)
- 38. Worrying about doing poorly interferes with my concentration on tests. (ANX)
- 39. I don't understand some course material because I don't listen carefully. (CON)
- 40. I feel very panicky when I take an important test. (ANX)
- 41. When I decide to study, I set aside a specific length of time and stick to it. (TMT)
- 42. When I take a test, I realize I have studied the wrong material. (TST)
- 43. I concentrate fully when studying. (CON)
- 44. I get so nervous and confused when taking an examination that I fail to answer questions to the best of my ability. (ANX)
- 45. I put off studying more than I should. (TMT)
- 46. I try to see how what I am studying would apply to my everyday living. (INP)
- 47. My mind wanders a lot when I study. (CON)
- 48. In my opinion, what is taught in my courses is not worth learning. (ATT)

- 49. I go over homework assignments when reviewing class materials. (SFT)
- 50. When they are available, I attend group review sessions. (STA)
- 51. I tend to spend so much time with friends that my coursework suffers. (TMT)
- 52. In taking tests, writing themes, etc., I find I have misunderstood what is wanted and lose points because of it. (TST)

**APPENDIX F** 

#### **APPENDIX F**

#### **Case Descriptions by Research Questions**

#### Mark

# <u>Research Question</u> 1: What learning strategies do students use in preparation for the problem-based learning classroom and why?

Mark spent most of his time on preparing for the exams. He mentioned that the ratio of his study time for PBL class and exam was about 20-30 % to 70-80%. To explain this, he commented, "So I spend just a couple . . . I'd say two or three hours per case. Most of my time is spent going through the content areas for the exams."

During class: Mark's PBL group read a case, finding cues, and formulating hypotheses. Then, they raised learning issues and solved stimulus questions. Mark tried to find cues from important information, such as age, symptoms, and psychosocial and medical issues. For PBL preparation, he tried to pull out some of the big things in order to get the whole picture and the general overview.

Learning issue study: To study learning issues, he usually looked for reference texts and articles that were provided in the class. He sometimes went to the learning resource center and used computer programs to study learning issues. However, he did not use library.

Like other students, Mark tried to match learning issues with objectives. For example, if a case had a patient with breast cancer, the learning issue might be looking at how the patient got this disease. He compared this learning issue to the objective list, and if it was on the content list, he studied all information and tried to memorize it. If it was not on the objective lists, he did not study or may just have read once if he had time.

### <u>Research Ouestion 2</u>: What learning strategies do students use in preparation for examinations (both class exams and the licensing exam), and why?

<u>Reading</u>: Mark had read coursepack, old objectives, and books more than once the second year. The first time, he read through the material to get the general idea and highlighted information. The second time, he read the highlighted passages and made marginal notes in the book.

Group study: After independent study, Mark met with two other friends a few days before an exam. When they met, each person read the coursepacks and mentioned the most important things. The others chimed in if a person forgot to mention important information. At the end of the group study, they summarized the important information. Group study gave Mark an opportunity to check his knowledge. Also, it made him connect information.

Integration strategies: Mark mentioned that understanding is to know the structure and to know how things work. It is knowing why something is important, how each discipline is tied in with others. On the other hand, rote memorization is learning something without tying it to anything. He thought that integration helps memorization because it gives something on which to hang information. Basically, Mark read materials carefully in order to understand them. Also, Mark mentioned that group study helped him connect the materials, as illustrated by his comment: Because I like to really be verbal and to be able to walk round and write on the board and stuff. It [group study] really just helps me facilitate things and start putting things together.

<u>Memorization strategies</u>: Mark mentioned that he did not use specific learning strategies because that took extra work. Rather, being exposed to the materials several times gave him a repetition that made him memorize the materials, as evidenced in the following comment:

I don't like doing all that extra work like making charts or making flash cards, so I just try to read. I do a lot of reading and that, you know, reading objectives, reading books, you know, three and four different times, and that's what works for me.

Selecting main information: Mark used an objective list as a guide for his study.

However, he did not pay attention to the starred objectives. Rather, he focused on the percentage content of the test. For example, if pathology had a 45% weight in the exam, he emphasized study in this are. Sometimes lectures and computer programs helped him know what important information was. Also, through group study, Mark and the other group members told each other important information and corrected each other if someone was missing important points.

<u>Computer programs</u>: Mark used computer programs because they were more condensed and concise than textbook and thus provided main information. He mentioned that it was like having a coursepack along with pictures. Computer programs stimulated him because they involved more activity, such as playing around with the mouse.

<u>Checking knowledge strategies</u>: Mark used group study as a way of checking his knowledge. Group members told each other what they studied and corrected each other if some information was missing or wrong.

Lecture attendance: Mark went to about half of the lectures. He mentioned that if the professor was good, it helped him pass the exam. He listened to the lectures but did not take notes. The lectures introduced him to the materials and indicated what he should emphasize in his studying.

<u>Additional strategies</u>: When Mark read the materials, he highlighted characteristics of a specific disease because doing that helped him to distinguish certain things from others.

<u>Board preparation</u>: Mark mentioned that he planned to take a board review course to prepare for the board exam.

# <u>Research Ouestion 3</u>: What do students think influences their learning strategies (such as goals, assessment of learning, student activity, teaching method, and course content)?

Mark mentioned that his goals, which were to be a competent doctor and to understand the material, influenced the way he studied. From PBL, he liked to get clinical aspects and a good interaction with people. He thought that PBL helped to achieve his goals and forced him to work as part of a group. However, he thought that to prepare for exams, personal study and group study helped more than PBL. Generally, he liked the PBL format better than lectures because it helped him integrate the materials, but sometimes he felt lost when there was little direction from the preceptors. However, Mark mentioned that PBL classes helped in the following ways:

1. <u>Small-group working skills</u>: Through the experience of the PBL classes, Mark became more patient because it was not a "personal business."

2. Independent study: Mark always carried a dictionary to look up words for

clarification. Also, PBL classes forced him to find additional resources on his own. He

mentioned that " It [PBL] forces you to go out and look material up instead of a professor

just giving you scribes."

3. Integrating materials: Mark said that cases helped him integrate the materials.

Further, by giving a big picture with a clinical context, the cases helped him understand the materials.

It just puts everything together. Like it goes through each disease, and it'll give you in stepwise fashion these are the symptoms, these are the clinical signs, this is how you diagnose it, this is how you treat it. So it gives you the big picture of how all these different things fit together.

# <u>Research Question 4</u>: Do second-year medical students at MSU CHM report that they study differently than they did in their first year? If so, how and why?

During his first year of medical school, Mark did not read books much and used them only for clarification purposes. He relied primarily on lectures and scribe notes. Second year, he put no great emphasis on lecture and scribe notes, but spent most of his time reading objectives and textbooks. Also, he spent less time on memorization the second year than the first year. Thus, he used fewer memorization strategies such as flashcards and mnemonics, because they required extra work. Mark focused more on integration of materials so that all "things fall into place." He also thought he needed more study time the second year because of the vast volume of materials he was required to cover.

Table F.1 contains a summary of the key features about Mark's learning strategies.

Table F.1: Key features of Mark's learning strategies

Q1	<ul> <li>PBL preparation : exams = 20-30 % : 70-80% study time</li> <li>Matching learning issues with objectives</li> <li>Using reference texts, articles, learning resource center, computers, and no use of library for learning issue study</li> </ul>
Q2	<ul> <li>Reading more than once: <ol> <li>Get a general idea, highlight</li> <li>Read highlighted passages, make marginal notes</li> <li>Group study: check his knowledge, help integration</li> <li>Integration strategies: read carefully for understanding, group study</li> <li>Memorization strategies: several readings - give repetition, do not use much</li> <li>Selecting main information: percentages of exam contents, lectures, group study, and computer programs</li> <li>Computer programs: more concise than textbooks, stimulating - more active</li> <li>Checking knowledge strategies: group study</li> <li>Lecture attendance: gives introduction to materials and what to emphasize</li> <li>Additional strategies: organize materials by highlighting characteristics of things</li> </ol> </li> </ul>
Q3	<ul> <li>Influences: his goals</li> <li>Goals: being a competent doctor and understanding materials</li> <li>PBL helps <ol> <li>Small-group working skills</li> <li>Independent study</li> <li>Integration of the materials</li> </ol> </li> </ul>
Q4	<ul> <li>More reading and integration the second year</li> <li>Less emphasis on lectures and scribe notes the second year</li> <li>Fewer memorization strategies the second year; takes extra time</li> <li>More study time the second year: vast volume to study</li> </ul>

Tom

# <u>Research Ouestion 1</u>: What learning strategies do students use in preparation for the problem-based learning classroom, and why?

Tom said he did not prepare for PBL classes separately from the exams because there was no time, as illustrated by his comment, "I don't really prepare that much for the PBL classes. I don't really prepare, read ahead for the PBL class at all just because I don't have time." Tom studied mostly for exams, and studying for exams helped him prepare for the classes.

During class: Tom's PBL group read a case, looking for cues. He found cues that were abnormal or were based on his previous knowledge. Then, the group developed hypotheses and diagnosed them, based on their previous knowledge, and raised learning issues.

Learning issue study: Tom mentioned that sometimes the preceptor directed students in forming learning issues. Tom looked for learning issues if he had time. Usually he used reference books, textbooks, and computer programs. He said that by using computer programs it was easy to find information. Tom did not go to the library to find learning issues, but he sometimes went to the learning resource center for medical texts. He knew which texts to look for by talking to classmates or by consulting the list of recommended texts.

Tom matched learning issues with objective lists. If learning issues did not match the objectives, he did not study them because there was no time. PBL classes helped him achieve the objectives because the learning issues usually coincided with the objectives.

169

Thus, by discussing learning issues, students could cover the objectives or at least they could have an introduction to the materials.

# <u>Research Question 2</u>: What learning strategies do students use in preparation for examinations (both class exams and the licensing exam), and why?

Reading: Tom said that his general way of studying was reading materials. He read the coursepack first highlighting what was important. Then he read the textbook, looking for what was in the coursepack, because textbook usually explained the same information better and more completely. Also, doing this gave him repetition. While reading, if he found something that was not in the coursepack but in the textbook, he wrote it down in the coursepack. For example, if an objective said to know four organisms that cause strap throat and the coursepack listed three causes of strap throat, he found the fourth cause from the textbook and wrote it in the coursepack. Tom then reread the coursepack with the information he added in the margins. He said that rereading the same information helped in memorization.

Group study: Tom met with two friends for group study. They talked and quizzed each other. They started with the first page of the coursepack and discussed it. They took turns talking and listening because they thought talking helped them associate better and remember longer. Each group member studied alone first because in that way they could go over the material faster when they met as a group. They met several times and went through the coursepack a couple of times. Tom mentioned that his grades had gone up since he had started studying with the group. Group study gave him a chance to hear something explained differently, which helped him understand better. He thought this was a good way to study conceptual materials.

Integration strategies (conceptualization): Tom said that discussing conceptual materials in a group helped him understand the material because by hearing somebody else explain it, he could see the same concept from a different perspective. Tom said he studied more by himself if the material was factual. He also read the textbook to understand the material.

<u>Memorizing strategies</u>: Tom wrote important facts in the margins while he read the material to help him memorize better. However, he explained that he did not use many memorization strategies, such as mnemonics, because he integrated the materials more, and integration helped his memorization.

Selecting main information : Tom focused on the objectives in his studying, "Yeah, I stick to the objectives, because that's what's going to be on the exam." He knew which were the important objectives by the number of stars on the objectives. More stars signified more important objectives. Sometimes Tom sorted out important information through his "gut feeling" and found the testable questions. For example, Tom mentioned that, "Does this predispose to cancer?" was a likely testable question; thus, when he studied, he focused on statements such as "This predisposes you to an adenoma, carcinoma, etc." Also, percentages of exam topics determined his focuses. Tom studied large-percentage topics first to make sure he got through them. He also used practice quizzes as a way of selecting information because they included what teachers thought important for the test.

171

<u>Computer programs</u>: Tom thought that computer programs were not very different from the textbook, but he used those programs because they provided repetition. He read the textbook first and then used computer programs. He thought that computer pictures were better than those in the textbook because the screen was large, colorful, and sometimes showed different pictures than the textbook did.

<u>Checking knowledge strategies</u>: Tom studied for the exams with two friends. They quizzed each other during group study, which gave him a chance to check his knowledge.

Lecture attendance: Tom attended the lectures because professors indicated which information was important; this gave him a study focus. Sometimes professors used pictures and slides, and Tom associated those with pictures in the textbook and the coursepack when studying. Also, professors sometimes explained things differently from the coursepack, which made him understand the materials easily. However, he mentioned that the quality of the lectures depended on the professors.

<u>Additional strategies</u>: When Tom read the materials and wrote down notes, he used different colors of ink to indicate different sources so that he could remember where he got the information.

<u>Board preparation</u>: Tom said he planned to take a board review course to prepare for the board exams. Although he had already bought board review books, he had hardly used them yet.

172

# <u>Research Ouestion 3</u>: What do students think influences their learning strategies (such as goals, assessment of learning, student activity, teaching method, and course content)?

To Tom, doing well on the exams was his main goal, and this influenced his way of studying the most. He perceived PBL as another way of having someone explain things to him, and he said that PBL helped him conceptually. Tom tried to pick information from PBL classes to prepare for exams, as evidenced in his comment, "I need to tailor my information toward what it takes for me to get through the exams as much as what I'm interested in or what I think is important."

In general, Tom liked the PBL format better than lectures because PBL was more interactive. He also said, "I learn more in an hour of PBL than I do in an hour of lecture."

Tom mentioned that PBL classes helped in the following ways:

1. <u>Small-group working skills</u>: Tom had to be sensitive to group dynamics and to know when to speak or listen in PBL classes.

2. <u>Integrating materials</u>: Tom said that PBL classes helped him integrate various disciplines through discussion and helped him understand the concepts. "I would have to say that PBL helps me more conceptually than it does factually," he remarked.

# <u>Research Question 4</u>: Do second-year medical students at MSU CHM report that they study differently than they did in their first year? If so, how and why?

Tom mentioned that he had not prepared for the lectures and studied what was emphasized in lectures for the tests the first year. The second year, he focused more on integration of the materials. Also, he was more organized, did more reading, and used more textbooks the second year. Whereas he tried to learn everything the first year, he focused more on exams and hence used objectives more for selecting main information the second year, as shown in the following comment:

I think I'm learning a lot more of what is on the exam. Last year I tried to learn everything, whereas this year I'm just learning more of what I see on the exams.

Tom also mentioned that he used fewer memorization strategies the second year because

he had previous knowledge, which gave him a context to help him memorize better.

A summary of the key features gathered from the interviews with Tom is presented

in Table F.2.
Table F.2: Key features of Tom's learning strategies

Q1	<ul> <li>Studying mostly for exams and not for PBL classes: because of lack of time</li> <li>Matching learning issues with objectives</li> <li>Using reference books, textbooks, computer, sometimes learning resource center, and no use of library for learning issue study</li> </ul>
Q2	<ul> <li>Reading: <ol> <li>Read coursepack with highlighting</li> <li>Read textbook, adding information in coursepack</li> <li>Read coursepack with added information in the margins</li> <li>Group study: talking, listening, and quizzing each other</li> <li>Integration strategies (understanding): group study, reading</li> <li>Memorization strategies: writing down important facts, group study</li> <li>Selecting main information: objectives, stars in the objectives, gut feeling (testable question), lectures, percentage of exam contents, and practice quizzes</li> <li>Computer programs: give repetition, better picture</li> <li>Checking knowledge strategies: group study - quiz each other</li> <li>Lecture attendance: selecting main information, easier understanding</li> <li>Additional strategies: organize materials using different colors and sources</li> </ol> </li> </ul>
Q3	<ul> <li>Influences: doing well on exams</li> <li>Goals: doing well on exams</li> <li>PBL helps</li> <li>1. Small-group working skills</li> <li>2. Integration of information</li> </ul>
Q4	<ul> <li>More reading, more textbook use the second year</li> <li>More organized the second year</li> <li>Focuses more on exams the second year: use objectives more for selecting main information</li> <li>Fewer memorization strategies and more integration the second year: because of previous knowledge</li> </ul>

Ann

It is important to mention that Ann had extended her program, so she was taking just some of the PBL classes. She said she had extended her program for her personal reasons and also for the philosophical evaluation of herself.

### <u>Research Ouestion 1</u>: What learning strategies do students use in preparation for the problem-based learning classroom, and why?

Ann said she studied for the exams and not for PBL class per se. She stated, "Very small for the PBL class, mostly for the test. And that benefits PBL, but it's not for the PBL." Because there was so much material to learn with limited time the second year, she focused on studying objectives rather than doing research for the PBL classes to survive. Ann estimated that the approximate ratio of study time for PBL classes and exams might be 1:50. She stated,

I don't really study specifically for group. Because PBL group doesn't really get you ready for the test and if you focus too much energy on the PBL group you're not going to be ready for the test.

During class: Ann's PBL group read a case, finding clues. Her group sorted out important clues by discussion. Then she formulated hypotheses based on her basic science knowledge and to be congruent with other hypotheses. Before the class ended, the group raised learning issues, trying "psyche out" teachers to see which objectives they wanted students to learn. "We try to psyche out the teachers and sort of say, 'Given this case, which of the objectives do you think they were trying to get us to learn from this case?" Also, she raised learning issues if it was an odd symptom, and also based on percentage of the exam content. Learning issue study: Ann said she usually did not study the learning issues because they got her "distracted from my basic mode of studying." Usually she did not study them because others would look them up. However, if a learning issue was interesting and easy to find, she sometimes she studied it, although she never went to the library to find information for learning issues.

Ann contributed to the group when learning issues matched the objectives because she studied the objectives. She raised a learning issue, and then narrowed it, based on the objective. If learning issues and objectives did not match, she did not study them. Ann stated,

We try to stay pretty focused as far as trying to incorporate the objectives that we're given for what's going to be on the exam. We try to keep our discussion focused around that, even though we're discussing this case. We try to learn things from the case that will also answer questions for our learning objectives for us. Because the learning objectives is what we get tested on.

Ann found condensed information from pictures and from flowcharts in the books or coursepacks, and made charts, diagrams, or summaries. Then, in class, she wrote them on the board to "impress" the group, and to get "brownie points." She found the information and made those charts in the process of studying for exams.

### <u>Research Ouestion 2</u>: What learning strategies do students use in preparation for examinations (both class exams and the licensing exam), and why?

<u>Reading</u>: Ann's basic study sequence was first reading old objectives, reading the coursepack, reading scribe notes, doing the computer program, and then reading board review books. In this way, she could get the same materials from different angles. She usually did not read textbooks because reading coursepack and objectives was a more

condensed approach in a limited time; also, she tried to read them twice. She said that when she read things a second time, she could go faster because she comprehended better and had an overall framework.

<u>Group study</u>: Ann met with other students before the exams, and they went through the objectives together. This helped when she was too tired to study. She said that group study worked well only when she already knew the material. During group study, people who knew more usually led the discussion and asked questions.

Integration strategies: Ann mentioned that she knew integration had been achieved if she could see the similarities between things and find a pattern. To find patterns and similarities, she often made charts and reviewed them just before the exam. Sometimes Ann used another person's charts from the previous year, which had a summary and the association of information.

<u>Memorization strategies</u>: Ann used fewer memorization strategies than she did her first year because she thought that memorizing one particular thing was a waste of energy. She tried to immerse herself in a large volume of materials instead. She also wrote down notes for easier memorization, as illustrated by this statement:

Like a drug that is, it's hard for me to remember drug names, so I'll write it down so I can remember it. Or if there are two diseases that are very similar and I want to differentiate them, I'll write down one or two words. I don't write down big lists or anything, but just if it's something that I can tell it's going to be a nitpicky thing that I need to know and I think I might forget, I'll write it down.

<u>Selecting main information</u>: Ann chose the important materials based on the percentage of the exam content and studied those with the highest content first. Among those materials, she tried to focus on more common and higher frequency diseases because

that knowledge would also be more beneficial in practice. Also, she used practice quizzes to focus on the important information. Sometimes computer programs helped her focus on important information because they were more concise than textbooks. Ann also mentioned that highlighting was a way of sorting out the important information to study, as illustrated by her statement:

Even if I never go back and read it, it [highlighting] really helps me to mentally highlight what's important. To mentally go back and have to be able to figure out what to highlight makes me think about it.

<u>Computer programs</u>: Ann mentioned that computer programs are more concise, contain more and bigger pictures, and explain materials better than textbooks. Therefore, she did not read textbooks, which were too wordy for her, but used computer programs as a way of saving time and selecting information to study.

Checking knowledge strategies: Ann did practice questions to check her

knowledge. She also asked questions during group study to check her knowledge.

No lecture attendance: Ann did not go to lectures at all, as she pointed out in the following comment:

I don't go to lecture. It's a waste of time. I'm a slow reader, but I can still read a scribe faster than I can listen to them lecture. It doesn't take me an hour, usually, to read a scribe.

Additional strategies: Ann said she sometimes used other people's objectives

because by studying other people's summary objectives with answers, she could limit what she studied from each objective. Another notable thing that Ann mentioned was that

her motivation had changed from the first to the second year. She studied to escape from

marriage and to prove herself to her parents the first year. But during her second year, Ann studied for herself and thus had an inner motivation to earn the degree.

<u>Board preparation</u>: Ann said that she planned to take the board review course to prepare for the board exam.

### <u>Research Question 3</u>: What do students think influences their learning strategies (such as goals, assessment of learning, student activity, teaching method, and course content)?

Ann said she was a slow reader and did not like to do more work than she had to, which influenced her way of studying. Her primary goal was to pass the exams, but she also wanted to comprehend the material to pass the boards. From the PBL classes, she liked to get connection with other students, friendship, and the contexts of diseases. Also, Ann liked to have good preceptors whom she could look to as mentors.

In general, Ann perceived a big discrepancy between PBL classes and exams. She enjoyed the PBL experience, but she did not think it helped in passing exams. She preferred lectures to the PBL format because lectures gave her a focus to study, especially when there was a large volume of materials to study. Ann said that although PBL tried to make students to go out and do research, she could not do this because there was too much material to study in a limited time, as illustrated by this statement:

As far as doing some extracurricular independent research, no, because we don't have time. It's like drinking water from a fire hydrant. It would be nice to go wade in the creek, but you're just trying to survive.

However, Ann said that PBL classes did help her in the following ways:

1. <u>Small-group working skills</u>: She had to listen and talk in response to group dynamics.

2. <u>Providing context</u>: PBL classes gave practical implications of trying to manage the case, given the typical resources that will be available to you in the hospital.

3. <u>Connecting with other students</u>: The PBL experience had provided her with friendships.

### <u>Research Question 4</u>: Do second-year medical students at MSU CHM report that they study differently than they did in their first year? If so, how and why?

Ann did not go to the lectures at all the second year, as she had the first year. Also, she said she used fewer memorization strategies the second year because of the vast volume of material to study; so memorizing the specifics wasted her energy. Ann tried to immerse herself in as much material as possible and thus tried to read more the second year than the first year.

Ann said she felt lost the second year because of the large volume of material and lack of precise guidelines in PBL classes. According to her, the second year was like "guess work." She was more anxious the second year so she tried to participate in some totally nonschool activities as a survival strategy. In her first year, her goal was to do well on exams, and by studying scribe notes she achieved that goal on tests. But the second year, her goal was to survive and to expose herself to the large volume of materials. She mentioned, "Last year was much more emotionally fulfilling and affirming. This year there's practically none of that, and it's frustrating."

Table F.3. contains a summary of the key features of Ann's learning strategies.

Table F.3: Key features of Ann's learning strategies

Q1	<ul> <li>Extending program: personal, philosophical re-evaluation of herself</li> <li>Studying for exams basically, not for PBL: lack of time</li> <li>Raising learning issues: psyche out teachers to see what they think important, based on percentage of exam content, odd symptoms</li> <li>Matching learning issues with objectives</li> <li>Learning issue study: in the process of studying for exams</li> </ul>
Q2	<ul> <li>Reading twice: does not read textbook <ol> <li>Get overall framework,</li> <li>Read faster and comprehend better</li> <li>Reading sequence: old objective - coursepack - scribe notes - computer programs - board review book; gives same materials with different angles,</li> <li>Group study: makes her keep studying, ask questions (check knowledge)</li> <li>Integration strategies: makes charts or gets another person's charts</li> <li>Memorization strategies: writing down</li> <li>Selecting main information: percentage of exam content, common and high-frequency diseases, practice questions, highlighting, and computer programs</li> <li>Computer programs: more concise, better explained, good picture</li> <li>Checking knowledge strategies: practice questions and group study</li> <li>No lecture attendance</li> <li>Additional strategies: limit study scope, motivation change</li> </ol></li></ul>
Q3	<ul> <li>Influences : slow reader - old study habits</li> <li>Goals : 1: passing exams, 2: comprehension</li> <li>PBL helps <ol> <li>Small-group working skills</li> <li>Give context</li> <li>Friendship</li> </ol> </li> </ul>
Q4	<ul> <li>Fewer memorization strategies and more reading the second year</li> <li>Feels lost, more anxious the second year: large volume of materials, lack of precise guidelines in PBL classes</li> <li>First year: studying scribe notes - good scores on exams</li> </ul>

Mary

# <u>Research Ouestion 1</u>: What learning strategies do students use in preparation for the problem-based learning classroom, and why?

Mary said she tried to relate PBL preparation to preparation for exam. She said the emphasis changed throughout the domain period. That is, a domain consisted of a three week periods; during the first week, she focused more on PBL cases, and later she focused more on exams. On the average, however, she focused more on exams.

During class: Mary mentioned that her PBL group was not very structured. They read a case and formed hypotheses, and then raised learning issues in line with the objectives. For example, if a case was about a man who took a lot of aspirin and thus had stomach problems, the learning issue might be "know the normal GI track." Then, she went over the objective lists during class to match the learning issues. Mary's PBL group did not discuss learning issues that were not on the objective list even though they had a clinical value, as illustrated by her statement:

We also try to keep our learning issues in line with the objectives list. So if there's something that's not directly pertaining to the objectives list, that may be more clinical, that we don't need to know for the exam, we'll usually ax it.

Learning issue study: To find learning issues, Mary read books and then took notes to recount to the class. In this way, she could understand and retain the material better. She used books from her own library, usually her first-year textbooks. Sometimes she read the coursepack and pertinent articles. She mentioned,

Well, generally I take a learning issue and open up a book and just start reading. And then often I take notes because I want to be able to tell my classmates back at PBL. PBL classes helped Mary achieve her objectives in two ways. First, they covered the objectives through discussion of learning issues during the class. Second, they kept her going and kept her up to date with her studying.

#### <u>Research Ouestion 2</u>: What learning strategies do students use in preparation for examinations (both class exams and the licensing exam), and why?

<u>Reading</u>: Mary read the objectives, books, and coursepacks, making charts as she did so. Then she memorized the information in those charts before the exams. When she read, she underlined important things and writes them down in the margins. She tries to relate important details to other information while reading.

Group study: Mary studied with one other student one or two days before an exam; they talked about exam materials together. For example, they might ask "Tell me all of the cancers that are in the thyroid" and then discuss the answer. Group study helped Mary conceptualize the materials because talking with a friend helped her see several reasons why a certain system worked the way it did. Also, talking with a friend confirmed her own knowledge.

Integration strategies: Mary frequently made charts the second year. After making charts or frameworks from the objectives, she would use textbook information to fill them in. She would construct a chart and picture it in her mind, trying to integrate the materials. Doing this also helped her memorization. Also, talking with people in group study helped her understand conceptual materials.

<u>Memorization strategies</u>: To memorize facts, Mary read the textbook and made a framework, and then associated two or three examples or facts with each frame. Then she

memorized the facts that filled up the charts. Making charts helped her memorize the material because charts imposed organization and helped associate information.

Selecting main information: Mary looked for stars in the objective lists to see which were more important materials to study. Sometimes she gleaned important information from lectures, especially when the lecturer was the one who wrote the test questions. She also used percentages of exam content to select the important information and did not study materials that constituted a low percentage of the exams. Mary also underlined, starred, and circled the important things in the textbooks and charts, highlighting information in the charts that was important medically.

<u>Computer programs</u>: Doing computer programs enabled Mary to see what professors thought was important because the same ones who wrote the test questions devised the computer programs. Also, test questions in the computer programs helped her. Computer programs had more pictures than textbooks and provided a change when she was tired of reading. Mary thought that doing computer programs was a more passive way of studying than reading textbooks and making charts because she could let the computer teach her.

<u>Checking knowledge strategies</u>: Mary's study group asked each other questions. This confirmed her knowledge.

Lecture attendance: Mary attended lectures because she paid for them. Even though she did not like this teaching style, she could still get information because the teachers were experts in the field.

185

Additional strategies: Mary thought that choosing resources was important this

year because so many resources dealt with the same information.

One of the biggest problems I found with PBL is that there's so much to know and there's so many different resources, you could find the same information in a billion things, different books. So it's really important to pick your resources and stick with them, because otherwise you get overwhelmed. And we already have so many books from first year, basic physiology and pharmacology and microbiology, we already have. You've got all the answers already pretty much.

Board preparation: Mary said she planned to take a board preparation program.

She believed that studying for exams would help her with the board exams.

### <u>Research Ouestion 3</u>: What do students think influences their learning strategies (such as goals, assessment of learning, student activity, teaching method, and course content)?

Mary said she had spent a year in England, and that had influenced the way she studied. In England, she had experienced a tutorial-based, one-on-one teaching environment. Thus, she liked PBL curriculum because it was an active learning experience; that is why she came to MSU.

Mary said goal was to pass the board and class exams, and to know the materials. She thought PBL classes helped more in understanding the materials than in passing class and board exams. She said the experience in PBL was very valuable because it related the material to patients and gave a context for the material. However, she also felt pressured by PBL because she had to attend sessions three times a week. But Mary did say it was fun, and sometimes she could get information from the group. According to Mary, PBL classes helped in the following ways:

1. <u>Small-group working skills</u>: Mary mentioned that because her PBL class was composed of just a few people, she had to watch the dynamics of the group.

2. <u>Independent study</u>: In PBL, Mary had to generate her own questions, and sometimes she felt scared because she did not know what was supposed to have learned.

3. <u>Exam preparation</u>: Mary said that PBL helped her do well on the exams. She said, "I always remember the things that I look up for PBL; I always remember for the exam." Explaining the material to the group in PBL class was more "functional" than just reading or memorizing because she had to know the content in order to talk about it to the group.

### <u>Research Question 4</u>: Do second-year medical students at MSU CHM report that they study differently than they did in their first year? If so, how and why?

Whereas Mary focused mainly on coursepacks the first year, she tried to find resources by herself the second year. Before finding resources, she thought about which resources the person who devised the test consulted. Mary made a lot of charts but she wrote down less the second year than the first year because there was not much time. Also, she needed to read all of the information at least once during her second year. Thus, her studying was not as focused as the first year. She said, "It's more of a survival instinct than anything this year." Also, whereas her goal was to learn as much as she could the first year, her goal the second year focused more on passing the boards as the time for board exam drew near.

Table F.4 contains a summary of the key features about Mary's learning strategies.

### Table F.4: Key features of Mary's learning strategies

Q1	- Relating PBL preparation to exam preparation
	- First week of the domain: focus more on PBL; later: more focus on exams
	- Matching learning issues with objectives
	- Learning issue study: use the previous year's textbooks, articles, and coursepack
	- Studying learning issues: read books - take notes - relate to class
Q2	- Reading: read objectives, coursepacks, and books
	making charts, underlining and writing down important words
	- Group study: helps conceptual materials, checking knowledge
	- Integration strategies: make charts, group study
	- Memorization strategies: associate facts with framework, charting
	- Selecting main information: stars in the objectives, lectures, percentages of the
	exam content, and computer programs, underline, star mark, circle, highlight
	- Computer programs: choose important information, test questions help her, good
	pictures, change pace when she is tired
	- Checking knowledge strategies: group study
	- Lecture attendance
	- Additional strategies: choosing resources
Q3	- Influences: old study approach
	- Goals: passing exams and knowing the materials
	- PBL helps
	1. Small-group working skills
	2. Independent study
	3. Help doing well on exams
	-
Q4	- First year: mainly coursepack
	- Second year: find resources based on test giver's material
	- More charting second year
	- Less writing down - because of time limits
	- Change goal: from learning as much as she can to passing class and board exams
	· · ·

Andrew

# <u>Research Ouestion 1</u>: What learning strategies do students use in preparation for the problem-based learning classroom, and why?

Andrew said he did not study differently for PBL classes and exams, but he focused primarily on studying for exams. He mentioned that PBL discussion reflected little on how well one did on exams.

During class: Andrew's PBL group read a case, finding abnormal cues. Then they formulated hypotheses from their previous knowledge of the area. Before the class ended, they raised learning issues. Andrew tried to match objectives with learning issues, as did most of the other students, by raising learning issues and seeing whether they matched the objective list. Thus, Andrew tailored the learning issues to the objectives; if two not match, his group did discarded the learning issues.

Learning issue study: Andrew studied learning issues by reading the coursepack and textbooks. He never went to the library to find learning issues. Usually, Andrew's PBL group discussed conceptual materials. His group did not discuss information that required more memorization, but sometimes they categorized facts for easier memorization.

# <u>Research Ouestion 2</u>: What learning strategies do students use in preparation for examinations (both class exams and the licensing exam), and why?

<u>Reading</u>: Andrew read the material more than once, as did most other students in this study. When he read the material the first time, he tried to understand and make sense of it. When he read it the second time, he skimmed it and tried to make connections. When he read, he also highlighted such things as "the most common cancer of the female" or "this is 20% of the cancers" because these would be testable questions.

<u>Group study</u>: Andrew did not study in a group. However, because he lived with two other students, he asked them for help if he had questions when he studied.

Integration strategies: Andrew studied conceptual materials first because this provided a framework onto which to place facts. To learn conceptual materials, basically he read and made a connection with previous materials; if he could not make connections, he went back and carefully reread the material. He mentioned that concepts stayed with him longer, so he saved memorizing facts for the last minute, as illustrated by this comment:

I figured if I got the concepts down that would give me more of a framework to put the pathology down upon it, and also concepts stay with you longer, whereas just the pure facts, pure memorization stuff I save for last.

<u>Memorization strategies</u>: Andrew sometimes used mnemonics for memorization. Also, the cases he got from PBL class sometimes helped him remember facts longer because they gave a context to which he could attach facts. He mentioned,

Putting a certain problem with a certain fact, and that way . . . and the certain ramifications of that person's problem, it would really stick with me more.

Andrew also used imagery for memorizing facts, as illustrated by this comment, "If you look at it on the page long enough, you kind of remember where it is on the page in your mind."

<u>Selecting main information</u>: Andrew looked at stars in the objective lists to see which were the important objectives. If there were no starred topics in an objective list, he went by the major headings and the most common items. He also used the percentage of the exam content. He used the previous year's objectives, and sometimes PBL classes helped him know what to focus on when he heard the preceptor or classmates talking. Also, although Andrew did not go to lectures, the scribe notes he obtained gave him the important information for the exam. Sometimes quiz questions also indicated what to study for the tests. Also, he sorted out testable questions through highlighting.

<u>Computer programs</u>: Andrew mentioned that computer programs helped him understand the material and memorize the side effects of diseases better than the textbook because the programs contained good pictures. For example, whereas textbook pictures just showed the uterus or the adrenal glands, computer pictures showed the actual clinical appearance of a person with a certain disease. That is, computer programs provided a visual images to help students memorize materials. Also, they contained quiz questions, which helped Andrew see the importance of certain information.

<u>Checking knowledge strategies</u>: Andrew knew he understood something if he could repeat what he had read, or if he could guess what was coming next because most of the medical information was in a logical progression.

<u>No lecture attendance</u>: Andrew did not attend the lectures "because they're all in the morning, and I like to sleep in." He said that in the morning it was peaceful and quiet at home, so he could use that time to accomplish most of what he needed to do.

<u>Board preparation</u>: Andrew planned to take a board review course to prepare for the board exam. He said he would pay for the review course, so this gave him extra incentive to be there.

191

### <u>Research Ouestion 3</u>: What do students think influences their learning strategies (such as goals, assessment of learning, student activity, teaching method, and course content)?

Andrew mentioned that time and his previous knowledge guided the way he studied. His goal was having a balance among doing well on exams, having an outside life, and having a good knowledge base. Andrew thought PBL classes helped him get a good knowledge base and relate hard science to clinical situations, but that they helped little for exams. He believed that the value of PBL depended largely on preceptor. In general, he preferred PBL classes to lectures because PBL gave him flexibility in scheduling.

According to Andrew, PBL classes helped in the following ways:

1. <u>Small-group working skills</u>: He mentioned that the PBL group gave him experience in interacting with others.

2. <u>Checking knowledge</u>: PBL group discussion gave Andrew a good idea of how much he knew compared to his classmates, and also let him know whether he was concentrating on too superficial and detailed things in his study. Also, it gave him some indication of where to start in the vast volume of material he had to cover.

3. <u>Independent study</u>: Whereas lectures provided everything the first year, Andrew was searching for important information by reading books, articles, and the coursepack the second year. To explain this, he commented, "Last year it was all lectured to you. Everything was on the lecture, so it was all there. This year at least you have to find it." 4. <u>Understanding</u>: Through PBL group discussion, Andrew could get a different point of view. Hearing someone explain something helped him understand the materials. Also, it gave a context through which he could get the framework for what he was learning.

5. <u>Selecting important information</u>: Andrew said that sometimes he could tell what was important information, either by hearing it from preceptors or through discussion with classmates.

### <u>Research Question 4</u>: Do second-year medical students at MSU CHM report that they study differently than they did in their first year? If so, how and why?

The first year, basically all test questions came from the lectures. Hence, Andrew attended the lectures, and if they were not good he just got scribe notes because they contained the material on which students were tested. The second year, Andrew did not attend the lectures. He also said that what his PBL group talked in class reflected very little of what was in the coursepack or books. However, he gained a good understanding of the material through PBL discussion. In his second year, Andrew's scheduling had changed, and he could spend his whole time on one subject. He studied more the second year because there was a greater volume of material and the class was less structured. Other than that, he claimed there had been no big change in his learning strategies.

A summary of the key features that emerged in the interviews with Andrew is contained in Table F.5.

193

Table F.5: Key features of Andrew's learning strategies

Q1	<ul> <li>Do not study differently for PBL class and exams: study primarily for exams</li> <li>Matching learning issues with objectives</li> <li>Using coursepack and books to find learning issue; no use of library</li> <li>Discussing conceptual materials during PBL class</li> <li>Categorizing factual materials for easier memorization</li> </ul>
Q2	<ul> <li>Reading: more than once: highlighting testable questions <ol> <li>For understanding,</li> <li>For understanding,</li> <li>Making connections and skimming</li> <li>No group study</li> <li>Integration strategies: reading, computer program pictures</li> <li>Memorization strategies: mnemonics, imagery, case study (gives context), and computer program pictures</li> <li>Selecting main information: stars, major headings or common things if no stars, percentages of exam content, old objectives, PBL class, quiz questions, scribe notes, and computer programs; highlighting</li> <li>Computer programs: good pictures, help selecting main information</li> <li>Checking knowledge strategies: if he can restate what he reads or can guess what is coming next</li> <li>No lecture attendance</li> </ol> </li> </ul>
Q3	<ul> <li>Influences: time and previous knowledge</li> <li>Goals: balance among doing well on exams, having outside life, and having good knowledge base</li> <li>PBL helps <ol> <li>Small-group working skills</li> <li>Checking knowledge</li> <li>Independent study</li> <li>Understanding</li> <li>Selecting important information</li> </ol> </li> </ul>
Q4	<ul> <li>First year: attending lectures and studying scribe notes for exams</li> <li>Second year: does not attend lectures</li> <li>Study more second year: more volume and less structure</li> </ul>

Roger

# <u>Research Question 1</u>: What learning strategies do students use in preparation for the problem-based learning classroom, and why?

Like most of the other students in this study, Roger said that he studied primarily for exams and not for the PBL classes per se.

During class: Roger's PBL group discussed cases, pulling out relevant facts based on their independent study before class and raising learning issues. At the beginning of the semester, Roger's PBL group assigned learning issues to students. But they found that this method did not prepare them for the exams, so now students studied what they wanted. Nowadays, they geared the learning issues toward the objectives by opening up the objective lists and looking at them. Usually, if learning issues were not on the objective list, Roger's group ignored them or did not focus on them during group discussion.

Learning issue study: If learning issues did not directly match the objectives, Roger studied just those learning issues that did match the objectives. To study learning issues, he read the coursepack if it was good. If it was not good, he read textbooks and board review books. Roger also used old objectives to find pertinent information, and sometimes he used computer programs. However, he did not go to the library because there were no up-to-date books there.

### <u>Research Ouestion 2</u>: What learning strategies do students use in preparation for examinations (both class exams and the licensing exam), and why?

<u>Reading</u>: Roger's basic study mode was using computer programs and talking with people. He usually read the material once, used computer programs, and then talked

about the materials with other students. Sometimes he did not even read the material once but just used computer programs and talked with classmates.

<u>Group study</u>: Roger sometimes got together with another person during the week before an exam and they would test each other. They would go over their notes and ask each other questions about the material they had reviewed. This also helped him identify unknown facts. Roger used group study as a way of checking his knowledge.

Integration strategies: Roger said that writing things down, such as process, helped his understanding. He also wrote explanations of unclear things in the margins of his coursepacks. For instance, if a coursepack said "stress ulcers are physiological stress," he wrote "not psychological stress" in the margin. Roger said that if he understood the process, he did not need to memorize. For instance, knowing the fact that "aspirin decreases swelling" is memorization, but if he knew the reason why this occurred, the memorization followed naturally. Sometimes, teaching or explaining to others during the group study helped him understand the materials better.

Memorization strategies: Roger highlighted things he did not remember well or that he had not known before. He sometimes used mnemonics but used fewer memorization strategies the second year than the first year because he understood more the second year. Also telling each other the story about something several times in the study group helped him remember better.

Selecting main information: To select important information, Roger used objective lists, percentages of exam content, computer programs, and starred objectives.

196

Sometimes the professor told students what was important to know in the lectures. Roger also highlighted important things, as illustrated by his comment:

As I'm going through it I'll see it and I'll say, "Oh, yes, there it is again." Or "That's the most important thing." And then I'll take the test at the end, and most of the time the things that I get wrong are the things I didn't highlight when highlighted.

<u>Computer programs</u>: Roger said that computer programs contained very precise, condensed, and focused information. They were developed by department faculty and included no extraneous information. Thus, he could recognize important information through doing computer programs. If Roger did not understand the material through computer programs, he looked it up in the textbooks.

Checking knowledge strategies: Roger used group study to check his knowledge.

Group members ask each other questions and explained things to each other, which helped him know whether he understood material or not.

Lecture attendance: Because some test questions were drawn from lectures and the lectures reinforced what he knows, Roger sometimes attended lectures. However, if a

professor was not good, Roger did not go to the lectures.

<u>Additional strategies</u>: Roger said that doing well on exams gave him confidence, as illustrated by this statement:

Getting good scores always helps because you feel like you are doing the right thing, and you feel like you can trust your judgment about what to study and what not to study.

<u>Board preparation</u>: Roger planned to study with the group to prepare for the board exam. He planned to take the board review course. He believed that studying for exams the second year would help him pass the board exam.

### <u>Research Question 3</u>: What do students think influences their learning strategies (such as goals, assessment of learning, student activity, teaching method, and course content)?

Roger said that exams were the greatest influence on the way he studied. Also, his exam scores influenced the way he studied. His goal was to do well on the board exam, as well as on the domain exams. Roger wanted to get important information for the domain and board exams from PBL classes. However, he seemed to think that PBL classes did not help him with his goal of doing well on exams, as he pointed out in his comment, "In the class it makes me feel kind of like I'm wasting my time, like I could be doing other things that would be more helpful."

Roger said that, at the beginning of the semester, PBL helped him because he did not have much information, but by now everyone knew what they had to do, so they just

went to PBL classes because they were required to do so. He stated,

At the beginning of the year, the PBL classes were very helpful because we didn't know anything about what was going on, but at this point, everyone kind of knows what's going on, and they go to the PBL classes because they have to. And I think it would be better for me, and better for our group as a whole, if we actually didn't go, because we don't really learn a whole lot during the PBL classes. So right now they don't really help too much with our studying.

However, Roger thought that PBL classes helped\_small-group working skills

because he had to learn to be more tolerant of others.

### <u>Research Question 4</u>: Do second-year medical students at MSU CHM report that they study differently than they did in their first year? If so, how and why?

Roger focused mostly on lecture notes and used textbooks only when he did not

understand the material in his first year. exams. In that way, he could score well on the

exams. Also, he was more anxious about tests and was less sure about what it was important to know the first year. The second year, Roger found that PBL classes were not necessarily related to the exams. He was busier and thought the material was harder the second year However, ironically, he had more free time the second year because he was more effective in his study approach. Roger said the experience of taking tests and achieving good grades gave him confidence and helped him be an effective learner.

Table F.6 contains a summary of the key features of Roger's learning strategies.

 Table F.6: Key features of Roger's learning strategies

Q1	<ul> <li>Studying for exams, not for PBL classes</li> <li>Matching learning issues with objectives</li> <li>To find learning issues: Using coursepack, computer programs, and old objectives; no use of library</li> </ul>
Q2	<ul> <li>Reading: once sometimes; basic study mode is doing computer programs and talking with people</li> <li>Group study: asks questions, identifies unknown facts</li> <li>Integration strategies (understanding): writes down the explanation of unclear things such as a process; explains to others during group study</li> <li>Memorization strategies: mnemonics, talks with friend several times, once he understood, then memorization follows</li> <li>Selecting Main information: objectives, percentages of exam content, lectures, stars in the objectives, and computer programs; highlighting</li> <li>Computer programs: precise, condensed: way of selecting main information</li> <li>Checking knowledge strategies: group study</li> <li>Lecture attendance: if professor is good</li> <li>Additional strategies: good exam scores give him confidence</li> </ul>
Q3	<ul> <li>Influences: exam</li> <li>Goals: do well on domain and board exams</li> <li>He feels he can study by himself now, and going to PBL classes wastes time.</li> <li>PBL helps <ol> <li>Small-group working skills</li> </ol> </li> </ul>
Q4	<ul> <li>Relies on lecture notes and sometimes used books the first year</li> <li>More anxiety on exams and less sure of selecting main information the first year</li> <li>Has more free time and confidence the second year because of test experience and good test scores</li> </ul>

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Nancy

# <u>Research Ouestion 1</u>: What learning strategies do students use in preparation for the problem-based learning classroom, and why?

Nancy said she focused more on exams than on preparing for PBL classes. The approximate ratio of time that she studied for PBL classes and exams was 1:50.

During class: Like other PBL groups, Nancy's group also read the cases, suggesting ideas and cues by looking at whole clinical picture and based on previous knowledge. Then they raised learning issues. Nancy tried to match learning issues with the objectives, as illustrated by her statement, "One thing that we do in our group is make our learning issues reflect the objectives that we're given in the PBL class, for the exam."

Learning issue study: Nancy found information for studying learning issues from coursepacks, textbooks, and computer programs. She did not use the library. Nancy said that PBL classes helped achieve the objectives by giving a real clinical context to what they were learning. Having a context made the material interesting and understandable. Also, asking questions during the PBL class helped Nancy understand objectives better.

### <u>Research Ouestion 2</u>: What learning strategies do students use in preparation for examinations (both class exams and the licensing exam), and why?

<u>Reading</u>: Nancy mentioned that she rarely found time to read the material more than once. She mainly read textbooks and coursepacks, and if she found time, she reviewed what she underlined or written in the margins or flashcards that she had made.

<u>Group study</u>: Sometimes Nancy studied with friends; group study provided repetition and kept her interested. Also, she could check her knowledge when group members quizzed each other. She could also pick up information because she studied with students from another PBL class. Nancy said, "It's neat to study with someone who's in another PBL group because you can pick up different stuff between the groups."

Integration strategies (understanding): Nancy read textbook carefully, trying to understand what she read. Also, studying cases in PBL class helped her understand the material better by giving them a clinical context.

<u>Memorization strategies</u>: Nancy wrote down little facts down that she found interesting, whether they were important or not. For example, if she read a sentence like "peptic ulcers occur more often in males," she would write in the margin "Males more common." Writing helped her memorize easily. She said she sometimes made flashcards and memorized what was on them.

Selecting main information: Nancy said that if she saw a certain topic in more than one category, this indicated it was important information. For instance, information on ulcers appeared in pathology, pharmacology, and psychosocial materials; thus it was obviously an important thing to know. She emphasized the objectives that interested her the most. She also said she could recognize good test questions from the notes and thus focused on those. She stated, "The most common cancer in teenagers is" would be a likely exam question. Also, studying with other PBL group students gave Nancy information about the importance of materials her group did not discuss.

<u>Computer programs</u>: When Nancy was bored with reading the coursepack, doing computer programs give a nice change in studying the same materials. She mentioned that pictures and diagrams associated with the materials in computer programs also helped her study. <u>Checking knowledge strategies</u>: In group study, Nancy and her friends quizzed each other, and that helped her check her knowledge.

Lecture attendance: Nancy said she attended the lectures because she liked to hear the professor discuss the material even though she did not grasp them at her first sitting. Also, she felt a responsibility to go to the lectures because she had paid for them; they were a good way be social with classmates, as well.

Additional strategies: Nancy mentioned that she switched to different sections and jumped all over the place in order to maintain her interest because studying one section in a domain for a long time was boring. Another notable thing that Nancy mentioned was that she thought the exam format in medical school had changed her way of thinking. She said that multiple-choice exams made students be less logical and made them pick out important words and concepts for the tests instead of overall ideas.

<u>Board preparation</u>: Nancy planned to take a board review course to prepare for the board exam.

### <u>Research Ouestion 3</u>: What do students think influences their learning strategies (such as goals, assessment of learning, student activity, teaching method, and course content)?

To Nancy, passing the exams influenced her learning strategies the most; the multiple-choice exam format also influenced the way she studied. She said she tried to pick out important words and major concepts but not ideas in studying for exams. Nancy's goal was to be a good physician. She also wanted to have good interaction from her PBL classes. In general, Nancy liked the PBL format, especially because it gave a context to a case, which helped her understand the materials. She commented, I like PBL. I can't stress how much more I like this year than last year. Last year was just so much more stressful. I don't know why it was like that. I can see where, if your PBL group isn't very forthcoming or doesn't work well together PBL can be a nightmare for you. But I've been lucky enough to be in a really good group and we work really well.

Nancy also noted that PBL classes helped in the following ways:

1. <u>Small-group working skills</u>: The small-group discussions enabled Nancy to stay

on track; she tried not to disagree too much. She said, "It's been interesting to see

everybody's role develop in the group"

2. <u>Understanding of the materials</u>: By giving a context to a case, PBL group

discussion helped Nancy understand the materials.

3. Exam preparation: According to Nancy, talking and arguing about the materials

not only helped her figure them out but also helped her prepare for the exams because

what the group discussed was related to the exams.

### <u>Research Ouestion 4</u>: Do second-year medical students at MSU CHM report that they study differently than they did in their first year? If so, how and why?

Nancy said that test items had come from lectures and she relied heavily on the lectures the first year. Also, exams imposed pressure and influenced her studying more the first year than the second year. Nancy read and understood more the second year than the first year. Also, she used fewer memorization strategies the second year than the first year.

A summary of the key features gleaned from the interviews with Nancy is presented in Table F.7.

 Table F.7: Key features of Nancy's learning strategies

Q1	<ul> <li>Focusing on exams, not on PBL classes</li> <li>Matching learning issues with objectives</li> <li>Learning issue study: uses coursepacks, textbooks, and computer programs; no use of library</li> </ul>
Q2	<ul> <li>Reading: <ol> <li>Usually reads textbooks and coursepacks once,</li> <li>Review things underlined or written in the margin, or flashcards if she has time</li> <li>Group study: quizzes each other, gives repetition, keeps her interested, checks knowledge, and picks up information</li> <li>Integration strategies: careful reading, PBL discussion</li> <li>Memorization strategies: writes down facts: interesting things, flashcards</li> <li>Selecting main information: corresponding information, testable questions, and group study</li> <li>Computer programs: uses them when she is bored with reading coursepacks, good pictures</li> <li>Checking knowledge strategies: group study</li> <li>Lecture attendance</li> <li>Additional strategies: reads jumping over all over the place, exam format changed her way of thinking</li> </ol></li></ul>
Q3	<ul> <li>Influences: passing exams and exam format</li> <li>Goal: to be a good physician</li> <li>PBL helps <ol> <li>Small-group working skills</li> <li>Understanding of the materials</li> <li>Exam preparation</li> </ol> </li> </ul>
Q4	<ul> <li>Relied on lectures and lecture notes the first year</li> <li>Exam had more influence and more pressure on studying the first year</li> <li>Fewer memorization strategies, more reading, and understandings the second year</li> </ul>

Janet

## <u>Research Ouestion 1</u>: What learning strategies do students use in preparation for the problem-based learning classroom, and why?

Janet studied primarily for exams and not to prepare for the PBL classes. When she studied for the learning issues, she tried to gear them toward the objectives, which were the focus of the exams.

During class: Janet's PBL group read a case, picking out cues from all the available data, such as gender, race, signs, symptoms, and psychosocial details. Then they discussed hypotheses from their previous knowledge. Janet mentioned that her group had two nurses, including herself, and could contribute more information for discussion. Then they raised learning issues for the next session and did the stimulus questions at the end of each case.

Janet tried to match learning issues with the objectives by referring to the objectives during small-group sessions. Thus, she did not prepare differently for the objectives, which were mainly covered on the exams, and learning issues.

Learning issue study: To find information for the learning issues, Janet read textbooks. Like most of the other students in this study, she did not go to the library. She studied learning issues in order to contribute to the group and to ask questions, which reinforced what she knew. Janet commented,

For PBL, I try to get what information I need for the class, but I try to keep it streamlined so I don't get waylaid and get away from the objectives, cause that's real easy to do.

206

# <u>Research Ouestion 2</u>: What learning strategies do students use in preparation for examinations (both class exams and the licensing exam), and why?

Reading: Janet read everything twice. The first time, she read the material carefully at a slow pace trying to understand it. She tried to answer questions and filled the objective list with resources. She highlighted the materials when she read them the first time. The second reading went faster because she only read the highlighted passages. She picked up things she did not understand at her first reading. She used the objective list to check whether she had covered all of the objectives.

No group study: Janet said she did not study in a group. She was too busy reading on her own and taking care of her children, so she studied whenever she had time.

<u>Integration strategies (understanding)</u>: Janet mentioned that seeing visual examples of materials such as paths from computer programs helped her understand them better.

Selecting main information: Janet looked at the objectives to see which information was important. She said that if an objective list was good, it was easy to find the main information; however, if the list was poor, she had a hard time finding the main information. Janet studied material comprising the largest percentage of the exams first. Sometimes, she used practice quizzes and old objectives to glean important information. She also mentioned that PBL classes informed her of what she needed to know.

<u>Computer programs</u>: Janet used computer programs only when she heard from others that certain programs followed the coursepack very closely. Visual path examples in computer programs helped her make sense of what she read. But Janet stated that computer programs were no better than the textbook so she used them only for supplemental studying. <u>Checking knowledge strategies</u>: Janet solved practice quizzes in the coursepack in order to check her knowledge.

<u>No lecture attendance</u>: Janet did not attend the lectures because she thought she could use the time more effectively studying by herself. However, she obtained scribe notes and read them before the exams because they gave framework to the scope of her study.

<u>Board preparation</u>: Janet planned to take a board review course to prepare for the board exam. She also believed that doing well on the domains now would help her do well on the board exam.

### <u>Research Question 3</u>: What do students think influences their learning strategies (such as goals, assessment of learning, student activity, teaching method, and course content)?

Janet mentioned that the pressure to pass domain exams and the board exam influenced the way she studied. However, in a sense, it also kept her motivated. Her primary goal was to finish medical school, and her secondary goal was to be a good doctor. Her goals from the PBL experience included contributing more to the group and getting reinforcement. She thought PBL helped in gaining different perspectives on issues but that it did not help her prepare for exams. In general, she enjoyed the PBL experience, but she preferred to study by herself, as illustrated by this statement, "I feel like small group is not really a great part of my learning. I economize my time. I feel like if I had that six hours to myself I could study more." Janet said that sometimes PBL class distracted her from her own studying when her group discussed issues that are not pertinent to the objectives. However, Janet thought that PBL classes helped in the following ways:

1. <u>Small-group working skills</u>: To interact with a wide variety of personalities in a group, Janet had to develop skills in working with people.

2. <u>Checking knowledge</u>: Janet said she asked questions during PBL class, and that reinforced what she knew, as illustrated by her statement, "It [PBL class] reinforces what I know. And sometimes it may let me know that I don't know something and I'll go back and research it."

3. <u>Information about what to know</u>: Janet mentioned that PBL class discussion made her realize what she needed to know. Sometimes she could find a good book, based on someone else's recommendation.

4. <u>Integrating materials</u>: PBL class helped Janet integrate the materials by providing contexts to cases.

### <u>Research Question 4</u>: Do second-year medical students at MSU CHM report that they study differently than they did in their first year? If so, how and why?

Because the first year was lecture-based, Janet basically read scribe notes and read textbooks once in a while. There were fewer materials to study, and they were easier the first year than the second year. The second year, Janet read textbooks more than the first year. Also, she did not attend lectures because there was more pressure on her time the second year. Janet said she used more strategies for selecting main information the second year than the first year because she had to find information by herself instead of having a lecturer give it to her. Also, she did not use flashcards the second year because they took too much time. Janet was more self-disciplined, independent, and diligent about studying the second year than the first year. Further, she said she could see the connections and relations between topics better the second year than she could the first year.

A summary of the key features that emerged in the interviews with Janet is

contained in Table F.8.

Table F.8: Key features of Janet's learning strategies

01	Studying for grome and not for DBL classes
יא	- Studying for exams and not for FBL classes
	- Matching learning issues with objectives
	- Learning issue study: uses textbooks and no use of library
Q2	<ul> <li>Reading: more than once <ol> <li>Carefully, slow pace: fills blank of objectives with resources, highlighting</li> <li>Read highlighted passages: goes faster</li> <li>No group study, No lecture attendance</li> <li>Integration strategies: read carefully, computer programs</li> <li>Selecting main information: objectives, percentages of exam content, quizzes, old objectives, and PBL classes</li> <li>Computer programs: only when they follow coursepack closely</li> <li>Checking knowledge strategies: practice quizzes</li> </ol> </li> </ul>
Q3	<ul> <li>Influences: passing domain and the board exams</li> <li>Goals: finish medical school and to be a good doctor</li> <li>PBL helps <ol> <li>Small-group working skills</li> <li>Checking knowledge</li> <li>Giving information of what to know</li> <li>Integration of the materials</li> </ol> </li> </ul>
Q4	<ul> <li>Used scribe notes primarily, rarely used textbook, less volume the first year</li> <li>More textbook reading, more integration, more pressure on her time, and more selecting main information strategies the second year</li> <li>No lecture attendance the second year</li> <li>Fewer memorization strategies the second year: because of time</li> <li>More self-disciplined, independent, and diligent the second year</li> </ul>
#### <u>Cindy</u>

Cindy was not taking PBL classes the semester the interviews were conducted because she had extended her program. She lengthened her program because she was engaged and thus needed time to plan the wedding. Also, she said she needed less school time and more free time. She took only clinical skills, social context class, and mentor which met once a month, with no PBL classes or lectures.

# <u>Research Ouestion 1</u>: What learning strategies do students use in preparation for the problem-based learning classroom, and why?

Not applicable

### <u>Research Ouestion 2</u>: What learning strategies do students use in preparation for examinations (both class exams and the licensing exam), and why?

Cindy mentioned that she had no exams this semester. Only papers were required for the classes she was taking. Also, because Cindy needed to take PBL classes before taking the board exams, she had no plans to prepare for the board exam preparation yet.

## <u>Research Question 3</u>: What do students think influences their learning strategies (such as goals, assessment of learning, student activity, teaching method, and course content)?

The primary influence on Cindy's learning strategy was time. Because she had more time the second year, she had less pressure and could read more. Her goal was to figure out what were the most important materials for her to know versus what was okay for her to know. It seems that she realized the importance of selecting the main information in a limited time.

### <u>Research Question 4</u>: Do second-year medical students at MSU CHM report that they study differently than they did in their first year? If so, how and why?

Cindy had no exams the semester the interview was conducted but did have some in the previous semester in her clinical skills and social context classes. When I asked Cindy about her exam preparation in her first year as compared to the previous semester, she said she started earlier, used fewer rote memorization strategies but more concept understanding the previous semester than the first year. She also wrote out objectives and read more before lectures the previous semester than she had during the first year. By writing out what she read, she learned better. She stated that there were so many materials to study the first year, she could not write as much then as she did when the interview was conducted. All these changes had occurred because she had more time the previous semester than she did the first year and thus could learn the material better. She stated, "I actually got out textbooks and read the chapters and I did a lot more with learning the whole concept instead of just trying to memorize facts for the exam."

Table F.9 contains a summary of the key features about Cindy's learning strategies.

Table F.9: Key features of Cindy's learning strategies

Q1	- Extending her program: no PBL classes, no lectures, only takes clinical skills, social context classes, and mentor
Q2	- No exams this semester, only papers are required
Q3	- Influence: time - Goal: figure out important materials
Q4	- The previous semester: had clinical skills exams: easier, more time than the first year - thus starts earlier, uses rote memorization, more integration, more reading, more writing down of objectives than the first year

### Susan

Susan took no PBL classes because she had extended her program in order to adjust to the medical environment and to catch up as a result of having no biochemistry background. Also, her marriage plans were another reason for her extension. She was taking first-year lectures and hence had more time than other interviewees in this study.

## <u>Research Ouestion 1</u>: What learning strategies do students use in preparation for the problem-based learning classroom, and why?

Not applicable

# <u>Research Ouestion 2</u>: What learning strategies do students use in preparation for examinations (both class exams and the licensing exam), and why?

<u>Basic study mode</u>: Susan mentioned that she used "three time exposure" to the materials, as she had done the first year. That is, she first exposed herself to the material through lectures. Then she read her notes, arranging materials, making structures, and highlighting. Finally, she memorized facts just before the exam. Susan said she usually did not read textbooks but instead read scribe notes.

Integration strategies: Susan tried to integrate scribes notes, her own notes, and the textbook. She mentioned that she used a structure to help her remember facts. She stated,

With immunology, any kind of immunological response you have various mechanisms, an integration of activity that all happens when a pivotal event occurs. So I learn all the minutia that happens along the way of one pathway of response, and then once I learn all those little steps, the important part, the structure part is that I condense all those parts. <u>Memorization strategies</u>: Susan said facts aloud in order to memorize them, as illustrated by this comment:

When it comes time to memorize facts, I say out loud the facts that I have to memorize and what their association is. I have it all laid out on a desk and I'll go over and get a piece of it and then I'll just talk and then walk and memorize it and then go get the next piece. So it's probably visual and kinesthetic because I'm moving around.

Also, she used structures in order to memorize facts easily.

Additional strategies: Susan said she asked the professors questions if she had any.

And if a professor's lectures were confusing, she did not attend them but just obtained the

scribe notes.

Board preparation: Susan had no specific plan to prepare for the board exam yet

because she needed to go through PBL classes first.

## <u>Research Question 3</u>: What do students think influences their learning strategies (such as goals, assessment of learning, student activity, teaching method, and course content)?

What influenced Susan's learning strategies most was her desire for success.

Susan's goal was to achieve a balance among academic success, clinical experience, and

her personal life. She said that lectures did not help with clinical experience, so she looked

forward to having PBL classes next year.

### <u>Research Question 4</u>: Do second-year medical students at MSU CHM report that they study differently than they did in their first year? If so, how and why?

Susan had a tutor the first year but she did not the second year. She mentioned

that she was more relaxed the second year because of the experience in medical school.

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She knew what she could accomplish in a certain amount of time and had more confidence

now that she could do it.

A summary of the key features that emerged in the interviews with Susan is

presented in Table F.10.

Table F.10: Key features of Susan's learning strategies

Q1	- Extending her program: no PBL classes: adjustment to medical school, no biochemistry background, and marriage plans
Q2	<ul> <li>Reading: lecture notes or scribe notes, no textbooks</li> <li>Basic study mode: three-time exposure: lectures -notes - memorization</li> <li>Integration strategies: uses structure</li> <li>Memorization strategies: says aloud, uses structure</li> <li>Additional strategies: gets help from professor</li> </ul>
Q3	- Influence: desire for success - Goals: balance among academic success, clinical experience, and personal life
Q4	- No tutor, more relaxed, more confident the second year

### Kelly (Pilot Study)

# <u>Research Ouestion 1</u>: What learning strategies do students use in preparation for the problem-based learning classroom, and why?

Kelly said she did not study for PBL classes per se. She tried to relate PBL classes

to exams; thus, studying for exams prepared her for the classes. She stated,

I study for the exam from the beginning and then if we happen to talk about something in the group that I've already studied for the exam that's wonderful. If we talk about something I haven't studied yet, I can file it away in my head as something I need to look at. I study my way, and when the PBL classes fit into my way of studying then that's great. When they don't, that's too bad.

During class: Kelly mentioned that her PBL group was relaxed and less formal

than other groups. They read cases and discussed them together, generating hypotheses.

But they did not write formal hypotheses on the board. Through case studies during the

PBL class, Kelly tried to connect all the information, as illustrated by her statement:

What I try and do is try and explain everything in the case and imagine in my head how all these different things are connected. And if I can't do that, then I assume that I don't know enough and I have to go research more so I can see how all these different things are connected.

Learning issue study: To prepare for the PBL class, Kelly looked at the big picture

of the case and tried to make connections among materials. If she could not see the

connections, she realized she had missed something and studied those things after class.

However, she did not go to the library for her research. What she did was reading

relevant parts in a textbook.

### <u>Research Ouestion 2</u>: What learning strategies do students use in preparation for examinations (both class exams and the licensing exam), and why?

<u>Reading</u>: Basically, Kelly read textbooks and the objectives twice. The first time, she read textbooks with no pressure or hurry, to get general concepts and to understand what she read. The second reading, she could remember better because the material was familiar through her first reading, as illustrated by this comment, "You read through something once, and [when] you read through it the second time everything will seem familiar and so you'll remember it better."

Group study: Kelly studied with her boyfriend because doing that kept her motivated and made her keep studying.

Integration strategies: Kelly read carefully, trying to understand the materials. She tried to compare texts with pictures, and texts with PBL cases, in order to integrate the materials for better understanding. When she studied, she tried to connect the materials just as she would in the PBL class. For example, when Kelly reads about a disease, she would think, "OK, if I were to get a case about this disease, what would this person look like?" and then she tried to think back about what she had learned. Also, using computer programs helped Kelly connect the materials better and hence aid her understanding.

<u>Memorization strategies</u>: Kelly made up stupid songs or silly acronyms or mnemonics to help her memorize facts. Sometimes, she imagined things to aid in memorization. Also, Kelly highlighted passages or wrote things down in the margins while reading. She said that doing these things was more active than just reading because she had to actually think about what she was reading and this aided her memorization. She read the material twice, and this gave familiarity to the materials and hence helped her memorize them.

Selecting main information: Kelly used the previous year's objectives as a way to select information for study. If objectives were not specific but very broad, such as "know the anatomy of the heart," she relied more on the textbook, whereas if objectives were good, she read the previous year's objectives. Kelly also used the percentages of the exam content to determine the relative importance of the materials; then she studied the largepercentage objectives first.

<u>Computer programs</u>: Kelly used computer programs because they had better pictures than the textbooks. Through computer programs she could move backward and forward easily and could connect the materials and pictures easily, which helped her understanding.

<u>Checking knowledge strategies</u>: Kelly did practice quizzes in the coursepack the night before the exam in order to see whether she remembered what she had studied.

<u>No lecture attendance</u>: Kelly did not attend the lectures because she thought she could use that time more effectively studying on her own. Also, she said she was not a morning person, and most of the lectures were in the morning.

<u>Additional strategies</u>: Kelly stated that she read the objective lists first to see what information she had to look for when she studied. Then she read textbooks and old objectives with the answers. After doing that, she reread the objective list to see whether she had missed anything. In this way she checked her coverage of the objectives.

218

<u>Board preparation</u>: Kelly planned to attend a board review course to prepare for the board exam. She also believed that studying for the domain exams now would help her pass the board exam.

### <u>Research Question 3</u>: What do students think influences their learning strategies (such as goals, assessment of learning, student activity, teaching method, and course content)?

Kelly mentioned that her old study habits influenced how she studied now. It seemed hard to change her own study approaches. Her goals included passing the domain and board exams, as well as getting the big picture. She believed that PBL classes helped her get the big picture, but did not help much with exams. Kelly liked to match basic science knowledge to clinical situations through PBL classes.

In general, Kelly liked PBL better than lectures. She said that PBL class was fun and big-picture oriented, whereas exams were detailed oriented. Also, she mentioned that PBL classes helped her integrate the materials through the discussion of cases provided with a context. Kelly also tried to connect the textbooks, pictures, and PBL cases when she studied for exams as evidenced by her statement:

I'm really making an effort to connect the things, just like I would if I was in PBL. When I read about a disease, I think, 'OK, if I were to get a case about this disease, what would this person look like?'"

## <u>Research Question 4</u>: Do second-year medical students at MSU CHM report that they study differently than they did in their first year? If so, how and why?

The first year, Kelly went to lectures regularly and studied exclusively the

coursepack notes, rarely using textbooks. She said she read the textbook more the second

year than the first year. Also, whereas her main goal the first year was solely to pass the

exams, she was focusing more on understanding and integrating the materials the second

year.

Table F.11 shows a summary of the key features about Kelly's learning strategies.

Table F.11: Key features of Kelly's learning strategies

Q1	- No PBL preparation; relates it to exam preparation
	- Learning issue study: usually reading textbooks and no use of library
Q2	- Reading twice: read textbooks and objectives
	2. Remember better because it is familiar through first reading
	- Group study keeps her motivated keeps her studying
	- Integration strategies: careful reading; tries to connect picture, text, and PBL case; uses computer programs
	- Memorization strategies: uses acronyms, mnemonics, imagery, and highlighting writing - more active; reading twice - familiar, gives repetition
	- Selecting main information: the previous year's objectives and percentages of exam content
	- Computer programs: better pictures, easier to understand
	- Checking knowledge strategies: practice quizzes
	- No lecture attendance
	- Additional strategies: checks the coverage of the objectives
Q3	- Influences: old study habits
	- Goals: passing exams and getting the big picture
	- PBL helps
	1. Integration
Q4	- First year: regular lecture attendance, exclusively studied coursepack notes
	- Second year: more use of textbooks
	- Goal changes: exclusively passing exams -> more understanding

#### Jane (Pilot Study)

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## <u>Research Ouestion 1</u>: What learning strategies do students use in preparation for the problem-based learning classroom, and why?

Jane mentioned that she did no study separately for PBL classes and for exams. She thought that what she learned from PBL classes was what was on the exams because her group stick to the objective lists. Jane did not study much for PBL class per se if the materials were not likely to be on the exam as shown in her comment:

I don't really spend that much time on the PBL things that aren't on the test. Everything I studied was directed toward the objectives, so it was really geared toward the exam.

During class: Jane's PBL group discussed cases with each other, and preceptors asked questions. They established a ground rule for their group to stick to the objective lists when they discussed the cases, and the learning issues they raised had to match the objectives.

Learning issue study: To find learning issues, Jane usually read books, taking notes. However, depending on the domain, she looked for materials differently. For example, although the professor gave them good coursepacks that covered everything for physiology class, for cardiology she researched different sources or books to look for information. Sometimes Jane went to the library or the learning resource center to find the information for learning issues. When researching books in the library, she tried to find the parts that matched the objectives. However, even though a learning issue might not be related to the exams, if it was interesting, she looked for the information.

### <u>Research Ouestion 2</u>: What learning strategies do students use in preparation for examinations (both class exams and the licensing exam), and why?

<u>Reading</u>: Jane mentioned that she read the previous year's objectives with answers to get an idea of what she needed to know for the test. If she found information that she could not understand while reading the old objectives, she read textbooks and took notes. Jane mentioned that she tried to get a general overview during the first week of the domain, and she took notes and tried to memorize things during the second week of the domain.

<u>Group study</u>: Jane said she studied with her friends, and they asked each other questions. Doing this helped her check her knowledge. Jane focused more on group study if the material was conceptual because by writing, drawing things on the board, and talking to friends made her think about pathways more actively.

Integration strategies: Jane integrated the materials through group study. For studying conceptual materials, she mentioned,

We found that it really helped us, talking things through together, you know, drawing stuff on the board to figure it out. So, I spent a lot more time studying with people.

<u>Memorization strategies</u>: Jane used flashcards or charts to memorize things. She read one source of information, took notes, wrote the notes on flashcards, and retyped them. She then rewrote them on a chart. Doing this provided repetition of the information, which aided her memorization.

<u>Selecting main information</u>: Jane said she figured out the important information by solving practice quizzes, as illustrated by her statement:

They do give us quizzes, and the same people who write the test questions write the quiz questions. So they usually give us a pretty good idea what's going to be on the test.

Jane used old objectives to see what were in the previous year's exams. Also, she knew that certain information was important if it was given in several different sources, such as lectures, textbooks, and objectives. Sometimes, lectures helped her determine what was important information. And having a physician as a preceptor in PBL classes helped Jane focus on what was important.

<u>Checking knowledge strategies</u>: Jane solved quizzes because they gave a good idea of what would be on the test. Through doing quizzes, she also could check how she was doing with her study. Also, her group asked each other questions, which helped her ascertain the state of her knowledge.

Lecture attendance: Jane said she went to the lectures and obtained scribe notes because they sometimes made her focus on important information.

<u>Board preparation</u>: Although Jane was not studying for the board exam yet, she believed that what she was studying now would help her pass the board exam. Also, she planned to attend a board review course to prepare for the board exam.

### <u>Research Question 3</u>: What do students think influences their learning strategies (such as goals, assessment of learning, student activity, teaching method, and course content)?

Jane said her goal was to be a good doctor. Also, she wanted to learn the material well enough so that she could apply it in the field. She also hoped, that from the PBL class experience, she would be able to integrate the materials better.

In general, Jane liked the PBL format better than lectures because it provided integration of the materials and she could learn well from the discussion in PBL classes. Jane also mentioned that PBL classes helped in the following ways:

1. <u>Independent study</u>: Jane mentioned that PBL classes encouraged and motivated her to look for materials when it was something related to the clinical setting. She said that even though something was not on the objective lists, if the material was interesting, she went to the library and researched it.

2. <u>Exam preparation (selecting main information)</u>: Jane mentioned that PBL classes helped her prepare for the exams in that they focused on important information in discussion. Sometimes the physician preceptors helped her pick out the important material.

3. <u>Understanding and integration</u>: Jane mentioned that talking with people during PBL classes and explaining things to each other helped her understand and integrate the materials. She stated, "So I think for me that's how PBL is good because it connects the clinical aspects and the physiology and the pathology, ties them all together."

### <u>Research Question 4</u>: Do second-year medical students at MSU CHM report that they study differently than they did in their first year? If so, how and why?

Because exams were based on lectures the first year, Jane read coursepacks and scribe notes, but she did not read textbooks. Also, the teachers sorted out the information to learn the first year. The second year, she had a greater volume of material to study, and she had to figure out what were the important things to study on her own. Jane said she was big-picture oriented the second year. Also, she said she could focus on one topic at a time the second year because, the exams were scheduled that way. Table F.12 shows a summary of the key features about Jane's learning strategies.

Table F.12: Key features of Jane's learning strategies

Q1	<ul> <li>No separate studying for PBL class and exam: studying for PBL class is a part of studying for exams</li> <li>Matching learning issues with objectives</li> <li>Studying learning issues if they are interesting. even though they are not on the objective lists</li> <li>Learning issue study: reads books and coursepacks if they are good, uses library or learning resource center</li> </ul>
Q2	<ul> <li>Reading: reads old objectives with answers first to get an idea of test information- if she cannot understand, reads textbooks and takes notes <ul> <li>First week of a domain: gets a general overview</li> <li>Second week of a domain: memorizes things</li> </ul> </li> <li>Group study: asks questions, checks knowledge, focuses on group study for conceptual material</li> <li>Integration strategies: group study</li> <li>Memorization strategies: flashcards, charts, repetition (reads- takes notes- writes on flashcards- retypes - rewrites on chart)</li> <li>Selecting main information: practice quizzes, old objective, lectures, overlapping information, and PBL class</li> <li>Checking knowledge strategies: practice quizzes and group study</li> <li>Lecture attendance: focusing information</li> </ul>
Q3	<ul> <li>Goals: to be a good doctor and learn materials well so that she can apply in the fields</li> <li>PBL helps <ol> <li>Independent study</li> <li>Exam preparation (selecting main information)</li> <li>Understanding and integration</li> </ol> </li> </ul>
Q4	<ul> <li>First year: lecture based: read coursepack, scribe notes, no textbook use, teacher selected main information</li> <li>Second year: more use of textbooks, select main information by herself, more big picture oriented, study one topic at a time</li> </ul>

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