

**USING “CASE STUDY” AND “COOPERATIVE LEARNING”  
TEACHING APPROACHES IN A SECOND-YEAR  
PHYSIOLOGY COURSE AT DALAT UNIVERSITY**

by

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**THESIS SUBMITTED IN PARTIAL FULFILLMENT OF  
THE REQUIREMENTS FOR THE DEGREE OF  
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of

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**Using "Case Study" and "Cooperative-Learning" Teaching Approaches in  
a Second-Year Physiology Course at Dalat University**

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## Abstract

The “teacher-centered” method, which is common in Vietnamese schools and universities, pays little attention to students’ developing cognitive and problem solving abilities in science, their self-confidence as learners and their skills in communication, working with others, critical thinking, and self-appraisal. There is a need for “student-centered” teaching methods in Vietnamese schools. This study investigated a “case method” of teaching in a second-year physiology course, with whole-class discussions and cooperative group work.

Taking place at Dalat University in Vietnam in the fall of 1995, the study involved a qualitative analysis of three sections of 42 students enrolled in the physiology course, focusing on students’ perspectives about school, students’ attitudes toward the “trial” methods of teaching and learning, and the feasibility of applying the new teaching approaches on a broader scale.

Data were collected from 3 main sources: (1) a survey, (2) a course evaluation, a self-evaluation and midterm examination, and (3) observations and a group interview with 6 students. The survey data are analyzed mainly by descriptive interpretation and partly by quantitative analysis. Main themes from the transcripts of the observations and interview are coded and analyzed by in terms of the focused research problems.

Findings from the study show that the students had highly positive attitudes toward school; they had a keen concern about the content and teaching methods in biology courses, about the need of social skill development. The new teaching approaches were reported to be useful in developing deeper understandings of science, and other skills such as oral communication, trust building, and self-confidence. Among the conclusions is a set of recommendations and limitations of the study.

## **Dedication**

This work is dedicated to the Canadian International Development Agency, Simon Fraser University, Dalat University, and the Department of Biology at Dalat University; the Department Head and all my colleagues, students of the third and fourth year , especially students from the second year part-time program of Dalat University who participated in experiencing the new approaches. Thank you for your inspiration and commitment.

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## **Chapter One**

### **Background and Statement of the Problem**

#### **Social context**

Following the unification of Vietnam in 1975, massive changes have occurred in the country's educational system. In 1990, the former Ministry of Education, the General Department for Vocational Training, and the Ministry of Higher and Secondary Technical Education were fused together as one Ministry of Education and Training. The first five years after reunification were also marked by a severe shortage of well qualified people in the general workforce, poor economic conditions, and very few resources for educational purposes. The government has undertaken enormous efforts to alleviate illiteracy, yet there remain some persistent problems in the remote mountain areas and in the Mekong Delta area, where there are inadequate schools and a shortage of teachers.

The Educational system in Vietnam has been organized into two levels of administration: the centrally-based administration for the country as a whole, and the locally-based provincial administration. Both of these belong to the Ministry of Education. All universities are directly administered by the Central Ministry, while kinderganen, elementary, secondary and high schools are administered by the General Department of Education in each province (Duiker, 1987).

In addition to the public school system, Vietnam still has the semi-public schools for students who did not take or pass the entrance exams for basic education level 2 (from grade 5 to grade 6), or for secondary school (from grade 9 to grade 10). The semi-public

schools include evening schools for students who work during the day and vocational schools for those who intend to obtain specialized skills.

In higher education, the Vietnamese use a system of competitive examinations to select university students. Only those students who have passed the "School Leaving Examination" are allowed to take the university entrance exam. If they pass the university entrance examination, which is administered by the individual universities, their tuition of the first semester is provided by the government. Scholarships and modest living allowances are awarded in the second semester of the first year for high performance students (A average). In an attempt to further open the university system, however, the Ministry has also decided to admit additional students on a tuition-paying basis. Thus, there are two training systems in Vietnamese universities: the "regular" and the "open" sections. But while students are kept in separate classes, they are taught the same curriculum. One of the effects of the "open door policy," then, is a greater variety in students' background, aptitude, and basic knowledge.

Before 1990, all schools of the country, except for university, had the same curriculum, created and revised by the Curriculum Revision Committee of the Ministry of Education. Each of the universities has its own curriculum for teaching and learning based on its own purposes, contexts, and culture appropriate to the goals of national education (Duiker, 1987).

The national incentive to upgrade the educational system, however, led to the development of a plan in 1990 to restructure post-secondary science education in Vietnam. A consortium of eleven universities was formed to undertake the incumbent

science curriculum development and teacher education. The broad intention of this plan was to establish a "University Credit System," which includes two phases of work for undergraduate students of science. The first phase is a "Basic Science" component which will be eventually taught in community colleges across the country. The university system of the first phase was divided into seven subject groups (Curriculum Development, Ministry of Education and Training, 1992) : Mathematics; Physics; Chemistry; Biology-Medicine-Agriculture; Economics; Humanities and Science; and Social Science. After two years of study in this basic science program, students will transfer in to university for the second phase of their education; the science specialization (fisheries, agriculture, engineering, etc.). This University Credit System will thus enable improved access to a basic science education, particularly in the remote areas of the country, and a solid foundation for further study of science in applied contexts.

While the broad purpose for this restructuring is to increase access to basic science education, and, therefore, to improve the scientific and technological literacy of the Vietnamese citizenry, there are many problems and conditions that help to shape the specific nature of the impending reform. The country has been somewhat isolated from the professional science and science education communities of the past twenty years, and textbooks and teaching methods reflecting current understandings in science are lacking. The curriculum has been focused almost exclusively on the study of theoretical and classical subjects, particularly Vietnamese literature (primarily classical and war literature) and mathematics, and, in spite of a policy emphasis to the contrary, has tended to under-emphasize practical experimentation and technical competencies for future

careers. In addition to these problems, the condition of teaching laboratories is very poor in a certain areas of the country, and this, in part, has led to a rather "rhetorical" science education, that is, one which relies heavily on rote memorization and routinization, at the expense of a "broad and deep understanding" of the subject matter which reflects the fundamental principles of science. The need to learn by memorization is exacerbated by the lack of practical, concrete laboratory activities that are relevant and motivating for students.

Under the open door policy, especially since the lifting of the United States embargo, the government is making a great attempt to rebuild the new educational system at all levels to meet the needs of a country which is developing eagerly and rapidly after several decades of war. There is a renewed spirit in Vietnam for curriculum development, and school and university curriculum revision has been undertaken at an unprecedented rate. For those unfamiliar with the historical and political context of Vietnam, it is difficult to imagine the impetus lying behind these recent developmental incentives.

Vietnam is now almost independent from external political control, and the country has arisen to voice ambitious development goals envisioning a renewed emphasis on its own national history and character, a new socio-economic structure, universal education, and broad scale welfare measures. Much of the burden for bringing such goals to reality has fallen upon the schools, and, clearly, if the schools are to carry out their charge, they must effect widespread curriculum changes (Duiker, 1987). The open door policy has been accompanied by a rhetoric that portrays a vast amount of information available to the scientific and literary world. We are told of an explosion in



information—a doubling each fifteen years or so. This rhetoric further stimulates curriculum revision.

The rapid growth of the nation's population is yet another factor related to the historical and political context of the recent educational reforms. The population of Vietnam is forecast to be 82 million by the year 2000, and there are accompanying visions of new approaches to administering schools and to teaching large groups. Team teaching, ability grouping, auto-instructional devices, educational television and teacher-aide programs are anticipated to help cope with the demands of expanding enrollments (Beresford, 1988). Such measures and innovations are included in the compulsory mandate of the government. The new curriculum itself is seen as a measure to help solve national problems such as birth control, unemployment, health care, etc. Finally, there have been warnings from Vietnamese and foreign commentators that the old theoretically-oriented curriculum is not appropriate to the current requirements and, if it were to become more overloaded with content, would actually reduce the amount of time students have to pursue their own interest and talents (Duiker, 1987).

One area of increasing knowledge which has had a special impact on the educational community concerns human learning. The newer ideas about learning and about individual differences among learners have led to new methods of teaching, such as inquiry learning, cooperative learning, role play, and many others. Not only is there a need to develop an appropriate science curriculum and program of studies that reflect the true nature of the science enterprise, the inter-relations among science, technology and society, and the historical and philosophical bases for scientific theories and

achievements; there is also a need for educational reform to fit with the shifting societal norms and expectations surrounding the role of teachers and schools. With the Vietnamese institutions of higher education currently changing from a Soviet to an American design, some of these norms and expectations have already begun to shift. The problem of fitting in with these shifting norms and expectations is extremely complex, however, and even when educators and administrators have agreed to move away from learning by rote insofar as the curriculum design is concerned, there remain reinforcing influences to rote memorization, such as the competition required for limited scholarships. Every semester only one-third of the students are admitted to scholarships, depending on their scores on entrance exams which tend to favour the recitation of information.

### **Dalat University context**

Dalat university, where this study takes place, is one of the universities which has attempted to apply the “University Credit System” since 1994. The education training program has two stages corresponding with Fall, Spring and Summer semesters. The credit system and grade point average are similar to North America Universities.

Stage I: 3 semesters for 90 credit hours

At high school in grade 10, students choose one of the following specialized programs:

Program A: mathematics, physics, and chemistry

Program B: biology, mathematics, and chemistry

Program C: mathematics, literature, and geography

Program D: mathematics, history, and foreign language

Depending on the program they finish at high school, students with a High School Diploma enter the University (after passing the entrance examination) in one of seven following programs: Mathematics, Physics, Chemistry and Biology, Business Administration, Vietnamese Studies, History, and English (Training Guide Book of Dalat University, 1995-1996). After this first stage students are granted a General University Degree. The Department of General Education at the University is responsible for administering the first stage.

It is important to note that, in an attempt to increase its operating scale, Dalat University has undertaken an increase in its enrollment from 6000 in 1994 to 8500 in 1995.

Stage II: 5 semesters for 120 credit hours

Students with excellent performance are eligible to register in courses from any of three programs in stage II directly, without taking a transferring examination. Average or low performance students must pass an exam to transfer into stage II.

The administration and organization of stage II is managed by each academic program. Students of stage II in the Department of Biology, for instance, are managed by the Department of Biology itself, not by the Department of General Education. Each department is also responsible for part-time education.

Dalat University also shares the same problems as the university system as a whole. Because of a lack of qualified instructors, as mentioned above, the auto-

instructional video-teaching method has now invaded most courses in Stage I. While Ministry's evaluations have been positive, students complain bitterly. Students attend school six days a week, and, with few textbooks available, they have to take notes completely from instructors' lectures. With the teacher-centered method students hardly have a chance to share their ideas, to acquire a deep understanding about the course, and to develop other skills such as personal communication, critical reasoning, and so forth. The University does not require students to attend class, and examinations are considered to be precise measures of students' performance. Since there are no midterm exams at Dalat University, the end of each semester brings successive final exams for many courses, which makes this time especially hard for students. Students also have no opportunity to give their feedback about the courses through course evaluations.

In addition to these problems, university classes in Dalat are characterized by racial and ability factors. Roughly 10 percent of students use the Vietnamese language (King) as a second language. These students confront many difficulties in understanding the materials presented in their courses, in communicating with others, and, often, in overcoming inferiority complexes associated with their social status. Although the government has given some special priorities of funding for members of minorities, the number of native students, who come from rural mountain villages and communities, in university has not increased since 1975 (Beresford, 1988).

### **The need for the study**

The “direct teaching” method, which is common in Vietnamese schools and universities, pays little attention to students' developing cognitive and problem-solving abilities in science, their self-confidence as learners and their skills in communication, working with others, critical thinking, and self-appraisal. Not only is there a need for different models of teaching in Vietnam, there is a need for teachers to know which models are suited for particular purposes, and which combinations of teaching models are appropriate in certain contexts.

### **Statement of the research problem**

The problem for this thesis is to develop and investigate a physiology course for second-year university students, emphasizing a repertoire of teaching models appropriate for the goals of educational and societal reform in Vietnam, as well as the current conditions surrounding education in the country. Specifically, the thesis addresses questions of how an intended curriculum is developed, what will be taught, and how it will be taught and assessed. The focused research problems are as follows:

- Do student-centered methods with whole-class and group discussions of STS content change students' attitudes toward learning science, when they have been under the strong influence of a teacher-centered tradition?
- Does the case study teaching method with cooperative learning in groups bring about a deep understanding of the course and other related subjects?

- Does discussion-based teaching help students develop their social skills?

In order to answer these research questions, on a small and limited scale, this thesis focuses on the teaching a physiology course to a class of 42 part-time students in the Department of Biology at Dalat University in Vietnam, in which various “student-centered” teaching approaches are developed and explored. Specifically, the thesis is an exploratory, qualitative study of a combination of student-centered methods, including whole-class discussion surrounding case studies in physiology.

### **Organization of the Thesis**

This is an exploratory study of “student-centered” teaching strategies for a basic science course in Dalat university. The teaching approaches emphasized relationships between physiology and scientific achievement in solving global problems, focusing on case study as a means of enabling cooperative learning in groups. Chapter One has introduced the context of education in Vietnam, the need for the study, and the statement of the research problems and questions for the study. Chapter Two reviews a literature on cooperative learning and the case study method in the teaching of science, focusing especially on biology and physiology. Chapter Three elaborates the method used in the study. Chapter Four presents the analysis of data collected from the field test in Vietnam. Chapter Five discusses the conclusions, limitations, and recommendations of the study.

## Chapter Two

### A Review of Related Literature

#### Cooperative Learning

*It is essentially the experience, the means, that fit human beings not to their external environment so much as to one another. Without the cooperation of its members society cannot survive, and the society of man has survived because the cooperativeness of its members made survival possible—it was not an advantageous individual here and there who did so, but the group. In human societies the individuals who are most likely to survive are those who are best enabled to do so by their group.*

*Ashley Montagu, 1992*

The great ideas of Ashley Montagu remind me of a Vietnamese saying: “*Mot cay lam chang nen non , ba cay chum lai thanh hon nui cao*” (One single tree cannot be a mountain but a high mountain can be conformed by three trees standing closely).

Societies are strong when people stand closely together, work in groups and help one another in every aspect of our complex life. Where, when and how can this be achieved? There is no doubt that cooperation and helping behavior must come from schools where students represent the new buds sprouting on the trees of education in an effective society.

Classroom learning through cooperative group work has its sources in philosophical, ethical, and psychological writings of the past 90 years (Sharan and Lazarowitz, 1980). First among the prominent forefathers of this educational orientation is John Dewey (1959), as cited by Sharan (1980). His thoughts on democratic processes inspired other writers who have made important contributions to the clarification and

development of the cooperative learning model, including Herbert Thelen (1963), John Michaelis (1977). All of these educationalists share important ideas that comprise the value base and intellectual underpinnings of cooperative learning.

In July 1975, the first International Conference on Cooperation in Education was held in Tel Aviv, Israel. More than forty educators from Australia, Canada, England, Israel, the Philippines, South Africa, and the United States gathered to discuss the theme of cooperation, a gathering which resulted in the establishment of the International Association for the Study of Cooperation in Education. Literature on cooperative learning has also been prevalent since the mid-seventies, including the work of David and Roger Johnson of the University of Minnesota (Johnson & Johnson 1981, 1974), Slavin (1983) of Johns Hopkins University, and Sharan (1980) of Israel. The researchers have studied how cooperative learning task and reward structures affect learning outcomes (Joyce and Weils, 1986). They state:

Important for us is the question of whether cooperation groups do in fact generate the energy that results in improved learning. The effect is largely affirmative- classrooms organized so that students work in pairs and large groups, tutor each other, and share rewards are characterized by greater mastery of material than the common individual-study. (p. 216)

It is mutual help and constructive interaction in the group that make cooperative learning effective, as well as the fact that the group collaborates on a task that invites cooperation (Webb, 1985). When carrying out a research in desegregated schools about cooperative learning in the classroom, Shlomo Sharan (1990) and others fully agreed with the observation by Slavin (1983) that:

Various elements of cooperative learning affect interracial relations primarily through the mediating variable of close interracial contact. (p. 86)



Johnson & Johnson carried out 122 studies from 1924 to 1989 to compare cooperation, competition, and individualistic learning. Their data suggests:

1. Students achieve more in cooperative learning than in competitive or individualistic interaction and the results hold for several subject areas and a range of age groups from elementary school age through adult (Johnson, 1980).
2. Students are more positive about school, subject areas and teachers or professors when they are structured to work cooperatively (Johnson & Johnson, 1975).
3. Students are more positive about each other when they learn cooperatively than when they learn alone, competitively or individualistically; regardless of differences in ability, and ethnic background, and whether they are handicapped or not (Johnson & Johnson, 1975, 1981).
4. Students are more interpersonally effective as a result of working cooperatively than when they work alone, competitively or individualistically. Students with cooperative experience are more able to take the perspective of others, are more positive about taking part in controversy, have better-developed interaction skills, and have a more positive expectation about working with others than students

from competitive or individualistic settings (Johnson & Johnson, 1975, 1978; Johnson, 1980).

### **How to teach cooperative learning**

In order to work cooperatively, students need to be guided by their teachers or professors to get collaborative skills. When working intensively with over twenty school districts and several American colleges and universities on training staff in the strategies of structuring cooperative interactions and teaching students the skills needed to work effectively with others (communication, leadership, trust building, and conflict resolution), Johnson and Johnson (1989) suggested an outline of the model of training as follows:

A. Select a lesson. Teachers should start with one lesson and build slowly as they and their students get accustomed to the "new" structure.

Cooperative learning groups have been shown to be especially effective where problem solving, conceptual learning, or divergent thinking are required.

B. Make the following decisions:

1. Select the group size most appropriate for the lesson. The optimal size of a cooperative group will vary according to resources needed to complete the assignment (the larger the group, the more resources available); the cooperative skills of the group members

(the less skillful the members, the smaller the group should be); the amount of time available (the shorter the time, the smaller the group should be); and the nature of the task.

2. Assign the students to groups. For variety of reasons, heterogeneous groupings tend to be more powerful than extreme homogeneity. A lot of power for learning in a cooperative group comes from the need for discussion, explanation, justification, and shared resolution on the material being learned.
3. Arrange the classroom. Group members need to be close together and facing each other, and the teacher as well as members of other groups need to have clear access to all groups. Within the groups, members need to be able to see the relevant materials, converse with each other easily, and exchange materials and ideas.
4. Provide the appropriate materials. Providing one answer sheet to be turned in by the group with every one's signature is one way to emphasize the positive interdependence. Another technique is to "jigsaw" the materials so that each student has part of the information needed and has a share of the responsibilities associated with their piece of the assignment (i.e., reading to group, researching and reporting back for discussion, etc.).

- C. Explain the task and cooperative goal structure to students. A clear and specific description of the task needs to be given coupled with an explanation of the group goal. The group goal communicates that the group members are in this together and need to be as concerned with other group members' understanding of the materials as they are with their own. The reward system needs to be consistent with the structure. Students will understand the group goal more easily if they are turning in a single paper that each group member is able to defend, or can receive bonus points on the basis of how well each group member does, or will be able to skip the next quiz (or get extra recess) on the basis of a group score. It is also important to establish criteria for success as a class in order to make intergroup cooperation possible and extend the cooperation across the class. It also necessary to specify the basic behaviors you expect to see in the group so that students have an "operational" definition of what cooperation is.
- D. When the groups are working, the teacher needs to monitor how well the groups are functioning; what skills are lacking, both related to the subject matter, and to the interaction; set up a way for the group to process how well they functioned and discuss how to do even better; and intervene where problems are serious to help a group work out their own problems. It is important to note that the cooperative group does not take the place of instruction, but instead translates it and

makes it useful. The teacher will still need to introduce new material and students will need to research and study so that they have something to share with their peers within the group.

During the process of carrying out the strategies listed above, teachers may wish to suggest more effective procedures for working together and more effective behaviors for students to engage in. Teachers may also wish to intervene and reinforce particularly effective and skillful behaviors that they notice (Johnson & Johnson, 1987, 1990). The following specifying desired behaviors are expected:

- Having each member explain how to get the answer
- Asking each member to relate what is being learned to previous learning
- Checking to make sure everyone in the group understands the material and agrees with the answers
- Encouraging everyone to participate
- Listening accurately to what other group members are saying
- Not changing your mind unless you are persuaded through a reasoned argument (majority rule does not promote learning)

- Criticizing ideas, not people

It is also recommended teachers not make the list of expected behaviors too long. Emphasizing one or two behaviors over a few lessons is enough. Students need to know what behavior is appropriate and desirable within a cooperative learning group, but they should not be subjected to information overload.

When the groups start working, the teacher instructs students to cooperate and lets them know they will not always be working in the same group. Much of the teacher's time in cooperative learning situations should be spent observing group members in order to see what problems they are having in completing the assignment and in working collaboratively. Johnson and Johnson (1991) suggest:

Whenever possible, teachers should use a formal observation sheet to count the number of times they observe appropriate behaviors being used by students. The more concrete the data are, the more useful they are to the teacher and to students. (p. 71)

But it is unnecessary to count too many different behaviors at one time, especially when the groups first start working together. At first teachers may want just to keep track of who talks in each group to get a participation pattern for the groups. The current list of students' behaviors includes contributing ideas, asking questions, expressing feelings, active listening, expressing support and acceptance (toward ideas), expressing warmth and liking (toward group members and group), encouraging all members to participate, summarizing and checking for understanding, relieving tension by joking, and giving direction to the group's work. These are all positive behaviors which should be praised when they are appropriately present and discussed when they are missing.

According to Johnson & Johnson (1991) and others' experiences of cooperative

learning groups, student observers can be used to get even more extensive data on each group's functioning. The observer is in the best position to learn about the skills needed for working in a group. Whether student observers are used or not, sometimes a simple checklist is helpful in addition to a systematic observation form. Johnson and Johnson (1991) suggest some typical questions to ask on the checklist summarized as follows:

1. Do students understand the task?
2. Have students accepted the positive interdependence and the individual accountability?
3. Are students working toward the criteria established for group work, and are those criteria for success appropriate?
4. Are students practicing the specified behaviors?

Students must build mutual trust in order to work together. Trust building has been considered as one of the most important skills in dealing with people at the workplace. At school, this skill develops through cooperative learning in groups.

Johnson and Johnson (1991) argue:

To disclose one's reasoning and information, one must trust the other individuals involved in the situation to listen with respect. Trust is a central dynamic of promotive interaction. Trust tends to be developed and maintained in cooperative situations and it tends to be absent and destroyed in competitive and individualistic situations. (p. 2:10)

### **Cooperative learning group method in teaching biology**

In 1984, Lazarowitz, Braid, Hertz-Lazarowitz, and Jenkins carried out cooperative learning group strategies in three schools of rural towns in California. The study involved 109 students from grade 10 to grade 12 taking a six-week biology course. The authors came to the following conclusions:

1. Cooperative learning methods that use specific group rewards based on group members' individual learning consistently increase achievement more than control methods.
2. Cooperative learning methods that use task specialization may increase student achievement more than control methods.
3. Group competition increase the instructional effectiveness of cooperative learning in some cases.
4. Equal opportunity scoring procedures may have a positive effect on student achievement.

## **Case Study**

### **History, development and significant meanings**

Case study methodology is most closely associated with the Harvard Business School. This method of teaching has been used for more than fifty years and achieved so much respect and success that it has been adopted for many other professional fields, including law, medicine, counseling, nursing, political science, and social work



(Bickerton, 1991). Recently, teaching with cases has been supported by many educators. Roland Christensen, a long time supporter and practitioner of case method teaching at Harvard, points out numerous advantages of this approach in his new edition of “Teaching and the Case Method” (Christensen, 1987):

1. The case method enables students to discover and develop their own unique framework for approaching, understanding and dealing with problems.
2. The case method supports a culture that places high value on review and innovation. When faculty must prepare teaching cases, their continuing contact with the world of practice provides a force for change.
3. The case method of teaching is economically efficient. With carefully crafted cases and trained instructors, it works well with large groups of students.
4. The pedagogy suits the mission of training students not only to know but to act.
5. Case study teaching is intellectually stimulating for the faculty.
6. It requires the faculty to explore not only what they teach but how.

Postman (1989) describes case teaching methodology as reporting an event, an

innovation or a project over a prolonged period of time by telling a tale or a story about how it has involved. Narrative, description and explanation are highly valued and utilized. Stakes (1985) agrees that case study methodology is becoming more widespread in science teaching. Selma Wassermann (1994) predicted that , in the near future, teaching with cases will be applied more frequently in schools not only for social studies but also for science instruction.

Teaching with cases uses the instructional approach described as “Play-Debrief-Replay” (Wassermann and Ivany, 1988). The whole process is often observed in classrooms in combination with teaching for thinking, teaching for understanding, active learning, cooperative learning and attitudes that encourage the empowerment of students. Some teachers use the case method explicitly. They create tasks related to curriculum and ask students to complete hands-on or “minds-on” investigative play, followed by debriefing and then replay. Some teachers use the approach implicitly, moving from play to debrief to replay in a clearly observable pattern but without using the labels (Wassermann, 1992 b). According to Herreid (1994), the instructional approach should have the labels because they present a specific scheme that is appropriate to different subjects, different instructional levels and a wide range of participants.

The “play” stage requires that students, while working in groups for at least one hour, participate actively in “mind play” with the study questions that direct each case. Students are not pressured by questions that force them to arrive at an answer but they gradually find out the "big ideas", which involve developing cases that allow for the examination of certain significant ideas and issues, and productive answers by developing

a deep thinking about the case. Big ideas are extracted from the curriculum and form the nucleus for a case (Wassermann, 1990).

In the “debrief” stage, students return to their whole class as usual and the teacher uses skillful questioning and responding strategies to work with students' ideas and help them reach for the deep meanings in the case and reason from the data. When the teacher debriefs skillfully, students are interested and motivated to know more (Raths, Wassermann, Jonas and Rothstein, 1986). This sets the scene for further study.

In the “replay” stage, students often review the supporting documents or the background reading resources, as well as films and other materials the teacher considers relevant to the continued study of the concepts being examined, to build a broad knowledge base.

The strategy of “play-debrief-replay” wants students to be responsible for their learning. They acquire information not only from teachers' lectures but from creating and gathering documentary resources and materials. When learning with cases, students choose their own study methods and direct their own interactions. The strategy also requires that the teacher creates the conditions in which all students' abilities can develop, and flourish. While working with cases, Wassermann (1992) emphasizes this instructional approach to teach cases for social and science classes, she argues:

“Play-Debrief-Replay” is seen in operation in classroom where the strands of active learning, teaching for thinking, cooperative learning, and the empowerment of students combine to form the total learning experience. (p.797)

Recently, cases have had a strong appeal for students who are turned off by traditional science courses oriented around a lecture format with a concentration on facts

and content rather than the development of higher-order thinking skills (Herreid, 1994).

Cases are most easily used in general education courses dealing with science and society although cases alone cannot solve all the problems of education. Herreid states:

Although the case method can not cure all of the ills in the teaching of science, it is nevertheless ideal for the development of higher-order reasoning skills, which every science teacher claims they strive to instill in their students. (p. 228)

### **Case study in biology with cooperative learning group strategy**

In a paper to the National Science Teachers' Association Conference, Reg Wild and Steve Cardwell, of the University of British Columbia, propose the use of case studies as an approach to teaching science. They argue that cases allow students to learn from the past experience and build on what they bring to the classroom.

Case study and related strategies can be important focus for interpreting STS (Science, Technology and Society) Curriculum and support materials. Both sides of an issue are discussed with no answer given. Cooperative group work is often important part. (Cardwell and Wild, 1992, p. 16)

They suggest that the use of case studies is strongly supported by a constructivist theory of learning.

In university level of biological science program, Hansen and Gottlieb of Modesto Junior College (1990) write in support of the use of case method in teaching biology courses as a means of implementing interdisciplinary education and developing critical thinking skills in undergraduate biology majors. They express their dissatisfaction with the traditional didactic method of lecture and regurgitation of facts. While they do not want to discard the content, they do not believe that lectures are the best way to teach biology. Instead, they recommend that:

Instructors provide a classroom environment in which students incorporate factual biological information within a context rather than a classroom in which they relate the discipline of biological science to their areas of the curriculum. The goal is that students become able to solve problems, that they engage in critical thinking, and that they apply these skills within the large framework of their educational and life experience. (Hansen & Gottlieb, 1991, p. 148)

Hansen implemented the case study method in her freshman biology class and with major students. The result, again largely anecdotal because of the newness of the process, indicated that the students felt the use of case study was successful.

According to the students, its importance was that the exercise connected biological information, biotechnology, and everyday experience. Collaborating in group work created a sense of camaraderie and community.

Case studies can be carried out not only by teachers with their narratives but also by students. According to Zeakes and Fulwiler (1989), one of the best ways to actively involve students in their education is to stimulate them through writing to learn. Samuel J. Zeakes and Toby Fulwiler of Radford University, had a class in parasitology using a writing-intensive approach with case study. They argue that writing would help lessen the drudgery of rote memorization to which students are traditionally exposed and would stimulate them to think.

Students of the class were assigned to read the chapter on trematodes from Markell, Voge and John, 1986, as cited by Zeakes (1989). The chapter material was presented and discussed in class using a lecture-discussion format in groups. Students were exposed to the subject material for the case study via lecture, laboratory and reading assignment. A five minute, in class writing exercise generated a complete case study. The students were asked to originate a case study dealing with a parasite they had studied.

They were to present their written case study and then evaluated others' case studies (the writer that received a highest mark from other students was a 20 year old Vietnamese-American). Students seemed to enjoy doing the case studies on their own and the analysis of their performance on an examination indicated that their understanding and retention of the concepts were excellent. Based on the achievement Zeakes states:

Modifications of the case study approach could be adapted to almost any class, no matter what the size or discipline. For example, the case study approach would be valuable in classes in the health sciences such as nursing, medicine, dentistry, veterinary medicine, and medical technology. Adaptations of the case study format could be used in psychology courses, law courses, history courses, social courses, and science courses. The possible applications, with some creative modifications, are unlimited. (p. 34)

Since 1990, case studies have been used at the State University of New York at Buffalo to teach a large number of biology courses in both laboratories and lecture. Herreid (1994) draws several conclusions from these experiences: the case method involves learning by doing, the development of analytical and decision-making skills, the internalization of learning, learning how to grapple with messy real-life problems, the development of skills in oral communication, and often team work.

In some cases, facts given by teachers also can be cases for students working together with discussion and reasoning (Zeakes, 1989). A question like "Why is amylase enzyme is necessary for digestive functions of mammalian animals?" could be used for teaching with case study (Yayer & Tweed, 1990).

### **Critics of the case study method**

There is a bias toward collected literature of only positive results. The case study

method literature certainly suggested that the method had its critics. However, this review has only been successful in finding one published criticism of the case study method. This was not separately published but was a part of a work on a broader topic (Drucker, 1954). Drucker argues that identifying opportunities is more important than designing solutions to these positive and negative situations. The author also questions whether it would be possible to prepare cases of sufficient quality so that the problem identifying would be developed. Drucker suggested that the student should first learn analytical processing procedures in initial coverage at the comprehensive level. The student should then learn to better supply these procedures with the case study method. The students should not attempt to induce analytical processing procedures on their own. Decisionmaking should therefore be based upon the specifically recommended analytical procedures and not included procedures. This criticism, however, concerns only one version of the case study method and not all versions.

Thus, regardless of its critics and praise, no matter whether case studies are written by teachers, or students or given as facts, this approach can be applied in teaching science, and particularly biology, combining with cooperative learning group methods. Joyce and Weil (1986) advise that teachers develop a repertoire of models. They argue:

The teacher should view these models of teaching as ways of accomplishing a wide variety of purposes. Since no single teaching strategy can accomplish every purpose, the wise teacher will master a sufficient repertoire of strategies to deal with specific kind of learning problems he or she faces...The teacher's repertoire of models is particularly important if he or she is responsible for teaching many children in several curriculum areas. But even the subject-matter specialist, whose responsibilities may be confined to teaching a single discipline to fairly mature students, faces teaching tasks for which no single model can be completely adequate.(p. 20)

In order to develop a repertoire of teaching models, teachers must be flexible in deciding which models are appropriate to various cultures, styles of learning, different kinds of subject-matter, and administrative/societal expectations of the school. On this point, Joyce and Weil (1986) argue:

To develop a repertoire means to develop flexibility. Part of this flexibility is professional. Every teacher faces a wide range of problems, and if he or she has an equally wide range of teaching models from which to draw, he or she can generate more imaginative solutions to the problems. On the personal side, having a repertoire requires the ability to grow and expand one's potential, and the capacity to teach oneself more varied and interesting ways of coping with one's own need to develop. The environment for personal growth is greatly enhanced when people can define their present situations and see the alternatives. The growing, developing teacher can embrace more forms of experience, explore more aspects of his or her students and find more ways of helping them grow. (p. 21)

From these arguments it can be seen that any curriculum development work ought to be accompanied by inquiry into teaching strategies appropriate for the purposes and goals of the reform. In the case of the development of a basic science program for the first- and second-year undergraduate programs in Vietnamese universities, the teaching strategies proposed are applied with the intention of developing students' cognitive and decision-making abilities in science as well as their social skills in working cooperatively together.



## **Chapter Three**

### **Research Methods**

#### **Description of the study**

The ideas for this project emerged during my first three semesters at Simon Fraser University. I am one of a cohort of Vietnamese students who came to Vancouver in 1993 to do a M.Sc in science education at Simon Fraser University. This was the first time I had gone abroad and I found the atmosphere at a Canadian university different from my home university in Vietnam in many ways. I was not used to the informal atmosphere of tutorial groups, or to professors who welcomed students' questions, or to students who were willing to share their ideas with a great deal of self-confidence. In my first classes in Canada, I was quite shocked. In Vietnamese universities students have to "sit properly" without hats or caps, and are not allowed to eat, drink or chew gum in class. When an instructor enters to the classroom students stand up automatically to greet their teacher and when the class finishes students again stand up to say goodbye to him or her (teachers have been respected just second to the King). Everything is quite different in Canada. Students go to their classroom with a sandwich, a cup of coffee, or softdrink. When they ask their professors questions, they do not need to stand up, and they can ask questions at any time. Professors answer questions in a way that seems to encourage the students to propose more questions; at my home university, students are sometimes too shy to ask questions to their instructors. Canadian students express freedom, self-confidence and self-esteem in their classes. After immersing myself in Canadian social life for a short time, I began to feel that our students at home suffer a lot from our

confucian culture. They lack social skills, which are neglected in our curriculum . And we educators lack concern about students' developing social skills before leaving school. I remember when I was at home, I often used oral examinations to evaluate students in my physiology courses. Although students could do the exams well they still lacked confidence in speaking. I asked myself the question: How could Vietnamese students develop their social skills when taking science courses? .

In Canada I had to use computers to do assignments although I had never touched a computer until a few weeks before coming to Canada. I learned to use computers and gain other skills through the help of my colleagues and professors, and I still feel indebted to them. It reminded me that Vietnamese students lack a close relationship with their peers in learning activities at school because of the “traditional” curriculum. I asked myself whether we educators could do something to improve the situations. How could we do it?

In my Canadian university classes, I was impressed that most professors had the patience to listen, to appreciate their students' opinions in discussions. We students never felt hurt in school here. At home, my teacher often scolded me when I had a wrong answer although I respected him very much. I have asked myself why there was a conflict in my feeling about what I have seen here and what I had experienced at home. I asked myself : How could we build a good relationship between teachers and students appropriate to our cultures and customs?

In my Canadian courses I have developed my self-confidence, trust-building and reasoning skills gradually through the class learning activities, while at the same time gaining a deeper understanding of the course content.

In contrast, Vietnamese students are indirectly set in an inactive mode of learning, taking notes in class lectures, going home or to the library to memorize as much as possible, and forgetting the course immediately after finishing their final examinations. It is really hard for them to have a chance to get a deep understanding of science without reading materials, discussions or opportunities to share their ideas with others. So my fourth question was : How can Vietnamese students get a deep understanding of science? Could they learn from one another? Do they want to work together in a competitive environment?

## **The preparation**

### **Survey questionnaire**

Based on the related literature on social context in Vietnam, especially in Dalat University, I began my research with the three following expectations:

1. I believed that Vietnamese students accepted the curriculum as it is taught now, and were willing to take an inactive role at school. I felt that they would only be concerned about getting the credits required to be able to leave for work.
2. In a competitive environment, if students lose their scholarship they have to pay high tuition fees, but if they win, they pay no tuition fees and get a modest living allowance as well. Competition for scholarships is a big challenge for average and

low performance students. I felt that high performance students might not want to work with others, especially with lower performance students because they might see it as a waste of time and energy. Lower performance students with inferiority complexes might want to defend themselves and not bother their peers.

3. Vietnamese students do not have many opportunities to develop social skills at school. In a time of rapid development, young people particularly need social skills to communicate with others. However, I expected that students who took science courses might consider skills like trust building, oral communication, self-confidence, and self-esteem unnecessary for science-oriented work .

In order to check the expectations, I prepared a questionnaire including ten statements focused on the three main themes listed above (Appendix A). I planned to apply the “student-centered” methods with whole-class discussions, case study and cooperative learning in groups in hope of bringing about a change in my students.

### **Case study**

I was looking for a case which would incorporate ideas from the first three sections of my physiology course (blood , cardiorespiratory system, and gastrointestinal system) in the physiology textbooks or science magazines. Finally I found a very interesting case written by Nuland (1995). I translated the case into Vietnamese language and wrote the publisher for permission to use it as a part of my lecture. The case entitled “The beast in the belly” or “the Pig-Bel” (Appendix C), involved bacterial infectious disease that causes the human body to collapse from unbalanced homeostasis, heart and

blood vessel failure, respiratory failure, intestinal gangrene, and mental disorders, resulting in high mortality rate in affected countries like New Guinea, Cambodia, China.

According to Selma Wassermann (1994), we teachers do not have to write our own cases. Wassermann states:

Not every teacher will want to consider writing his or her own cases. Teachers have other things to do with their time, and good teachers hardly find adequate time to do everything they want to do in the first place. There are lots of good cases already available for teachers to choose from. Why should teachers consider writing their own cases? (p. 39)

I chose the “Pig-Bel” because it combined the major topics which I wanted to cover in the physiology course. This case could arouse students’ curiosity to research other fields such as microbiology, and biochemistry. Regarding criteria for choosing a case, Wassermann (1994) suggests:

A single case will not, in the best of circumstances, deal with all the topics to be studied in the course. It doesn’t need to. The case needs to touch on at least one topic, leaving the door open for further study through reading (texts, articles, stories), films, speakers, and other information -rich resources, as well as other cases. (p. 27)

### **The physiology course**

I went back home to work at Dalat University on September 5, 1995 after two years of study in Canada. At my university, I obtained permission to teach a part-time class in physiology using cases. The course was based mainly on the “Textbook of Human Physiology”, by Guyton (1977), translated into Vietnamese by Gi Trong (1978), and partly on the “Human Body in Health & Disease”, by Wood (1983) and the “Physiology”, by Berne and Levy (1988). I made 45 copies of each chapter, one for each

of the 42 students, one for one my colleagues, one for the Head of Department of Education and the last for myself.

### **Application of the study**

#### **Background survey with consent form**

The survey was carried out with 92 students from three different populations: 38 students from the second year part-time class, 28 students from the third year full-time class, and 26 students from the fourth year full-time class. Preliminary to the main survey I did a background survey to ascertain how the three populations differed. This included a consent form in which students' willingness to participate in the research was clearly indicated (Appendix E).

I was planning to do the survey with the second, the third, and the fourth year-students because I wanted the survey to be completed by students who already experienced biology courses and student life. Besides, I considered the survey result as one of my significant data to confirm the possibility of the generalization of my study to both full-time and part-time classes.

#### **Feedback from the pilot study**

I piloted the survey with 6 students from each class and after making changes based on their feedback, I finished the background survey with consent form on September 22. It was encouraging that there were 100 % of students attending the three classes were willing to participate in the survey and 8 % of them were willing to be

interviewed. (As is usual at Dalat University, about two-thirds of total students attended class).

### **Doing the survey**

The survey was carried out on September 26, 27, and 28 respectively for the fourth, the third, and the second year classes. I used Minitab statistical software to organize the data. On the worksheets, there appeared to be very little difference in the results from the three populations.

Here are the main themes which emerged:

- The students wanted biology courses to be taught with STS (Science-Technology- Society) information, with “student-centered” methods through class and group discussions.
- The students liked to learn from their peers, to work together. They agreed that the higher performance students should help the lower performance ones.
- The students considered social skills very important for their future achievement in the workplace and they agreed that the biology curriculum should have learning activities that help them develop these skills.

Encouraging by students’ positive attitudes indicated in the survey, I started to prepare for my teaching which would form the main part of my research.

### **Teaching with “student-centered” methods**

The physiology course started on September 29. For the first lesson about 34 students attended the lecture. The class leader told me that day was special; usually only 29 to 32 students attended lectures. The regular lecturer Lam Ngoc Tuan was there to watch me teach the course. I sketched out my plan to work with the three sections only; lecturer Tuan would continue teaching the course afterwards. The plan was as follows:

- I randomly assigned four heterogeneous groups, regardless of experience, age, and ability. I guided them to work cooperatively for the case study.
- I would introduce the meanings of every section, its significant relationship with other fields, books available in university library, and a schedule for the course: three morning classes a week (Tuesday, Thursday, and Saturday) from 7:30 am to 10:45 am.

We had seven classes as scheduled:

September 29: Introducing the schedule, the history of physiology.

October 3 : Blood. Its functions and immunity mechanism.

October 5: Circulation. Heart and blood vessels.

October 7: Respiration. Lungs and gas exchange.

October 10: Ingestion. Functional mechanisms of digestive tracts and digestive glands.

October 12: Case study discussion and course evaluation.

October 14: Self-evaluation and midterm examination.



- I would provide lecture handouts of each section for each student with questions suggested.
- I would give lectures by providing information on the general mechanism of each physiological system and asking students to answer the questions or discuss any problems related to the course.
- I would supply the case study with questions and materials on October 7 for the preparation of group discussion.
- I would organize small group discussions about the case “Pig-Bel” for the “play” stage and whole-class discussion for the “debrief” stage and the “replay” stage (stages in the process of working with cases).
- I would organize a midterm examination with ten questions. Two-thirds of the mark would be based on the course content and the other third of the mark would be based on the content of class and group discussions.

The first class took more than one hour to schedule the course work. Students seemed to be excited and happy because they did not have to take lecture notes, nor did they have to pay for photocopy costs as in other courses. After a short break I commenced my new teaching strategy. I introduced the meanings of the history of physiology as related to other sciences. Suddenly I asked one female student sitting near to me.

“If you were a scientist of the sixteenth century, which systems of human body would you like to study first? Why?”

After a little hesitation she answered, “ If I were a scientist of that time I would like to study the gastrointestinal system and nutrition because we need food to survive, without food a person would soon die. We need to eat”.

There was a big laugh because during the war food was a big concern for everybody, and it still seems to be a keen concern in many remote areas around the country. The class seemed to be excited, some students discussing something related to my question. I asked the same question to a male student sitting in the middle of the class.

“If I were a scientist of that time I would have chosen the circulation, heart and blood vessels, because the heart is the most important organ of our body. If our heart stops working or our blood vessels are broken, we certainly die.”

“ Can I put forward an idea? One male student in the left corner asked me to allow him to speak.

“Of course. Please. ” I encouraged him.

“ I think if I were a researcher of the sixteenth century, I would have started with the respiration system. I understand that every organ of our body is very important especially the heart and blood vessels. We could not work well if we had no meals, but we could stay alive for a month without food, with water intake. And it is very hard to ask our hearts to stop working, and in a case where we bled gradually we could survive. If we stop breathing for a few minutes we die immediately.”

“I heard that a person would die immediately if she or he were hit right here,” added another male student, pointing to the back of his neck. “We have a respiratory control center here and we would die if this were severely injured.”

“What do you all think about this matter?” I asked.

There were no answers.

“ Who agrees with the idea that we would have started to study respiratory system first? Please raise your hand to show your approval.” I proposed.

About 80% (27 students) of the class approved the statement. I asked students to read the handout carefully about the history of this period. It was clear that in the sixteenth century the scientist Michel Servet began his study with respiratory system and William Harvey, before studying the circulatory system, also began his study with this system first.

When we had a second break, I passed by a group of male and female students standing by the front door in the hall, I heard one of the male students speaking:

“Oh my God! I got terrified when she called my name. I am sure we all won't dare to attend this course the day after tomorrow. We will all stay at home!” They laughed. They were not aware of my presence.

We continued our discussion and finished the class at 10:45. Three male students approached me with smiles. One of them spoke first.

“ Teacher, we really like this style of teaching and learning. Through discussion we could learn many things not only the course knowledge itself but also ways to reason, and think.”

“Yeah. This is the first time I have experienced this method. I think we students become more active and work independently with this process”, the second student added.

“Yes. This approach makes us work harder but we understand better. We can speak freely. I think with this method of teaching and learning we should take a multiple choice examination”. This student was the class leader and he wanted to consult with me about an appropriate type of exam.

“Thank you for your recommendation” I answered him. “I think in order to develop your writing skills for this style of learning that besides reading and talking, we should have a written exam. OK. We will think more about this matter. Thank you so much for your participation and encouragement.”

From the starting point that day I felt happy and easy in hope that the new approach could be applied smoothly.

On October 3, I went to my class with a curious feeling, students might stay at home as they “declared” in the hallway. On the contrary, I found the class more crowded than the previous one. I told them about what I had been thinking and they burst into cheerful laughter. We went on to discuss the blood system with the suggested questions related to blood plasma and blood cells, their numbers, functions, genetic technology with hemoglobin, immunity, blood donation and transfusion, and AIDS. Students seemed to be getting used to discussion which entailed a great deal of participation.

On October 5, I was planning to invite Tan, Lien (fellow CIDA-sponsored scholars) and the Head of Department of Education of Dalat University to attend my class as camera operators and observers respectively. Unfortunately the students had a

biochemical exam in the afternoon so they stayed at home to prepare it without informing to me ahead of time, only three female students showed up. I was embarrassed and sorry for this accidental delay. We planned to have a double lecture for the whole day on Saturday to compensate for the missing class that Thursday.

On October 7, the Head of Department of Education, Tan and Lien attended my class as planned. We worked with chapter II: "Heart and Blood Vessels". The students were not distracted by the camera or observers but they were a little inactive and quiet. I asked two students about their general view of heart and blood vessels. Their answers were uncertain. A male student confided the "trouble" to me with a sad voice:

" Please forgive us because we just finished an exam and half the class failed to complete the questions. We felt sad and exhausted so we could not prepare for your course properly. We are sorry about that".

I changed my strategy and reviewed the general structures and functions of heart and blood vessels during class discussion. I also told them the story of the artificial earth designed by American scientists. (By the year 2000 the scientists hope that they could be able to create an artificial earth and free it into the universe without earth's gravity. The artificial earth, could, in theory, help human beings live longer because we would not have to move vertically but horizontally, free of gravity, and our hearts would not have to work as hard as usual to pump blood). The students became active again and we spoke of many things outside the questions but still related to the course. I got useful feedback from the two observers which I tried to apply immediately, for example, giving students

enough time to think before answering the questions or waiting for students to speak voluntarily instead of directing questions to individuals.

In the afternoon we worked with chapter III: "Lungs and Air Exchange". We concentrated on the organization and mechanics of the respiratory system, pulmonary circulation, gas exchange and gas transport, control of respiration, and especially the environmental and developmental aspects of respiration. Although we tried to keep pace with the schedule we felt comfortable with class discussions as usual.

On October 10, class discussion went smoothly with chapter 4: "The Digestive System". We talked about the structures of gastrointestinal system and gastrointestinal motility, about gastrointestinal secretions, about digestion and absorption, all in a connection with health and diseases.

Students were asked to prepare the case study for the next class. They seemed to be excited to work in groups to change the atmosphere of class discussion.

### **Teaching with case study: The "Pig-Bel"**

#### **"Play" stage**

On October 12, we worked with the case "Pig-Bel" through group discussion as the "play" stage of the case study. We had two rooms for four groups with 33 students attending. Each group had a group leader and a secretary for group management, to write down students' discussion and their attitudes respectively. The students had gotten used to talking in the whole-class discussion and they worked very well in small groups for more than one and a half hours with the "big ideas" proposed as suggested questions

(Appendix D). We concentrated on the mechanisms of homeostasis, acid-base balance, on body immunity with the functions of white blood cells, on blood glucose with blood pressure and kidney function, and on structures and functions of gastrointestinal system.

At 9:00 am we took a break in order to move to the “debrief” stage.

### **“Debrief” stage**

It took one hour for the “debrief stage”. In the “debrief stage” we worked in very relaxed conditions; students were eating some sweets, cookies and even smoking cigarettes (mostly male students). Each group had to present students’ discussion results and I was responsible for writing down their ideas to make the connection among the four groups’ work. Students did their job very well, and their individual accountability and collaborative spirit showed very strongly.

We had a video camera and tape recorders but unfortunately that day we had no electricity and my video battery would not last longer than an hour. My brother , who was an “instant video operator”, had to run to somewhere to recharge it. As a result, the video tape recording was sometimes interrupted, but the audio tape recorders worked very well with all the groups.

### **“Replay” stage**

After finishing the “debrief” stage we had about 20 minutes for the “replay” stage. We talked more about the role of trypsin, the toxin of parasite roundworm *Ascaris lumbricoides*, about interitis necroticans in Vietnam. Then I reconfirmed students’ discussion results by providing them the information of “the Pig Bel” which I collected

from the "Microbiology" by Prescott, Harley, and Klein (1990), the "Infectious Disease" by Farrar, Wood, Innes, and Tubbs (1992), and the "Nutrition in Health and Disease" by Anderson (1982), stating that "the Pig-Bel" was the enteritis necroticans, that it was *Clostridium perfringens* and its fatal effect on human health as follows:

"*Clostridium perfringens* type A is a very common cause of food poisoning, and *Clostridium perfringens* type C causes a much more serious necrotizing enteritis in various parts of the world. *C. perfringens* food poisoning is due to a heat-labile enterotoxin released during germination of spores in the food or in the gastrointestinal tract after ingestion. The clinical picture consists of diarrhea and abdominal scamps, usually without fever or vomiting. Outbreaks usually follow ingestion of meats or gravies. the classic vehicle is meat pie with a crust: the vegetative cells but not the spores are killed during cooking; the crust maintains anaerobic conditions while the spores germinate; and the bacteria release toxin as the pie cools. Necrotizing enteritis is almost associated with invasion of the bowel wall by the *Clostridium perfringens* type C and maybe due to the action of  $\beta$ -toxin, which is a potent lecithin's that causes cell lysis. Sporadic cases are seen around the world, in adults and especially in children. Epidemics have been described in Northern Germany (in Darmbrand) in the mid-1940s, and in the Highlands of New Guinea during ritual orgiastic feasting on inadequately cooked pork (Pig-Bel). The illness begins suddenly with severe abdominal pain, vomiting, bloody diarrhea, and shock. Pathological findings include patchy necrotizing lesions, which may progress rapidly to segmental gangrene with gas in mucosa, mesentery, or regional lymph nodes. Gas may be seen radiographically in the wall of small bowel. Treatment includes



supportive care with replacement of food and electrolytes losses and decompression of the bowel. Penicillin G should be used intravenously in large doses and *C. perfringens* type C antiserum containing  $\beta$ -antitoxin should be administered if available. Complications of paralytic ileus, strangulation and perforation of the bowel may necessitate abdominal exploration and resection of involved segments of the intestine.”

The students seemed to be highly satisfied with their group work.

### **Course evaluation**

At 10:30 am we moved to course evaluation work. I explained why we needed to get feedback from the students to improve the teaching of the course. I emphasized that there was no need to sign their name anywhere in the course evaluation sheet. It seemed that they did not feel intimidated and were willing to write down their thinking about the course work done over the course more than two weeks. The content of the course evaluation sheet was very similar to that of some North America Universities (Appendix F). It included two parts: one was the good point and drawback of the course content, the other was the good point and drawback of instructor’s method of teaching. Finally students chose the suggested statement evaluated the course and instructor based on 3 levels: bad, good, and very good.

### **Self-evaluation and midterm examination**

On October 14, the midterm examination took place at the usual time, 7:30 am. Before taking the exam, each student received a self-evaluation sheet to grade himself or herself on the three sections of this physiology course. At first, they hesitated, perhaps

they afraid of giving themselves too high mark. I emphasized the advantage they would get from a precise self-evaluation. The self-evaluation content consisted of two main parts with six levels from 0 to 5 (0,1, 2, 3, 4, 5) considered as marks (Appendix G). Depending on their self-evaluation, each student's total mark can be a maximum of 50 or a minimum of 0.

It took 15 minutes to finish this work and we started the exam at 8:00. It was a 150 minute written exam with 10 questions (Appendix H) in which two-thirds of the questions referred to lectures and one-third to class and group discussions. The exam would count for 40 % of the total course mark.

### **Data collection and analysis**

#### **The survey**

Data analysis of the survey used as a combination of qualitative and quantitative methods. Firestone (1987) argues:

When focused on the same issue, qualitative and quantitative methods of analyzing can triangulate, that is, use different methods to assess the robustness or stability of the findings. (p. 20)

In order to compare the result of the three populations (two full-time and one part-time classes) descriptive statistics were employed with “ One Way Analysis of Variance” (ANOVA). ANOVA is often used to ascertain the differences among three or more groups (Huck, Cormier, and Bounds, 1974).

The rough data with a 3 scaled choice was coded as a number for positive, neutral and negative choices. Each population would get ten averaged marks from the ten

statements. As a result, these three populations got their independently averaged marks from the ten statements. The statistically significant differences of the averaged marks among the three populations would be determined by ANOVA.

For example:

Statement 1 : Science courses should be taught with STS content.

Agree    Disagree    No opinion

3 marks for “agree”

2 marks for “disagree”

1 mark for “no opinion”

Responding to the above statement, population one (the third year full-time class) got 24 agrees, 3 disagrees and 1 no opinion. The population’s averaged mark for this statement was 2.821

### **Observation**

Observations are a primary source of data in doing qualitative research.

“Observation is a research tool when it (1) serves a formulated research purpose, (2) is planned deliberately, (3) is recorded systematically, and (4) is subjected to checks and controls on validity and reliability” (Kidder, 1981, p. 264, as cited by Merriam, 1988).

There have been several reasons why investigators want to gather data through observation. Merriam (1988) argues:

As an outsider an observer will notice things that have become routine to the participants themselves, things which may lead to understanding the context.

The participant observer gets to see things firsthand and to use his or her own knowledge and expertise in interpreting what is observed, rather than relying upon once-removed accounts from interviewers. ( p. 88)

Some parts of the checklist of elements likely to be present in my observations, which are used by “several writers (Selltiz, Jahoda, Deutsch, and Cook, 1959; Goetz and Lecompte, 1984; Patton, 1980; Taylor and Bogdan 1984, as cited by Merriam), were used to gather data as follows:

The setting: The physical environment of the class, the context, kinds of behaviour which vary depending on circumstantial attributes; encouragement and discouragement, examination stress, etc.

Activities and interactions: Students’ interaction with the class and group discussions and how they interrelated to the learning activities.

Frequency and duration: Frequency and duration of student responses in discussions, conflict and conflict management. The occasions that gave rise to the responses.

Subtle factors: Informal conversations among students themselves during the class break, nonverbal communication such as the sense of a relaxed atmosphere, and gestures such as nodding, smiling, laughing, yawning, etc.

### **Whole-class discussion**

The whole-class discussion process of each section of the course included preparing for the discussion, beginning it, encouraging participation, and bringing the discussions to a close as guided by Gastel (1991). According to Gastel, the thought of discussions in science courses conjures up the inactive images of classroom, she argues:

By engaging students in using material that they have encountered in lecture and independent study, discussions can aid them in retaining it and learning to apply it. Discussions are well suited to helping students

develop skill in reasoning, problem solving, and critical thinking, as well as in communication. They give students close contact with instructors who can serve as role models. In addition, they can give instructors useful feedback on what students are (and are not) learning and thus aid in improving teaching. (p. 61)

Whole-class discussion played a crucial part of my study, giving students chances to participate in learning with the new approach prior to working with cases.

Transcriptions from class observations, with video support, looked for student participation in whole class discussions. The descriptive analysis of the data is based on three main themes identified as follows:

- Memorization-dominated discussion
- Conflict and conflict management
- Male-dominated discussion

#### **Case study discussion**

Based on the transcriptions of the “play”, “debrief”, and “replay” stages, recorded by the group secretaries assigned as group observers, the data is analysed with regard to four main themes as follows:

- Female-dominated discussion
- Seeking information from other materials
- Reasoning skill and deep understanding
- Individual accountability

### **Self-evaluation and midterm examination result**

Perhaps the most fundamental condition of creativity is that the source or locus of evaluative judgment is internal. The value of his product is, for the creative person, established not by the praise or criticism of others, but by himself. (Roger, 1961, p. 354)

One of the more profound changes being supported for students in classrooms of the 1990s is the shift of locus of control over student evaluation from being totally in the teacher's domain, into that of the students (Wassermann, 1994). Self-evaluation is a tilt in the direction of partnership, in which teacher evaluates students, and students evaluate themselves, and the results are examined and compared in a collaborative effort at helping the students to take the next step in their learning. Also, sometime teachers evaluate themselves, and students evaluate teachers each other. The relationship between self-evaluation and examination results reflects the students' skills of self-appraisal and self-confidence and their achievement through these approaches to teaching and learning. The data is analyzed descriptively for future application as well.

### **Course evaluation**

Feedback from the course evaluation is considered as crucial data to evaluate the success of the teaching experiment in this thesis work.

### **Interview**

Interviews have commonly been used as a means of gathering qualitative data. In order to elicit information from another person, a person-to-person encounter is the most

common form of interview used, and “group or panel formats can also be used to obtain data” (Merriam, 1988, p. 71).

This interview was carried out mainly based on four kinds of questions that “can be used to get different types of information from respondents” (Patton, 1980, as cited by Merriam, 1988) as follows:

- *Experience/ behavior questions*, related to the students’ past and present experience with different approaches and their behaviour toward those activities.
- *Opinion / value questions*, concerned with the students’ ideas about specific matters concerning improvements to the course itself and teaching methods.
- *Feeling questions*, aimed at understanding the emotional response of the students to their experience and thoughts about the approaches.
- *Knowledge questions*, explored what students consider to be factual information regarding the research topic.

The transcription of the group interview was also analysed with regard to several main themes as Bogdan and Biken, 1982, (as cited by Merriam, 1988, p. 77), suggest.

The main themes that were coded include:

- Students’ impression of the approaches
- Social skill focus
- Deep understanding of the course

- Strong competitive spirit
- Teacher-student relationship
- Suggestions for improvement in the content of physiology course.

### **Internal validity**

The data collected in qualitative research is open to interpretation. The aim is “not to find the ‘correct’ or ‘true’ interpretation of the fact, but rather to eliminate erroneous conclusions so that one is left with the best possible, the most compelling, interpretation” (Bromley, 1986, p. 38, as cited by Merriam, p. 167). The truth, in terms of reality itself, can never be grasped (Merriam, 1988). In a sense for researcher “what seems to be true is more important than what is true” (Walker, 1980, as cited by Merriam, p. 167)

Another difficulty associated with internal validity and qualitative research is one of the basic assumptions operating within the research framework; namely, that “reality is holistic, multi-dimensional and ever changing; it is not a single, fixed, objective phenomenon waiting to be discovered, observed, and measured” (Merriam, 1988, p. 167). In real terms this means that qualitative data gathered on one day may be different from data gathered from the same person on another day given the contextual and circumstantial events surrounding the collection of data. Data collected from class discussions, group discussions, and especially group interviews was affected by the contextual and circumstantial elements that surely influence its internal validity.



Fortunately, triangulation has been recommended as a strategy to promote internal validity. Using triangulation, data from observations are accompanied by course evaluations, self-evaluations, midterm examination, and interviews so that data to be synthesized and analyzed to avoid excessive researcher's bias and other problems as mentioned. The study, however, could not strengthen the internal validity by using member checks and repeated observations due to time constraints.

### **Reliability**

To what extent can the findings of the study be replicated? According to Merriam (1988), reliability has been problematic because human behaviour is never static. But “without reliability no scientific progress can be made toward the accumulation of knowledge about relative stable causal laws” (Bednarz, 1985, as cited by Merriam, p. 170). Fortunately, qualitative research is not based on the isolation of laws of human behaviour. Merriam (1988) argues:

Rather, it seeks to describe and explain the world as those in the world interpret it. Since there are many interpretations of what is happening, there is no benchmark by which one can take repeated measures and establish reliability. (p. 171)

In fact, reliability and validity are closely connected in the conduct of research:

“Since it is impossible to have internal validity without reliability, a demonstration of internal validity amounts to a simultaneous demonstration of reliability” (Guba and Lincoln, 1981, as cited by Merriam, p. 171). Furthermore,

the reliability of a study can be assessed through various techniques of analysis and triangulation (Merriam, 1988).

Strategies used in the study to promote reliability include the investigator's position: a statement of the researcher's position vis-a-vis the whole class and the group interview, and the description of social context of this study. Triangulation and an "audit trail" (Merriam, 1988) showing how the data has been collected and analyzed, have both been used to promote reliability.

### **External validity**

Generally speaking, external validity has been concerned with the extent to which the researchers for some time. In order to reach the requirements of external validity, a thick description "so that anyone else interested in transferability has a base of information appropriate to the judgment" (Lincoln and Guba, 1985, as cited by Merriam, 1988, p. 173), is employed throughout the data analysis process. The data analyzed also emphasizes on some phenomena that appeared in class and group observations to provide comparisons available for users'; they "can make comparison with their own situations" (Goetz and LeCompt, 1984, as cited by Merriam, 1988, p. 177).

## **Chapter Four**

### **Findings of the Study**

#### **Background survey**

The survey dealt with three populations: one second year part-time class, one third year full-time class, and one fourth year full-time class. The three populations differed in age, knowledge, family location, educational background, and future ambitions:

##### **The second year part-time class:**

Total number: 42

Participation number: 38 (24 males and 14 females).

Average age: 33 years old

Social status: full-time workers.

Place of work : 78.95 % from outside Lam Dong province, 21.05% from within Lam Dong province.

Ambition after graduation: 39.47 % returning to current jobs, 31.57 % upgrading experience, 23.6 % doing research, 5.6 % taking graduate courses.

##### **The third year full-time class:**

Total number: 43

Participation number: 28 (13 males and 15 females)

Average age: 21 years old

Social status: full-time students, with 71.42 % from outside Lam Dong province, 28.57 % from within Lam Dong province.

Ambition after graduation: 25% going to work, 35.71 % taking graduate courses, 35.71% doing research.

**The fourth year full-time class:**

Total number: 38

Participation number: 26 (11 males 15 females).

Average age: 22.66 years old

Social status: full-time students with 61.54 % from outside Lam Dong province and 38.46% from within Lam Dong province.

Ambition after graduation: 57.69 % going to work, 34.61 % doing research, 7.69 % taking graduate courses.

The total number of three populations participating in survey was 92 students. Although they differed as listed above, their opinions toward school were fairly consistent.

### Survey

The survey included ten statements. The first two statements focused on the content of biology courses which should be taught. Statement four, five, and six concentrated on the teaching methods in biology courses. The last four statements related to cooperative learning and social skill development.

**Statement One:** *Regardless of the basic training program of Dalat University, the contents of biology courses should not be concrete and pure science.*

TABLE 1. AGREEMENT PERCENTAGE OF STATEMENT ONE

Class #	Agree (%)	Disagree (%)	No opinion (%)
Second year	71.05	15.79	13.16
Third year	85.71	10.71	3.58
Fourth year	73.08	11.53	15.39

This was very different from my first expectation. The students seemed to be active and had a keen concern about what biology courses should be taught at school (Table 1).

**Statement Two:** *Biology courses' contents should consist of STS (Science-Technology-Society) information.*

TABLE 2. AGREEMENT PERCENTAGE OF STATEMENT TWO

Class #	Agree (%)	Disagree (%)	No opinion (%)
Second year	100.00	0.00	0.00
Third year	96.43	0.00	3.57
Fourth year	97.15	0.00	2.85

The data appeared that the more experienced and older the students were, the greater were their concerns about the statement (Table 2).

**Statement Three:** *Biology courses instructed with a combination of theory and real-life applications by using student-centered methods stimulate students to develop positive attitudes toward learning science.*

TABLE 3. AGREEMENT PERCENTAGE OF STATEMENT THREE

Class #	Agree (%)	Disagree (%)	No opinion (%)
Second year	100.00	0.00	0.00
Third year	92.86	0.00	7.14
Fourth year	100.00	0.00	0.00

All of the second year part-time students who had work experiences and all of the fourth year full-time students who were going to finish university courses soon

completely supported the idea that biology content should be instructed with a combination of theory and reality. So did the third year full-time students (Table 3).

This data indicates that the more experienced and older students tended to feel more strongly in favour of the statement.

**Statement Four:** *Class and group discussions of the course through case study with STS content can help students develop deep understanding of science and social skills.*

**TABLE 4. AGREEMENT PERCENTAGE OF STATEMENT FOUR**

Class #	Agree (%)	Disagree (%)	No opinion (%)
Second year	100.00	0.00	0.00
Third year	82.14	0.00	17.86
Fourth year	92.30	0.00	7.70

It is easy to understand why the part-time students all agreed with the statement. Almost all of them were used to discussions at their workplaces. The data again appeared that the more experienced and older the students were, the greater were their concern about this teaching approach (Table 4).

**Statement Five:** *During giving lecture instructors should propose questions related to the background knowledge and encourage students to answer.*

**TABLE 5. AGREEMENT PERCENTAGE OF STATEMENT FIVE**

Class #	Agree (%)	Disagree (%)	No opinion (%)
Second year	78.95	7.90	13.15
Third year	92.86	0.00	7.14
Fourth year	80.77	0.00	19.23

Although the majority of supporting the statement was not as high as previously, it clearly indicated that the students had positive view of this style of teaching (Table 5).

It seems that the evidence disproved my first expectation. The students' choices indicated that they were hungry for information from STS content, that they wanted to be taught with a combination of theory and reality, that they wanted to be active in their study at school.

**Statement Six:** *Regardless of their levels of performance, students could learn many things from their peers at school.*

TABLE 6. AGREEMENT PERCENTAGE OF STATEMENT SIX

Class #	Agree (%)	Disagree (%)	No opinion (%)
Second year	89.50	2.50	8.00
Third year	92.86	0.00	7.14
Fourth year	84.61	3.84	11.55

Learning from peers at school was appreciated but fewer students from three populations supported cooperative learning activity (Table 6).

**Statement Seven:** *High performance students should concern and help the lower performance students in their study.*

TABLE 7. AGREEMENT PERCENTAGE OF STATEMENT SEVEN

Class #	Agree (%)	Disagree (%)	No opinion (%)
Second year	92.10	0.00	7.90
Third year	85.71	0.00	14.29
Fourth year	69.23	0.00	30.77

There seemed to be a tendency toward self-defense in the three populations with regard to this statement (Table 7). It is easy to understand why the majority of the part-time students agreed with the concept because they did not have to compete with their peers to get scholarships; all of them had to pay tuition equally. Among the full-time students there remains a competitive spirit which still influences their perspective towards cooperative learning, and maybe the last year students were concerned not to have tutoring consume all their time.

In any case, the data showed that my second expectation was incorrect; there were a majority of students at Dalat University wanting to work together cooperatively.

Statement Eight: *Social skills such as oral communication, trust building, and self-confidence need to be taught and practiced.*

TABLE 8. AGREEMENT PERCENTAGE OF STATEMEN EIGHT

Class #	Agree (%)	Disagree (%)	No opinion (%)
Second year	92.10	2.63	5.27
Third year	75.00	3.57	21.43
Fourth year	84.61	0.00	15.39

Once again the second year part-time students supported this statement with the highest majority among the three populations. Through their working experiences, the students believed that social skills needed in dealing with people obviously needed to be taught and practiced. The lowest majority was the third year full-time students who were a little indifferent to these skills while the fourth year full-time had more concern about them (Table 8). We could say, again, that the more experienced and older the students were, the greater were their concern about social skill development.



**Statement Nine:** *School should have learning activities to get students involved in learning and practiced the social skills.*

TABLE 9. AGREEMENT PERCENTAGE OF STATEMENT NINE

Class #	Agree (%)	Disagree (%)	No opinion (%)
Second year	97.36	0.00	2.64
Third year	89.28	0.00	10.72
Fourth year	96.15	0.00	3.85

Again, the older and more experienced students appeared to have stronger concern about how university students could develop their social skills than the younger and less experienced ones (Table 9).

**Statement Ten:** *The performance and success of students in the workplace after graduating will depend very much not only on their qualifications but also on their social skills.*

TABLE 10. AGREEMENT PERCENTAGE OF STATEMENT TEN

Class #	Agree (%)	Disagree (%)	No opinion (%)
Second year	86.85	2.63	10.52
Third year	60.71	14.29	25.00
Fourth year	84.61	3.84	11.55

Although the majority of supporting the statement was not as high as previously, it revealed that Vietnamese young people took a positive view of social skills (Table 10). The Vietnamese people have the good reputation of being hard working. Traditionally speaking, Vietnamese people want to work independently, rather than to speak. We have learned a good lesson in recent years from Japanese workers who have made their country

a leading economic power because Japanese people know how to work cooperatively.

Johnson & Johnson (1984) argue:

The industrial strategy of Japan is a good illustration of this principle. Japanese management has been quoted as stating that the superiority of Japanese industrial system is not based on the fact that their workers are more intelligent than are the workers of other countries, but that their workers are better able to work in harmony and cooperation with each other, a goal that U.S. companies have been working towards for years. (p. 17)

It seems good for the developing countries like Vietnam to follow the Japanese model. It is especially important for young people learn how to study and to work cooperatively.

Again the data evidence proved that my third expectation was not correct too. Students of the three classes agreed that in order to develop social skills they need to be trained and to practice through school learning activities. It was very interesting that the part-time students with years of experience at workplaces approved very strongly of the concept, while the third year full-time students gave weaker support to this matter. It may be concluded that the more experienced and older the students were, the greater were their concerns about social skill development.

In order to ascertain the significance of the data, statistics was employed with one way analysis of variance (ANOVA) as mentioned in chapter III. Each population got a different mark for each statement. The survey had 10 statements so each population got 10 different marks (with a maximum of 3 and a minimum of 1). After computing I arrived at the following quantitative data:

TABLE 11. ANOVA summary table for comparison of different averaged-marks of the three populations

LEVEL	N	MEAN	STDEV
Third year full-time	10	2.7353	0.1776
Four year full-time	10	2.7437	0.1890
Second year part-time	10	2.9470	0.3213

  

ANALYSIS OF VARIANCE					
SOURCE	DF	SS	MS	F	P
FACTOR	2	0.2874	0.1437	2.53	0.099
ERROR	27	1.5346	0.0568		
TOTAL	29	1.8220			

(df: degree of freedom, SS: sum of squares, MS: mean square)

With: df within groups is 27

df for between groups is 2

critical F found is 3.33 at level .05 and 5.28 at level .01

experiment F is  $2.53 < 3.33$  with  $p = 0.099 < 0.05$

From the statistical analysis, it can be concluded that there are no significant differences among the averaged-marks of the three populations (Table 11). This means that all the students of the three populations had the same perspectives towards school; biology course subject matter, cooperative learning, and social skill development.

## Observations

The observation data was collected from two sources: whole-class discussion and case study discussion as follows:

### **Whole-class discussion**

As described in chapter III, class discussion was a strategy that changed to adjust the varying situations in the class. General speaking, in these first three sections of the physiology course, the students appeared to participate eagerly in class discussion work, but I would like analyze these following categories of activities in class discussions.

### **Memorization-dominated discussion:**

When students had enough time to read textbooks and think about the proposed questions ahead of time, they could relate the course background to their experiences, so in class they were very active in discussing or proposing questions to the instructor voluntarily. But the discussions were still weighted toward memorization. Here was the observation supported by the camera when the students discussed the cardiovascular system.

Q: "Tell me about the blood pressure in a normal body and in an injured case where there has been bleeding?"

A: Doi: "First of all, I would like to talk about the cause of blood pressure formation in our body. When heart contracts, I mean the ventricles, they push blood from heart into arteries with very strong pressure: 90 mm Hg in right ventricle and 140 mm Hg in left ventricle. The pressure inside the blood vessels varies with the condition of the heart and the arteries as well as with other factors. In a normal condition the pressure decreases as the blood flows from arteries into capillaries and finally into veins. Ordinarily, measurements are made of arterial pressure only. You know we call it a

sphygmomanometer. I am sure that everyone here has experienced this equipment at some time. In case of injury, bleeding causes low pressure, and since blood from veins cannot not go back to the heart, heartbeats become weaker and slower resulting in death”.

Vy: “Yeah, we have two kinds of blood pressure: the systolic pressure occurs during heart muscles’ contraction and averages around 120 millimeters of mercury. The diastolic pressure occurs during relaxation of the heart muscle and averages around 80 millimeters of mercury.”

A: “By the way you two mentioned the pressure being different in the two ventricles.” “Could you tell me the reason for the difference?”

All the students were silent.

I guessed they were thinking about the structure of the heart wall. I gave them a metaphor: pressure made from a pump with a thick wall and pressure made from a balloon. I really wanted them to think more about the function of the thick wall of the left ventricle and the thinner one of right ventricle.

The class was still silent. My expectation was incorrect. I then mentioned the evolution process of the heart from invertebrate to vertebrate animals with its structures and functions. At the end of the class there was a male student who raised his hand , willing to speak.

Thuy: “I think the different pressures are caused by the structure of the heart.”

“Could you tell me more about the different structure of the two ventricles?” I asked him.

The student seemed nervous about this question. His eyes were fixed on the handout, trying to find the right answer there.

Fortunately there was another male student wanting to share his ideas.

Dung: “I think the different pressure made in the two ventricles is a evolutionary process. (He repeated what I had said) The thicker the heart wall is, the higher the pressure the heart causes. In order to pump blood from heart to lungs, the heart doesn’t

have to work very hard because the distance from heart to lung is very short so the wall of the right ventricle is thinner than that of the left one. (The student knew how to reason, good). By contrast, in order to pump blood from the heart to the rest of the body with exception of the lungs, the left ventricle needs a strong and thick wall to form a high pressure. This process can explain why left ventricle could have 140 mm Hg of pressure when contracting.”

The class appeared to agreed with him. When a decision-making process was required, 100 % of the students raised their hands to support the answer. Obviously it took a long time for the students to figure out the problem through an available metaphor, and then to use reason. They often accept the concepts inactively.

The second scene of memorization-dominated discussion was as follows.

It was a Saturday afternoon. We were working in a relaxed but serious atmosphere.

Q: “Could you please tell us the cause of the difference in the air components in inhaling, resting in lungs and exhaling ?”

Nguyen: “Hm... I did not think carefully about this so I could not say. I’m sorry.”

Hai: “I don’t know actually. From the diagram I can tell the difference but I haven’t figured out the cause of it.”

Think: “Yeah. I think there is a special reason for the difference but I don’t know what it is either.”

Usually the students just accept a concept, and memorize it automatically. They can answer “how” and “when” questions but they can hardly answer “why” ones. In order to improve this situation I think the physiology course needs to go deeper into the mechanisms of the physiological processes with diagrams and metaphors illustrated.

### **Conflict and conflict management**

Sometimes in class discussions, students wanted to protect their opinions when speaking, and had serious arguments whenever they had conflicts with their peers' ideas. Here is an example from class observations.

The average life span of red blood cells (erythrocytes) in the circulation is 120 days. From 10 % to 20 % of senescent red cells break up within the blood stream, where the liberated hemoglobin is bound to a specific carrier protein, haptoglobin. Some plasma hemoglobin is cleaved intravascularly into globin and heme. The latter binds to another carrier protein, hemopexin. Both complexes and the great bulk of senescent red cells are cleared from the circulation by the liver and spleen; the liver for catabolization and the spleen for macrophages.

We mentioned jaundice (yellow skin) of newborn infants.

Q: "Why do jaundice symptoms appear in newborn infants?"

Vy: "Jaundice caused by an excess amount of bile in blood. I think when a baby starts to take milk, the infant's liver has to produce a lot of bile because milk has fat, so the abundant bile would be in blood stream and this would cause jaundice."

Chanh: "I don't think so. Infant jaundice is caused by the decrease in the number of erythrocytes. During the time the fetus is nurtured in his or her mother's body the baby doesn't have its own respiratory system connected directly to outside, so he or she needs a very high number of red blood cells; 7 millions/ mm<sup>3</sup> of red blood cells to get enough oxygen from the mother's blood . When the baby is delivered it breathes with its own lungs so the number of red cells becomes excessive. The tiny body doesn't need so many red cells any more, especially with an abundant supply of oxygen in fresh air. Millions of red cells die suddenly. The liver has to work hard to produce biliverdin for bile but the tiny body cannot use up the bile so biliverdin moves freely in the blood stream and makes jaundice appear."

Vy: "I don't think so. We should relate the case to acute hepatitis B. The jaundice caused in hepatitis B is different from infant jaundice."

Chanh: "Yeah. Jaundice in acute hepatitis B is another thing. In newborn infants I am sure that it is caused by the sudden decrease of a large number of red cells."

Chieu: "In my opinion, I believe that Vy's idea is right, jaundice caused by excessive bile in blood stream. Vy was right on that point. Jaundice can be caused by many reasons: blockage at the bile gall duct by parasites, for example. I also agree with Chanh about infant jaundice. Chanh's idea was completely correct."

The atmosphere of discussion sometimes became intense because ideas conflicted; the students had a propensity to protect their opinions and try to prevent themselves from being hurt. Fortunately the students were very friendly to their peers and gradually they recognized their wrong ideas and were willing to accept others' right ones. The situation usually became reconcilable through conflict management by third parties who knew how to appreciate others' opinions.

#### **Male-dominated discussion:**

In class discussions I found that the voluntary speaking was weighted to male students. In chapter I, blood system, among 14 students of voluntary ideas expression there were 11 males and 3 females. In chapter III, respiratory system, there were 12 male students spoke voluntarily while only 4 female students did. Here is the table of the difference between male and female speaking voluntarily.



TABLE 12. MALE-DOMINATED DISCUSSION

Chapter #	Male volunteers (Number of speaking students/Number of attending students)	Female volunteers (Number of speaking students/Number of attending students)
Blood system	11/23	3/15
Cardiovascular	9/24	3/13
Respiratory system	12/24	4/14
Digestive system	10/25	3/15

Although the numbers are too few to warrant the use of statistics the ratio of male and female volunteers listed above begin to suggest a phenomenon of male-dominated discussion (Table 12).

### **Case study discussion**

#### **Female-dominated discussion**

In group discussions in the “play” stage, in contrast with the class discussions, female students eagerly spoke to their peers. Female students that started the discussion in all four groups (Appendix D). The following table shows the different frequency of speaking between male and female students.

TABLE 13. FEMALE-DOMINATE DISCUSSION

Group #	Male volunteers (Frequency of speaking/Number of attending students)	Female volunteers (Frequency of speaking/Number of attending students)
One	9/6	14/3
Two	13/4	5/4
Three	8/4	11/4
Four	5/4	8/4

Each student expressed her or his ideas at least once. There was a female student in group I who spoke five times. Although there are not enough cases (one case only) to use statistical analysis, the ratio of female and male students expressing their ideas give a picture of female-dominated discussion in all groups except group two (Table 13).

Ironically, in the “debrief” stage all the presenters for group work were male students, female students played a secondary role only, adding supplementary ideas to the case study activity. It could be interpreted that maybe the female students felt comfortable speaking in small groups, especially in a time limited discussion. It appeared that group discussion could be a good way to motivate female students to speak more frequently as compared with class discussion.

#### **Seeking more information from other materials:**

When preparing the course at home the students certainly sought more information related to the course and especially to the case study, the “Pig-Bel”, from other materials rather just than the handouts. The students knew the detailed information of this bacteria; an obligate anaerobic endospore-forming, gram-positive rod, strong gas-producing. The students can identify the bacteria’s name and its pathological cause; it is very commonly found in soil, aquatic sediments and intestine system. Because of its

spores, contaminated food that has not been heated sufficiently still contains *C. perfringens*. In a favourable environment, especially in rewarmed meat dishes if large amount is ingested, the endospores can germinate, and an enterotoxin produced during sporulation in the gut causes hypersecretion. Severe diarrhea comes from this symptom. *Clostridium perfringens* produces a neurotoxin so it causes disorders of the nervous system. The patient's very large abdomen is caused by its gas producing tendency.

Here are some short excerpts from my students' discussions (Appendix D) which indicate that all the four groups' members contributed to their group work by seeking more information about the case from other materials, identifying the name of *Clostridium* and the infectious disease in Vietnam.

Hue (group I): "I think the "Pig-Bel" disease is caused by *Clostridium perfringens*...."

Anh (group II): "I'm wondering whether enteritis necroticans in our country could be the "Pig-Be" or not. Symptoms of the two diseases are very similar to each other. In my own opinions, the "Pig-Bel" is enteritis necroticans."

Thanh (group III): "Listen to me, people. I just found something here. We can come to a conclusion about whether the "Pig Bel" is enteritis necroticans. They say (she reads the book aloud) about "Gas producing enteritis necroticans" in Vietnam as follows: Caused by *Clostridium* ..."

Le (group IV): "...I think this patient had diabetes so the symptoms were a little different from our enteritis necroticans. This "Pig-Bel" might be enteritis necroticans...."

When seeking more information from other materials the students related the physiology background to their own experiences from work to provide very interesting group discussions. Here an anecdote of their experiences' sharing with group peers:

Trung (group I): "The case study did not say that this disease happened in our country but according to my experience through many years working at QN hospital, we have had many similar cases, if not say exactly same cases. We call it enteritis

necroticans. The clostridial toxin causes the lack of oxygen in certain areas of intestine. Amputating the infectious parts of intestine through emergency operation is the only one method that we have to treat enteritis necroticans for a severe infection of the bacteria...”

Chung (group II): “...Through more than 8 years working at LD hospital as a clinical technician, I think that the “Pig-Bel” disease is widespread in Vietnam. We often confront with the same symptoms of the disease although patients’ bodies are not usually bloated and swollen as was Grace’s.”

Ngoc (group IV): “...The clinical symptoms are very similar to enteritis necroticans which is widespread in Vietnam; bloated abdomen, vomiting, bloody stool including black feces, respiratory failure, low blood pressure. I am wondering whether it is the “Pig-Bel” or not.”

From the transcripts of the discussions of the four groups working independently, I found that every member of the group sought more information from other materials as well. Here are the summary of their “findings”:

- The case “Pig-Bel” did not give any detailed information about the Clostridium’s toxin release and the affects of the toxin on human body. Through other materials students could understand the mechanism of toxin effected to the nervous system.
- The case has no information about the species of Clostridium. Through other materials and their own experiences the students could identify this bacteria was Clostridium perfringens .
- The case did not mention the “Pig-Bel” in Vietnam. Based on their knowledge and experience, the students could figure out that the disease is the common enteritis necroticans in Vietnam.

### Reasoning skills and deep understanding

As described above, in whole-class discussions, the students revealed their memorization ability more strongly than their reasoning skill. Through contact with the case in group discussions, the students became more active and independent on their knowledge, experience, and especially reasoning skill. By so doing the students were able to gain a deeper understanding of the course and other fields related to the course. They could identify the reasons for the patient's symptoms by going from one step to another to ascertain the mechanism of the bacteria infection. From their physiology background students knew that usually there are about 6000 - 8000 / mm<sup>3</sup> white cells in blood stream but in this case, the white cells increased to 28.500/ mm<sup>3</sup>. This means that there were invasive microbes causing inflammation in the patient's body. Clostridial enterotoxin is a neurotoxin that is absorbed from the gut and blocks acetylcholine release at neuromuscular junctions by binding to the synapses of motor neurons and preventing the release of the neurotransmitter acetylcholine. As a consequence, muscles do not contract in response to motor neuron activity, and flaccid paralysis results. The activity of enterotoxin could explain why Grace, the patient could not walk and feel her hands and legs within 48 hours of eating the contaminated food. Besides, the bacteria's enterotoxin produces a large quantity of gas (mainly CO<sub>2</sub>) which blocks blood circulation in intestine because CO<sub>2</sub> enlarges the vein system. With absorbing functions through the intestinal wall blocked, fluid went out to her abdomen cavity by inactive diffusion. Gangrene set in. Enterotoxin also caused skin capillaries to dysfunction; blood vessels can not contract, then the patient's skin became blotched.

Here are some excerpts from the transcripts of the group discussions  
(Appendix D).

Cuc (group D): (Her voice sounds a little weak) "I am thinking that the patient's skin symptom was probably caused by skin gangrene. The bacteria's toxin was responsible for this. And I also believe that the toxin blocked intestine peristalsis and

rhythmic contractions that normally push along the intestine's contents. Water in the intestine couldn't be absorbed into the blood and it came out of the intestinal wall to her abdominal cavity. Why was the patient's abdomen so large? I think this symptom can be attributed to gas producing. Not only her abdomen but her whole body was bloated, right? The blockage of body liquid with absorption failure, and kidney failure resulted in the whole symptoms."

Chieu (group II): "...An excess of ure, and potassium in her body resulted in a disordered acid-base balance, and whenever potassium becomes abundant in our body, the transmission of nerve impulses through nerve cells would be blocked. That evidence could also explain why the patient became paralyzed."

T. Huong (group III): "Yeah. Diabetes makes our body become weak to resist harmful bacteria. That's why the number of white blood cells increased very rapidly: 28 thousands/mm<sup>3</sup> in this case. Clostridial toxin binds to the synapses of motor neurons and prevents the release of the neurotransmitter acetylcholin..."

Phong (group III): "Because of enteritis necroticans, water and food could not go through the dead intestine. The blockage caused nausea, and vomit and the liquid went naturally from intestine to abdominal cavity based on the mechanism of diffusion. The patient's girth became larger not only because of gas in her intestine but also because of the liquid in her abdominal cavity..."

Ngoc (group IV): "Yes. Because children have weak immunity to attack the invasion of the bacteria. Besides, our children's guts in general are the habitat of parasites. The roundworm *Ascaris lumbricoides* releases a special chemical that can be a trypsin inhibitor. Trypsin is an enzyme that could destroy clostridial toxins. And one more thing that is important is sweet potatoes in our country are still a main source of starch for meals in many countryside families which are too poor to buy rice. So that's why our children often get this disease more than adults."

Although the students were concerned about the general facts they collected, they could understand the mechanism of diffusion and know how reason to figure out the cause of the patient's bloated body. By reasoning the students could prove that the disorder of acid-base balance (one factor of homeostasis) caused the transmission of nerve impulse to be blocked and paralysis to finally result.

The case study did not discuss the reason for the patient's intestine being paralyzed. Understanding the functions of the bacteria's toxin, the students found the reason for the paralysis by ascertaining the mechanism of the synapse-toxin binding. Again they could get at the cause of vomiting and the bloated abdomen by getting deep understanding about the functions of diffusion and absorption.

By reasoning, the students knew why children would be more likely to get the Pig Bel than adults. When sharing their ideas with other peers, the students could provide the whole class a chance to get a deeper understanding of the functions of trypsin not only for digestion but also for body resistance to foreign materials. The functions sometimes blocked because of a close relationship with other factors such as roundworm *Ascaris L.* and a "papain-like substance" as one student proposed.

In discussion the students had a tendency to emphasize the mechanism of human body functions. Here are some short statements that illustrate this tendency in group work (Appendix D).

D. Huong (group III): "Clostridial toxin causes gangrene. Mechanism of gangrene is a lack of oxygen, nutrients, minerals and water which come from the blood for tissues' consumption. Once gangrene appears, bleeding will be a consequence..."

Le (group IV): "The mechanism was clostridia germinated rapidly with their toxin released blocking the neurotransmitter acetylcholin so her intestine became inactive. Fluid went through from the intestinal wall to abdominal cavity and it made her abdomen swollen..."

Class discussions mainly concentrated on the course topics and partly on society and technology aspects (health and disease). The Pig Bel mentioned some topics from the course such as the role of white blood cells, blood glucose, blood pressure, homeostasis, and functions of intestinal system. The case opened many directions for students to figure out the mechanics of every symptom by applying their knowledge of physiology. Through discussions, students could share their ideas and get a deeper understanding of the course.

### **Cooperative group work and individual accountability**

In the “debrief” stage, the spirit of cooperative group work and accountability was evident. The students had a great sense of their groups’ work and their individual responsibility when representing their ideas in this stage, and this was especially true of the female students.

We started the “debrief” stage with the first group. The students decided who would act as a representative for the whole group. There was one male student with clear and strong voice who reported on his group’s discussion. He related the patient’s symptoms to the disorders of homeostasis mechanisms usually caused by the patient’s chronic diabetes. Her immune system was too weak to resist the attack of foreign invaders 24 hours after eating a small amount of pork. She just ate very little pork, she became ill. The students were sure that only *Clostridium perfringens* can cause this disease.

A female student from this group immediately assisted her group peer with some more ideas that he had not completed. She talked more about the patient’s circulation that became disordered after intestinal gangrene and kidney failure took place. She thought the patient’s abdomen was bloated because body fluid was blocked.

It was very interesting that the accountability of the group member turned out very obviously when a male student of group I talking about papain. The following excerpt of the “debrief” transcript could prove the meaningful spirit as mentioned.



Dai: "I would like to add this ideas. The case study does not tell the name of the substance in sweet potatoes which destroys trypsin. We discussed it and we do not know its name but we can guess it by relating to biochemistry knowledge. Almost every kind of fruit or starch-produced source which contains a milk-like liquid, such as papaya or sweet potatoes, has lots of papain, a natural enzyme which can destroy protein. So whenever we take sweet potatoes alone, for example during the war when we had to eat sweet potatoes all the time, we felt an unpleasant heartburn. Sweet potatoes have papain which destroys trypsin, I think."

The group was successful in dividing the presentation task, the male student presented the group work and did very well in giving the class a clear picture about the affects of the bacteria and its toxin to the patient's body through physiology knowledge. Three students wanted to complement his ideas to improve their group's work. In group discussion, they did not mention the chemical mechanism in sweet potatoes which prohibits the function of trypsin, but in the "debrief" stage the male student of the group talked about this chemical substance. He believed that any kind of fruits or vegetables which contain a milky liquid have papain, a natural enzyme which occurs in papaya. This enzyme can hydrolyze protein, so he felt that sweet potatoes have papain which can prohibit trypsin function. His deductive reasoning, although it needs to be considered more, could be seen in the spirit of cooperative working and individual accountability.

There was no conflict among these groups in the "debrief" stage. Group II stated that they had the same discussion and they also had some more special ideas related to this disease in Vietnam. They were sure that the "Pig-Bel" was the enteritis necroticans disease to which has been attributed deaths of Vietnamese children living in New Economic Areas (NEA) or remote places. Those families live in difficult situations so their children are malnourished, and their weakened bodies are susceptible to attack by parasites and *Clostridium perfringens*. When tested, the number of parasites is always paralleled by the number of *Clostridium perfringens*. The students figured out that

roundworm *Ascaris Lumbricoides* secretes a substance inhibiting trypsin's functions so the roundworm can take away the nutrition from food intake. Trypsin becomes inactive so the enzyme can not destroy clostridial toxin, which results in the "Pig-Bel".

The spirit of cooperative group work and individual accountability in this group was also very high. There was a male student wanting to clarify the mechanism of the patient's paralysis symptoms. He emphasized: "Clostridium perfringens produces neurotoxin, and this toxin is a kind of enterotoxin, a kind of protein. The neurotoxin blocks acetylcholin release at neuromuscular junctions by binding to the synapses of motoneurons and preventing the release of neurotransmitter acetylcholin. As a consequence, muscles could not contract in response to motor neuron activity, and a flaccid paralyze appeared". Another female student then continued his demonstration; she mentioned the mechanism of diarrhea. The enterotoxin made the gut hypersecretion resulted in a onset profuse diarrhea; lots of clostridia are usually found in cultures of feces of patients. She also talked about the mechanism of vomiting which happens when the pressure between esophagus-stomach and the intestine are different. When gas release caused the obstructed intestine to contract, the pressure in gut became considerably higher than that in stomach so the patient had to vomit to balance the pressure in the gastrointestinal system. Physiologically speaking, the student understood that vomiting is a reaction to protect the body from foreign invaders or toxic materials taken in from food.

Similar to other groups, the assigned student presented his group's work very articulately and other members added more ideas to convince the class about their understandings. In group discussion the students did not mention the mechanisms of diarrhea and vomiting, but in the "debrief" stage one group member wanted to clarify the patient's symptoms by going deeper into the mechanisms of diarrhea and vomiting which protect the human body from toxic invaders.

While sharing the ideas of the other two groups, group III still had their own concern about the case study as follows: The patient's body was bloated, her original

weight was 125 pounds and before operation took place, it had gone up to 185 pounds: 60 pounds, almost 30 kilos difference. Due to the kidney failure, and intestinal gangrene, body fluid absorption was blocked and it moved to her abdominal cavity. The mechanism of fluid movement here is inactive: fluid diffused automatically from the higher concentration to the lower concentration. Her intestine was blown up with gas but gas has very little weight so her sudden weight could be attributed to water intake blocked both orally and intravenously. The enterotoxin released caused intestinal wall hypersecretion and chlorides ions while inhibiting absorption of sodium ions.

The spirit of cooperative group work was also high with this group. When sharing the same understanding, the students wanted to give more demonstrations for fluid blockage and diffusion, and to clarify aspects of the diarrhea mechanism.

It seemed more difficult for the last group to present their ideas because of the excellent contributions of the other three groups but the group was ready to debrief. One members of the group talked about the relationship of the "Pig-Bel" to tetanus and gas gangrene. Another mentioned that the patient's skin blotches were caused by blood circulation disorder and enterotoxin causing subcutaneous hemorrhaging. Even though it was the last group to present its work, the group members were active in discussion and had a keen concern about the differences between gas gangrene and tetanus, which were not mentioned during group discussion. They also raised the new subject of subcutaneous hemorrhaging.

In short, whenever a group member presented the group's work, other members added their ideas to complement their peers' presentation. During group discussion, I could sometimes see conflict and conflict management. But in the "debrief" stage there was no conflict within these groups and all students appeared to have a cooperative spirit, and individual accountability beyond my expectations.

## **Interview**

Interview data is analyzed based on several main themes. This triangulation method of data analysis will strengthen the validity of the thesis.

### **Students' impression of the approaches**

As mentioned in chapter III, some students had experienced the “student-centered” method at their workplace and they were interested in the methods of instruction. But for most of the students, this was their first chance to get involved in class and group work discussions. When the students were used to learning with the new models, they really appreciated and liked the approaches. Here is the excerpt from the transcript of the interview.

Doi: “For me, I actually got used to learning with these methods of teaching at my institute. I have worked at the Vaccine Institute in Nha Trang for seven years as a technician of the B.C.G Producing Department. Recently our Institute has had many training programs provided by UNESCO and many professionals have come to our Institute for short-term training programs. They speak English, of course. They teach courses by using an overhead projector, and handouts are available. When we go to class we just discuss what is suggested in the handouts. After finishing a section, we have to take an examination. They want to make sure that we understand the previous section before taking a new one. In general, I really like and appreciate these methods very much.”

Vy: “This is the first time for me to learn with these methods of teaching and learning. I feel I like getting involved in discussions even though sometimes the atmosphere was really serious with conflicting ideas, or when we could not find a right answer.”

Ky: "...I think the methods help students to work harder and better. I could understand and remember the course content right away in class. I didn't have to spend my time so much to memorize it at home."

Le: "... This is the first time I took science course with these new methods. Usually I am very quiet so I often got terrified if I had to answer questions. When I got familiar with the methods of learning, I found it interesting."

Huong: "I have the same feelings as Le does. I feel it is helpful to learn science like this."

Reflecting the data from the survey (Question #4), the students agreed that the teaching approaches made students work harder but better. Class and group discussions helped them to develop a deeper understanding of science.

### **Social skill focus**

Before 1985 Vietnam had a movement of group work at schools in which high performance students had to be responsible for low performance students' learning improvement. Each group had at least one member of Communist Youth Party (Doan vien Doan Thanh Nien Cong San).

In order to get an understanding of the student's perspectives towards the new approaches they had just experienced, I asked them to reveal their ideas by making a comparison between two learning activities. The following excerpt from the interview transcript gives their opinions on this matter.

Vy: "I think, we were at high schools before 1985. At that time, I remember we had a kind of group work. It was a "national movement" which required students to work together. High achieving students had to help low achieving students to improve in their learning. At least one of the group members had to be a Communist Youth partner so we felt it was something mandatory and political." (laughing).

Thinh: “Yes. In 1980 when I was in secondary school, we had a group learning movement. High performance students had to help lower performance students. I used to be good at math and I had to take care of two peers in my class.”

Q: “Did you feel happy to work with your peers?”

A: “I understand that it is very human to help one another but I did not feel very happy because of “political responsibility”. Sometimes I felt stress if my peers appeared to have no improvement.”

Doi: “At that time we did not focus on social skills such as oral communication, self-confidence, and trust building. So I think that in working in groups with case studies we can not only develop a good understanding the but also develop social skills that our education system has not taken to be important.”

Ky: “I agree with you all.”

By comparing the disparity of the two learning activities of different situations, I believe that the students told the truth about “political atmosphere” they used to have when learning with their peers ten years ago. They realized that the cooperative learning in class or in small groups they had just experienced was comfortable. They understood that these approaches could help them get a deeper understanding of the course and develop social skills such as trust building, conflict management, and oral communication too.

### **Deep understanding of the course**

Employed to triangulate other thesis data analysis, the purpose of the interview was to focus on students’ opinions of the course and the teaching approaches to ascertain whether they could get a deep understanding of the course or not, especially with reference to the cases.

The students did not think that learning with cases was time consuming. In other courses they had to take notes in class. When they opened these notes at home, they often

felt skeptical about their contents because instructors always lectured too fast so they hadn't had enough time to note down everything properly. The students felt confident with the case study course. According to them, the case must be interesting and make them curious to learn more. This case study, the "Pig-Bel", meets that requirement so they liked to talk beyond their responsibility to simply speak. The students agreed that they tried to find materials related to the course and the case, and to collect information, but the university library had very limited sources of science books. From the teaching approaches, the students found they could learn lots from peers in class and group discussions, especially in the "debrief" stage. The following excerpt from the interview transcript can describe students' thoughts about the case.

Vy: "I have the same thought as Thinh. I do not think the case study is time consuming. Through the case we can have a general view of the course. I regret that we won't have a chance to work on a second, and third case. Through the case we gain a deeper understanding of the course. We tried to get a deeper understanding by ourselves and we also wanted to learn eagerly from our peers' discussions or arguments. In class, usually we preferred being asked to speak rather than volunteering to speak first. In group, we spoke freely and in the "debrief" and "replay" stage we felt very relaxed and interested."

Ky: "I agree with you two very much."

The students concurred that with the lecture available they could use their time to seek more information from other materials to get a deeper understanding of the course, to discuss in class or groups. They believed that the case "Pig-Bel" was interesting for them and made them more curious about all physiological symptoms. From the case discussion, the students could get a better understanding not only of the course but also of other fields such as microbiology, pathology, and biochemistry.

### **Competitive spirit**

Students had been used to learning individually and competitively for long time with traditional teaching and learning so it is very easy to understand why they wanted to compete with other groups in the “debrief” stage, even though it was just in fun. Here are some of their ideas about the competitive spirit shows in the “debrief” stage.

Thinh: “...So I think we learned lots from our peers in class and group discussions, especially with the “debrief” stage. We felt very excited to see our ideas put down on the blackboard by the teacher and to wait for other groups to do the same. It was a kind of competitive feeling to see whether our group would be appreciated or not.”

Vy: “... It would be more exciting if in the “replay” stage teacher went to a conclusion that which groups had the best ideas or right discussions. We can determine by ourselves but we need teacher’s evaluation...”

The students were looking forward to receiving appraisal from their instructor and peers. It was very natural because cooperative learning does not mean no rewards or appraisal. By contrast, as Johnson & Johnson (1984) suggest, bonus points or rewards for the best group would be appreciated during teaching with cooperative learning in groups.

Johnson & Johnson state:

In addition to an assessment on how well they are learning assigned concepts and information, groups should also receive feedback on how effectively they collaborated. Some teachers give two grades, one for achievement and one for collaborative behavior. (p. 39)

When presenting their collaborative work the students were expecting to be evaluated well. They can recognize by themselves how well they performed but an instructor’s evaluation is more highly valued.

### **Teacher-student relationship**

As mentioned in chapter III, I wished to build a close relationship between teacher and students during teaching with the new approaches. I often listened to students’



speaking, encouraged them to speak out about their ideas. The following excerpt from the debrief transcript could demonstrate how the students felt about the teacher-student relationship.

Think: "Not only me but almost my friends appreciated this course very much. We could learn many things from the course itself, from the teacher, and from other peers. I think that this methods makes us more active at learning."

Vy: "Besides, fortunately you are our instructor. You have a very gentle manner to encourage us to join class discussions. You often listened to our conversations, you respected our ideas even when we had with wrong answers so we feel very comfortable to talk. I am really not sure that other courses could apply these methods because almost all the instructors in this university are very hard. They would get angry if we had wrong answers." (laughing).

Huong: "I think so. Whenever we are asked to answer, we get terrified and we often lose our confidence, our self-control and we forget everything we want to say."

Doi: "Yes, I agree. So I think it depends very much on the instructor's personality. I found one more thing very nice in these methods, we students never feel hurt if we have the wrong answer because instructor never says that this was the right or wrong answer."

When talking with them the students made an open "comparison" of my manner and that of other teachers'. I understand that the students just wanted to let me know about their feelings at school toward the traditional and the new methods of teaching. They lose their confidence when being asked questions by other teachers but they never feel bad about those teachers' anger; it is very "common and natural" in student life at school anyway.

### **Suggestions for improvements in the content of physiology course**

Most North America universities elicit student feedback on courses and instructors to help improve courses. The feedback I got from course evaluation and from the interview will be valuable in developing a better physiology course and improving the teaching methods.

According to the students, every student ought to have course materials available ahead of time. For industrious students the benefit of advance reading meant this was their favourite choice. For not-so-diligent students this benefit makes them “lazier”. They did not have to pay for those copies. They did not have to go to class to note the lecture down. The students proposed that all of them should have to buy the copy of the course materials with their own money to make them more responsible for their study. Actually the university does not demand that students go to school every day. Passing examinations is considered as the best course evaluation anyway.

The students were really concerned about having the instructor’s final conclusions although they recognized that they could reason on their own. Traditionally speaking, the teacher’s evaluation has been respected and considered more valuable, so the students wanted every discussion to be clarified by instructor’s full explanations or conclusions. Here are their ideas on this matter:

Doi: “Yes. Actually the instructor did give us many ways to solve the problems. We also wanted to solve the problems by ourselves but the textbooks and materials related the course were in such short supply that we could not do that. Sometimes we got confused because we did not understand how to reason, or to find the best answer.”

Thin: “Materials related to the course and the case study are still limited. We share this difficulty with the rest of the university. If we would have had enough support from books and lab work we could have had gotten better results with these styles of teaching and learning.”

In terms of examination organization, the students agreed that a midterm examination was very useful but they preferred a multiple choice exam to a written one. The midterm examination they took was a bit difficult for them because time was limited and the students were not used to writing a concise exam using key words. For every question they wrote a composition with an introduction, body, and conclusion. So it was hard for them to think carefully and to reason properly to finish the exam well.

According to the students, the course would be better if it included clear pictures, diagrams or models showing the structures and mechanisms of biological processes, especially information related to physiology. The students understood that sometimes they need to use their imagination, but science requires exact information so they also need exact illustrations too.

The students agreed that in discussion they should not ignore social skills but that also they should not concentrate on these skills so much. They wanted to pay more attention to the topics under discussion rather than how to discuss it. They were sure that no one would feel hurt if she or he had a wrong answer.

The students really appreciated the course because it dealt with daily life, and particularly with health and disease. But they agreed that the course would be more interesting if it included even more information about health and disease. They recommended I prepare at least three cases for the holistic structure of physiology course in future.

### **Course evaluation**

There were 81.81 % of students who stated that the course content and methods of teaching were very good. Their evaluations in detail were as follows:

**Good points:**

- The course was well prepared with organized, clear, and concise content which helped students to understand the concepts easily.
- The methods of teaching motivated students to work harder on the course, to speak out, and to get a better understanding not only of the course but also of other aspects of science. Students could grasp the course content through class and group discussions at school so they spent less time memorizing it at home.
- The instructor was always enthusiastic, listened to students' ideas respectfully.

**Drawbacks:**

- The course lacked reference materials.
- The course should be illustrated with more pictures and diagrams.
- The instructor's explanations were really needed to ascertain the right or wrong concepts.

There were 19.09 % of students, who also agreed with the above evaluation, felt they lagged behind the class, and had to do too many mandatory preparations at home while they had to prepare for other examinations as well.

When teaching the course, my intentional teaching strategy was to avoid judging students' ideas and arguments, or explaining biology concepts to the students. If the case needed explanation, I supplied many directions to the students to figure out the problems by themselves such as using metaphors, information from other materials, etc. I really wanted the students to think and to reason, and to find their own correct answers. But the students sometimes got confused and appeared to lack the reasoning skills perhaps because they were used to the traditional of learning and teaching. Besides, as they stated, the shortage of books and materials was the main reason for them to explain why they needed to have full conclusions and explanations from their instructor.

So I completely agree with students' course evaluation, including both good points and drawbacks. These comments will be useful to improve the teaching methods in my future work at Dalat University.

### **Self-evaluation and midterm examination result**

#### **Self-evaluation:**

Based on the criteria of participation and course preparations provided, the students graded themselves with the following results as follows:

Grade A: 7 students (16.60 %)

Grade B: 15 students (35.72 %)

Grade C: 17 students (40.48 %)

Grade D: 3 students (7.2 %)

A combination of self-evaluation and midterm examination result shows that the students did not evaluate themselves precisely. Let us take a look about the results which came from students' performance. Students who had good participation could get a 10 % bonus mark regardless of his or her exam mark.

#### **Midterm examination**

Midterm examination result:

Grade A: 13 students (30.95 %)

Grade B: 19 students (45.95 %)

Grade C: 7 students (16.66%)

Grade D: 3 students (7.2 %)

Comparing the results of self-evaluation and the midterm examination, the data shows that only 17 students (40.47 %) graded themselves precisely. There were 17 students (40.47 %) who self-undergraded themselves and 8 students (19.05 %) who overgraded themselves.

Undergrading is probably a typical characteristics of Vietnamese students because humility is valued.

When marking the exam papers I found that students' performance was mainly based on memorization. There was one question (The functions of gastro-enzymes in intestinal system) which required students to understand the favourable conditions of temperature, pH, etc. suitable for enzymes to activate, but almost 100 % of the students could not answer precisely. Through the interview, students revealed that the exam time was a bit short to allow them to think deeply about the questions. I think this fact will help me set an appropriate time frame for future exams.

Results of the self-evaluation and the midterm examination show how the self-appraisal and self-esteem of the students developed through the class activities. I observed that the students did not welcome the chance to evaluate their own work. They did not see self-evaluation as a chance to learn more about themselves, as an opportunity to examine their strengths and weaknesses, and determine where more work was needed. They seemed afraid to be honest in owning up to where they were having trouble. They did not see that the ability to look at themselves honestly allowed them to be more open to learning.

Evaluation has been considered, however, as the teacher's job in Vietnamese schools. Students think that they can learn more when someone else does the evaluation for them. Ironically, all of the students who overgraded themselves belonged to the average and below average achieving students, while the majority of students who undergraded themselves was belonged to above average and high achieving students. Aside from humility, maybe these students lacked a good skills in self-evaluation. They were unable to look at their own work critically. Looking at their work critically would leave them open to criticism that they would prefer to avoid. So in order to the make self-evaluation process better and more precisely, the skills of self-evaluation needs to be taught and practiced for students through learning activities at the university.

## Chapter Five

### Conclusions, Limitations and Recommendations

#### From the research questions to the research results

Returning to the research questions posed in chapter One, I found that the research results provided some answers.

**Research question one:** Do student-centered methods with whole-class and group discussions of STS content change students' attitudes toward learning science, when they have been under the strong influence of a teacher-centered tradition?

Before taking the course taught with "student-centered" methods the students indicated a positive answer to this research question through their response to the survey statement: *Biology courses instructed with a combination of theory and real-life applications by using "student-centered" methods stimulate students to develop positive attitudes toward learning science.* The second year part-time class which I instructed supported this statement unanimously. After participating in a few classes of the physiology course, the students stated that the new approaches encouraged them to be active toward the course and other related fields. They were stimulated to look for more information from materials outside of class, to propose more questions and to find more solutions to share with instructor and peers in class.

Although the majority of students supported the approaches from the course evaluation, the results were not unanimous (81.81 %); still, it is obvious that the first research question was answered positively; the subjects did have a positive attitude toward learning the course instructed with STS content and "student-centered" teaching methods.

**Research question Two:** Do case study teaching methods with cooperative learning in groups bring about a deeper understanding of the course and of other related subjects?

Before taking the course, the second year part-time students were one of the three populations who showed the strongest support for the following statement, agreeing with it unanimously: *Class and group discussions in a course using case study with STS content can help students develop deep understanding of the course and social skills.* After finishing three sections of the physiology course, the students again confirmed their ideas about the approaches through data collected; through the course evaluation and the interview. In the course evaluation, there were 81.81% of students who agreed that through seeking more information from other sources, and sharing their experience and ideas via class and group learning activities, they gained a better understanding of the course and of other related subjects such as microbiology, and biochemistry. One of the main themes coded and then analyzed from the interview data was “Deep understanding about the course” (chapter IV). The students confirmed that they found it interesting in discussing the “Pig-Bel” case, that they sought more information related to the case and the course to find out about the mechanism of the disease. They had the chance to perceive the entire range of physiological symptoms, and to learn more about the disease in Vietnam through discussion process especially the “debrief” stage.

With support from the data analysis of the interviews, I concluded that the second research question could be answered positively.

**Research question Three:** Does discussion-based teaching help students develop their social skills?

In the survey, statement eight (*Social skills such as oral communication, trust building, and self-confidence need to be taught and practiced*) and statement nine (*School should have learning activities to get students involved in being taught and practiced the*



*social skills*) both concentrated on social skill development. The students from all three populations showed their strong support (from 92.10 % to 97.30 %) for the importance of social skill development in education. After experiencing the learning activities, the students responded to these statements through course evaluation, class and group discussions which I observed, and interview data, as analyzed in chapter Four.

In course evaluation, 81.81% students agreed that the approaches helped students develop social skills; they wanted to talk, to share and to consider their peers' ideas. From class discussions and group observations focusing on social skills, it was noted that the students learned to manage conflicts, developed trust and interpersonal skills, and communicated ideas. Students showed evidence of the quality of their thought in the oral communication of their ideas. When they made oral presentations in class, especially in the "debrief" stage, their language was clear and their views were based in data. They were able to give legitimate examples from valid sources to support their points of view. When they spoke, it was easy to understand what they said, to follow their reasoning. In class discussion there was a tendency for males to speak more frequently than female students. In contrast, in group discussion, females compensated; males were dominated by females. After taking the course, and especially the case study as part of the course, the students recognized that one of the purposes of the case study teaching method was to focus on social skill development. They stated that while learning through class and group discussions they felt that they liked to talk, and to share their ideas with peers in class to get a deeper understanding of the course content.

From the evidence above, it is clear that the research convincingly supports a positive answer to the third research question, with strong triangulation of the data.

## Conclusions

With the positive answers to the research questions having been elicited from the findings, some basic conclusions can be synthesized as follows:

- The biology second, third, and fourth year students at Dalat University had positive attitudes toward school. They had keen concerns about the content and teaching methods in biology courses that would develop positive attitudes toward science, as well as a deeper understanding of science and improved social skills. The older, and more experienced students were more concerned with STS content of biology courses, student-centered teaching methods, and learning activities which develop social skills at school. These results suggest that there must be a need for developing appropriate curriculum of biology courses including STS content with its learning activities.
- “Student-centered” methods with whole-class discussions and case study was confirmed to have helped the students develop a deeper understanding of the physiology course by developing reasoning, and encouraging students learning from peers, and seeking more information from other materials. Results confirmed that , while sharing their ideas with instructor and peers, the students learned social skills: communication abilities, trust building, conflict management, and especially individual accountability.
- From the observed phenomenon of male-dominated discussion in whole-class work and female-dominated discussion in group work, it was concluded that whole class discussion and group work should be both conducted to develop deep understanding of science and social skills for both female and male students equally.
- Skills of course evaluation and self-evaluation need to taught and practiced for students through learning activities at university.

### **From research results to generalizability**

Trying to implement the new approaches in a traditional environment of teaching and learning, especially since I had little experience of or training in case study teaching and student centered-methods, I realized that this research offered an opportunity for me to learn about my own teaching. While improving my own teaching skills I need to solve some problems which I will face in my future teaching.

#### **Limited funds for course preparation:**

I wonder whether these approaches could be generalized given the shortage of academic funding. The university is so poor that it can not afford for to hold lab for all part-time classes; only full-time students can access labs which are funded partly by the Ministry of Education and mainly by student tuition fees. The physiology course in which I instructed had no lab component. The idea that “the combination of theory and reality (including lab work) stimulates students to develop positive attitudes toward learning science” could not be completely realized in these circumstances.

Photocopying costs were also a problem. With the help of CIDA program funds, I could provide the students enough copies of course materials so that they could prepare for class at home. Students appreciated the benefits of having copies of these materials. In future, if budgets did not cover photocopying, the university could ask students to pay for the costs, as the students interviewed suggested, but their enthusiasm may be reduced if costs rise too high. In the long-term, the problem could be solved by larger government budgets for education but under present conditions, lack of funding makes me pessimistic about the generalizability of these approaches.

### **Lack of concern from colleagues and faculty**

All faculty members did support my research; they provided me whatever I needed to make my study work. The Head of Department of Biology was very approachable, and helped me edit the content of my survey, recommended I work with the first and second year full-time students, and provided great support. However I felt uneasy that my colleagues did not show any interest in what I did or what my findings were. I offered to present my work (in Vietnamese) to the faculty but they answered that they did not need to have my report. They were happy that I could finish my work punctually. Sometimes I felt isolated with the “frivolous” approaches to teaching since “money can tell everything”, from my colleagues’ perspectives I guess. In my own estimation, success or failure in education depends very much on funding but teacher education also depends on time, effort, experience, enthusiasm, and a sense of responsibility and commitment. Money alone could not solve all problems we face in education, a human science. What is required is more subtle than money.

Sometimes when teaching the class I saw many students from other classes standing outside the classroom door, watching me and talking about what they saw on the blackboard. I wished I could do something more to prove the significance of the new teaching methods but I found it impossible. I realized that I really needed the concern of my colleagues and faculty to support me with their own experiences, and I needed to obtain feedback from them to improve my teaching approaches. I wonder whether, when I come back to my country to continue my job, the teaching approaches will have a chance of survival or whether they will be “fatally” isolated because of the strong trend toward traditional teaching methods.

### **Lack of patience or tolerance for unexpected situations**

I sometimes became confused and disappointed because of unexpected situations that almost made me lose my temper. I understand that it is not a good idea to blame

students or to be “aggressive” with them. I did confront students on two occasions: one was the day almost all students stayed at home to prepare for an exam in another course, and the other was when I teaching chapter II, on the circulation system. In the former case, I was frustrated and embarrassed because of the presence of my two colleagues. The students did not apprise me of their absence ahead of time although I had promised them in the first class that I would let them know at least two days in advance if I needed to cancel the class, and I expected the same from them. I had controlled myself to some degree but I felt really upset afterwards. These feelings discouraged me for a while although some members of the class met me on my way going home and apologized to me for what they had done. The second incident happened when the class was so inactive that none of the students wanted to concentrate on the course. They were so worried about exam results from other courses that a depressed atmosphere was created in the classroom. I tried to switch from a “student-centered” method to a teacher-centered method to adapt to the class mood, students kept silent until break time and then rushed out of the class as if they had been suffered a painful duty. I have learnt to be more flexible and deal with my own distraught feelings. I need to train myself to have more tolerance for dealing with unexpected situations in order to make the class atmosphere more active, and productive.

### **Preparation of course and other materials**

Within very short time I prepared the course in Vietnamese. The cost of photocopying was a big concern and materials from the university library were too scarce to meet class needs. I agree with the students that the course lacked information from other sources, and the course material itself lacked illustrations and diagrams. I know that I could have done better to prepare the course but I had limited funding and time. Nevertheless, I felt uneasy throughout my teaching. Fortunately, the students could share their experiences and they helped me to make the course work. In my future teaching,

such problems must be avoided. Good preparation of the course and other materials ought to result in better “student-centered” methods of teaching with cases.

### **Flexibility in instructing methods**

Before applying the approaches, I read about how to develop good questions that build habits of thinking in students. I was sure that good questions would be framed in a way that encouraged thoughtful examination; the questions would invite students to think, and to reason rather than demanding from them a pat answer. In order to avoid a forced choice between “yes” and “no” I overused the facile “why” instead. The students became “exhausted” and I sometimes overwhelmed the students with too many why questions. Unfortunately I realized this near the end of my teaching. The students deserved a more flexible atmosphere and more open questions.

### **Limitations of the research**

Some problems and limitations of the study defied easy solution.

- Research time was limited. The research took place over only 4 weeks (one week for doing the two surveys, and three weeks for teaching and interview) so it was impossible to check the results by repeated observations or interview cross-examination. The limitation resulted in a weak validity, reliability and generalizability for the study.
- Subjects were not homogeneous: the 42 part-time students differed from one another in terms of age, experience, background knowledge, salary, marital status, etc. This may affect the generalizability of the research, especially in terms of full-time classes.
- Using one case and dealing with a shortage of reference books and materials made the course less effective than expected.

- The transcript of the group discussion on the case “the Pig-Bel” was based mainly on student observers. I could observe only group one from the beginning to the end and the video taping of the other three groups was discontinuous. So the data from group work with case study was somewhat limited.
- Data analysis process concentrated only on descriptive analysis rather than going deep into details of the phenomena or psychological aspects of the students because research time was short. Replication of the research was impossible, resulting in a poorer consistency of analysis.
- By a “strange” coincidence the students who voluntarily participated in the interview were all high performance students so the interview lacks data from lower performance students, resulting in a biased analysis.

### **Recommendations for application**

I suggested that, although Dalat University remains poorly equipped in terms of textbooks and lab equipment, the physiology course could be taught in ways would help it approach international standards.

- The course content should be supplemented with more pictures and diagrams related to physiological structures and processes to help students grasp the concepts.
- The course should focus more on the mechanisms of physiological processes and on information about health and diseases.
- The course is best taught using the case study method involving at least three cases with students involved in group work.
- The course can provide students with opportunities to think and to reason, although sometimes instructor’s explanations and conclusions are needed to compensate for the shortage of textbooks, materials, and lab work.

- Overuse of “Why” questions should be avoided in class discussions.  
Questions should not be too abstract, too general, ambiguous, or leading; they must be clear and invite students to think, and speak out about their ideas.
- Aside from giving bonus points for participation, encouragement can be given by awarding a prize to the best group.



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## Appendix A

### Survey of Students' Perspectives Toward School

Please circle the appropriate number on the right which most closely corresponds to your feeling about the statement on the left.

1	2	3
Agree	Disagree	No opinion

1            2            3

1. Regardless of the basic training program of Dalat University, the contents of biology courses should not be concrete and pure science.
  
2. Biological courses' contents should consist of STS (Science-Technology-Society) information.
  
3. Biology courses instructed with a combination of theory and real-life applications stimulate students to develop positive attitudes toward science.
  
4. Class and group discussions of the course through case study with STS content can help students develop a deep understanding of science and social skills.

5. During giving lectures instructors should propose questions related to background knowledge and encourage students to answer.
6. Regardless of their levels of performance students could learn many things from peers at school.
7. High performance students should concern and help low performance students with their study.
8. Social skills such as oral communication, trust building, and self-confidence need to be taught and practiced.
9. School should have some learning activities to get students involved in learning and practiced social skills.
10. The performance and success of students in the workplace after graduating will depend very much not only on their qualifications but also on their social skills.

## **Appendix B**

### **Interview Questions**

(Interviewees are students)

**Question # 1 :** How did you feel when attending classes that used the new teaching methods?

**Question # 2 :** Before 1985 we had a form of cooperative learning in groups, and now we are working cooperatively. How do you see the differences and similarities of the two learning activities?

**Question # 3:** What are the good points of these new teaching methods?

**Questions # 4:** What drawbacks do you see in these methods?

**Question # 5:** What are your suggestions for improving the curriculum and teaching methods?

**Question # 6:** While taking the course how did you feel about the presence of:

- a) the video camera
- b) the tape recorder
- c) noises from other groups

**Question #7:** Your opinions about your group:

- a) Was the group the right size?
- b) Did the group function well?
- c) Did you or anyone in the group monitor the group's performance ?
- d) Did you feel uncomfortable when you dominated other's ideas or, by contrast, someone dominated yours?

**Question # 8:** Were the cases:

- a) time consuming?
- b) chances to read materials and get a deep understanding of the subject?
- c) chances to hear others' ideas?
- d) chances to collect materials and write down 'big ideas'?

**Question # 9:** What you like to be taught for the rest the course:

- a) Continue with cooperative learning in groups for lab
- b) Continue the course with case study and cooperative learning in groups
- c) Turn back to the traditional methods of teaching and learning
- d) Keep teaching the course with pure science only



## Appendix C

### The “Pig-Bel”

(A summary of “The Beast in the Belly”, by Sherwin (1995))

Not long ago a 24-year old woman named Grace Lopat registered for assignment as a substitute teacher in the elementary school system of a small town outside New Haven, Connecticut. Although Grace walks nowadays with a barely perceptible shuffle, in all other ways she presents the perfect image of vibrant good health. It comes as no surprise, for example, to learn that she placed third in a country pageant a few years ago. Even forewarned with the knowledge that since the age of eight she has required twice-daily insulin injections to control her diabetes, anyone meeting Grace would have good reason to see her in the personification of that idealized image of a past generation’s sketchers and artists, the American Girl. Certainly it is a great deal easier to think of her as a wholesome, smiling beauty contestant than it is to imagine her mottled and swollen, in a delirium of fever and near death, being rapidly wheeled towards an operating room one spring afternoon four years ago. She had been assessed a Class 5 risk for anesthesia, in the opinion of every physician who saw her. To this day, she’s not sure whether to credit her survival to the flabbergasting marvels of modern scientific medicine or the spiritual intervention of her long-dead father, and a few of her doctors sometimes wonder. Either way, it took a miracle to save her life.

The American Society of Anesthesiologists describes a person in Class 5 as “a moribund patient who is not expected to survive without operation.” No one, doctor or otherwise, seeing Grace Lopat just before those preoperative moments had reason to dispute that description, and most observers would have projected her survival period to be hours rather than days. I was her surgeon, and I have now had four years to think about it. I am absolutely convinced that I have never taken a sicker patient to the operating room, even if I include in my recollections those few who did not leave it alive.

The reason for Grace’s survival is no easier to pin down than is the origin of her sudden catastrophic illness. Although our clinical team was later able to trace the details

of the process that made her so sick, we are still puzzled by the “why” of it. We know the culprit but have no idea how it managed to get as far as it did. Even the instructions we gave Grace after her recovery were based on guesswork: She was told never to eat pork again. The injunction had no scientific basis. In fact, it was nothing more than a kind of clinical rabbit’s foot that none of us were willing to throw away, probably because it was the only one piece of advice we could think of. Grace never shared our concerns; I recently discovered that she eats pork whenever she can.

Actually, the amount of pig meat consumed by our patient in the day before the onset of her illness was not enough to indict it. She’d had a Chinese dinner about 40 hours before her first symptoms, and it included pork fried rice and spareribs. Other than that, she has no recollection of having eaten anything at all different from her usual fare.

Grace’s medical saga began in May, on the Monday of final-exam week at the state university where she was completing her sophomore year as an education major. She has just taken the performance exam for a dance course in which she ‘d been enrolled that semester. It was about three o’clock in the afternoon, and she was walking across the campus, feeling pleased with how well she ‘d done and thinking about the coming series of finals.

“All of a sudden, I was on the ground, I couldn’t imagine how I got there. I got up quickly because of course there were thousands of people around the campus, and I was thinking, ‘Dear God, I hope no one saw me fall.’ I looked around and there were no stones, no sticks, no cracks in the sidewalk, there was absolutely nothing that I could possibly have tripped on. It was my legs gave out, and I thought it must have been because I ‘d just danced for an hour. My roommates said later that I was such an idiot I must have tripped over my own two feet.”

On the following morning Grace awoke feeling sick.

“I was vomiting, I was running to the bathroom with diarrhea, and I was sweating. I thought, ‘Oh great, I caught some kind of a gripe, some kind of a flu. I went back to bed, but I kept going in and out of it. Finally, my roommates began to get worried because there had been several times in the past when I got dehydrated and had to go to

the hospital because my diabetes went out of control. But when I tested my sugar, it wasn't any higher than usual.

“Finally, the girls started to get scared. They called my mother at work, and she took me home. I drank lots of diet ginger ale the rest of the day and used suppositories to stop vomiting. That whole night I was dizzy and throwing up, and drinking water and vomiting again. By early the next morning, my abdomen was aching and I couldn't feel my arms and legs. I tried flapping my arms around and I still couldn't feel them. No matter how weak I'd been in the past, nothing like that ever happened before. I was in hysterics, it was like a nightmare.”

Anne Lopat, Grace's mother, has been teaching elementary school for more than twenty years. After her husband, Bill, died suddenly of a coronary when her only child was ten, Anne became not only the small family's sole breadwinner but Grace's entire support system. After Grace's juvenile diabetes was diagnosed in 1978, Anne took it on herself to learn all she could about the disease, and to become something of an expert in the various ways it manifested itself in Grace. Her job wasn't always easy. Like most diabetic kids, Grace had a way of breaking the rules, and it sometimes took all of Anne's accumulated diabetic wisdom to extricate her child from the consequences. Occasionally her efforts failed, and it would then be necessary to rush the dehydrated girl down to the Yale-New Haven Hospital emergency room. Over the years, actual admission had been necessary seven times, always to treat acidosis, the rapid buildup of metabolic products in the blood of diabetics, which can lead to air hunger, coma, and finally, if not reversed, death. The last admission had been only six weeks earlier.

But knowledgeable as Anne was about the way Grace's diabetes behaved, on that May morning she found herself facing an entirely new symptom. “When she woke me at about 5:30 and said she couldn't feel her arms and legs, I knew I had to get her down to the hospital right away. While I was helping her to the car, she told me she couldn't even feel that she was touching the ground.”

There was no prolonged wait in the emergency room when the Lopats signed in at 6:19. As Grace recently told me, “Generally, you can come in holding your head in your hands and they tell you to wait. But when you are a diabetic, they take you right away.”

Blood samples were drawn and intravenous fluids were started without delay.

About an hour and a half after arrival, Grace was told that her test results seemed reasonably satisfactory. But she couldn't be reassured, and she began to feel herself become increasingly panicky. Soon she was shouting.

"Nothing felt right. At that point, the doctor and nurses were changing shifts, and no one was paying any attention to this screaming person. I was yelling, 'Won't someone listen to me? There's something wrong!' My abdomen really, really hurt, like it was a tight, tight muscle spasm and everything was all squeezed together. That frightened me, but I tried to blame it on the 24 hours of vomiting. But what really scared me was that I had no body perception. I didn't feel like I was there. It was that same feeling I've had when I've had a tooth filled and been given gas. It's like I have no body at all.

"My mother kept talking to me all the time, trying to calm me down because I was yelling and thrashing around. And then she asked me if I knew I was going to the bathroom, I didn't. Then I heard her yell, "My God, it's blood!" and then she began calling out, 'Nurse, Nurse!' The nurse came right away, and after that my only perception was dribs and drabs of the faces of the doctors and nurses around me."

In fact, Grace's blood tests had not been normal at all. The most striking abnormalities were a markedly elevated white blood cell count of 28,500 per cubic milliliter (the normal level is about 5,000 to 10,000) and what is called a shift to the left, which refers to a large increase in the number of mature and immature granulocytes, cell that increase in number when an acute infection must be fought off. At 654 milligrams per deciliter, the blood sugar was elevated to some seven times its normal value, and a moderate degree of acidosis was present. The entire picture was characteristic of the abnormalities that rapidly appear when a diabetic develops serious infection. Once the proper cultures had been taken, the emergency room physicians started Grace on several intravenous antibiotics.

The most unusual aspect of the blood studies was the extremely high white cell count, which was approximately twice what might be expected in the ordinary kind of infection. But far more worrisome than the laboratory results was Grace appearance. She was throwing herself around the gurney and shouting for help without seeming to be

completely aware of what she was doing or that she had just passed half a pint of bloody stool. The skin of her entire body had become mottled, with great purple-gray blotches appearing everywhere, separated from another by small patches of stark whiteness. Her body temperature was a full degree below normal and her blood pressure was beginning to fall. The entire sequence of event added up to the clinical picture of a sepsis, a massive bloodstream infection that leads rapidly to inadequacy of the circulation, often followed by organ failure and then death.

On the presumption that the bloody stool and abdominal pain might be clues to finding the infected site from which the bacteria were being hurled into the circulation, the resident physicians sought consultation with Suzanne Lagarde, a gastroenterologist on the hospital staff. When they phoned the patient's physician, Murray Brodoof, to tell him their plan, he said he would also contact a surgeon, on the chance that some remediable intra-abdominal event might be the cause of his patient's strange symptoms. I was draping a middle-aged man for a hernia repair when Brodoof's message reached me. Because I was decked out in a sterile regalia, the nurse held the phone to my ear, and Brodoof described what he had been told. I was committed to the operation about to begin, so I had the nurse page the resident on my surgical service, and I delayed the operation just long enough to ask him to go directly to the intensive care unit, to which Grace had by then been transferred.

Sue Lagarde is a slight, bespectacled woman in her late thirties whose stylish good taste in clothes seems pleasantly incongruous with her studious face. She is a skilled clinician, and so enthusiastic about her work that she approaches diagnosis with a certain cheerful ebullience, manifested most directly by a rapid verbal delivery in which the words tumble out so closely on one another that she seems always on the verge of stuttering. When Lagarde examined Grace, she saw a young woman with what she called a hysterical personality throwing herself around the intensive care unit bed, complaining loudly and sometimes incoherently of diffuse body pain. The girl's was cold and broken out with blotchiness doctors call livedo reticularis. Although she shouted bitterly and above all about belly pain, there was no abdominal tenderness and only a mild degree of distension at the time of Lagarde's examination.

Of all the confusing, indeterminate findings, the most disquieting was the acidosis, it was worsening in spite of vigorous treatment. Whatever the obscure nature of the disease process might prove to be, it was obvious to Lagarde that she was dealing with a desperately ill young woman whose condition was deteriorating rapidly. The situation was not only dire, it defied diagnosis. Lagarde recommended what she called a fishing expedition, including a CT scan and a neurological consultation to help point out the proper diagnostic direction. Unless some sense could be made of Grace's bewildering set of symptoms, she would soon reach a point beyond retrieval.

By that time I was completing the hernia repair. As soon as the dressing was applied, I paged the surgical resident. He responded in less than a minute and assured me that the young woman had no "surgical problem." His examination of her abdomen, he said, was without findings that might suggested the need for operation. "She's hysterical kid," he said, "and whatever she got is medical, not surgical. You don't have to see her." He went on to describe Grace's bizarre behavior, her blotchy skin, and the laboratory findings. It was clear that he was a bit irritated at being asked to consult on a patient who so obviously didn't need to be seen by a surgeon.

I stopped by the waiting room to have a few words with my patient's wife, and then headed up to the medical intensive care unit. One of the nurses quickly briefed me on Grace's condition; though it already been very bad when Lagarde examined her a short time earlier, it was now worsening rapidly. Despite the attempted clinical detachment of the nurse's description, it was obvious that she was upset, even distraught. The best intensive care nurses never do become inured to the daily tragedies they witness, and helplessness in the face of imminent catastrophe, especially when it involves a patient not much younger than oneself, is unbearable even for the most stoic of professional personnel.

After our brief discussion, I sat down with Grace's chart to run a quick eye over the lab reports and the previous medical and nursing notes. As I scanned the three pages of neurology consultation, my eyes caught the word hysterical, this time used to explain the arm and leg symptoms, which fit into no clinical pattern that made sense. The overall impression of the neurologist was that the patient's symptoms were the effects of diabetic

acidosis. His final recommendation was: "Suggest close clinical observation. Consider L-S (lumbosacral) CT if symptom persist."

On the next page I found the surgical resident's note, describing his findings. At the end, under Impression and Plan, he had written, "Benign abdomen in setting of acute neurological event and GI bleeding suggest vasculitis (underlining his) though sepsis possible... possibly meningococcus. No evidence for acute abdominal process." There was a tone of finality in the note. Even the customary concluding words of the surgical consultation, "Will follow," were absent. In their place was "Will speak with Dr. Nuland." I stood for a moment at the entrance to the class-enclosed cubicle where Grace lay attached to electronic monitors, a nasal oxygen line, and a tangle of intravenous tubing. As I observed her from the foot of the bed, I asked the nurse to pull the sheets away so that I might look at the patient's entire body from that perspective. Even to me, a case-hardened veteran of other people's affliction, the exposed sight was harrowing. The mottled object on the bed looked like a bloated corpse somehow preternaturally animated by the terror of yielding to eternal stillness. Its thrusting chest was straining up and down like a perverse bellows sucking air into itself, while the head and all four extremities were flinging about in a frenzy of attempted escape. In the glare of brilliant MICU illumination, the skin looked almost eerie. Although I had been told of the livedo reticularis, I was unprepared to see the depth or extent of the large violaceous bursts, especially as they were so harshly revealed by the many foot-candles of piercing light. The pattern of blotch and pallor involved every visible inch of body and was much deeper in its purplishness than I had ever encountered, except on the freshly dead. The thing's leg were quite swollen from the knee downward, and even its face had become puffy. Almost paradoxically, the swelling of the lids made the open frightened eyes seem to bulge, very like, the tissue behind them was also swollen.

The abdomen was so distended that it partially obscured my view of the heaving rib cage. In answer to my question, the nurse said that the abdominal girth had reached its grossly protuberant size over the previous two hours. When I stepped to the bedside and tapped on the belly in the diagnostic maneuver called percussion, the amphoric boomlet of resonance that filled small cubicle had the pitch that might be produced by a felt

hammer hitting a kettledrum. With good reason, clinicians call such a note tympanitic. Grace's tympanitic abdomen told me her intestines were blown up with gas, and the absence of gurgles when I listened through my stethoscope meant there was no peristalsis, no rhythmic contractions that normally push along the intestine's contents. When I pressed down, as gently as I could, into the abdomen surface, the grimace on Grace's puffy face let me know I was hurting her. She had stopped speaking some time earlier, but her bulging, uncomprehending eyes stared fearfully at me.

When an abdomen is expanded by a large volume of gas in a short period of time, it rises like an over-yeasted loaf of bread. Years ago clinicians used the word meteorism to refer to this rapid belly ballooning, which is encountered only in unusual circumstances. What it means, almost always, is a belly with dead bowel in it. In my clinical experience, almost no other acute abdominal disease will raise the white count as high as intestine does when it is in the process of dying. A drastically risen white count in a patient with a drastically risen belly is a surgical call to action. Unless some thing is done quickly, the patient will not survive.

The presence of dead bowel furnished a logical explanation for Grace's sepsis and also explained why all the vigorous measures being applied were not resulting in any improvement in her acidosis. As long as a major source of infection remains untreated, there is no way to stop the process of decline. Obviously, Grace needed an operation soon.

As I was quickly writing my consultation note, Mike Bennick walked hurriedly into MICU. Mike is an intense, fastpaced young gastroentologist who had trained with Sue Lagarde and was now her associate in practice. He hadn't seen Grace before, but Lagarde had described her condition to him. He instantly recognized how much had changed since his partner's examination of a few hours earlier and concurred that immediate operation was mandatory.

Bennick and I went out to speak to our patient's mother. We found Ane Lopat standing with her two aunts and an uncle, just outside the door of MICU. Bennick had recently treated Anne's mother, and he knew that she would have confidence in his recommendations. He also knew that this very forthright woman, frightened though she



was, would be impatient with explanations redolent of chart jargon, or with any hint of evasiveness. As I would increasingly come to appreciate during the next few weeks, she wanted the truth flat out, and Bennick now gave it to her as directly as possible, softening the harshness of his message by the gentle tone in which he delivered it: "Anne, Grace is dying, and we don't know why. We have to look inside it's her only chance."

Anne is a large woman, not only tall but roundly and firmly heavy. Even when she distressed, there is a stolidity and determination about her. She listened to me carefully, and her face revealed nothing. She kept her gaze fixed on me, and when she occasionally blinked, it was done very slowly, as though she were momentarily closing her eyes to keep her thoughts from being observed. She seemed by force of will to be separating herself from anxiety in order to focus her mind's entire attention on each successive detail of what she was being told. She never looked away, even when I concluded by telling her that the operation would kill her daughter if we were wrong, if no source of sepsis was found in Grace's abdominal cavity. When she had heard me out, she simply nodded, and the slight downward motion of her head punctuated my final words with a full stop. Then she said, "Please operate right away."

I called the OR and asked for the next available room. Within minutes an anesthesiologist was at Grace's bedside, trying to determine whether she was already too far gone to tolerate his gases and drugs. The last paragraph of his scrawled consultation note summarized the pessimism we all felt: "Class 5. Critically ill, undergoing resuscitation, insulin, fluids, oxygen. Plan rapid sequence incubation. Patient has poor prognosis, heroic measure to attempt to save life."

Grace was having few lucid moments by then, but she clearly remembers the brief period when she was in the holding area just before being wheeled in for the surgery. She was still thrashing about and trying to find some comfortable position on the gurney.

"I wanted to be on my side because I was thinking, "I'm going to die , I'm 20 years old, and I'm going to die." A priest came and was praying. He was making the sign of the cross, and I thought, "Oh my God, this is the last rites," that's a sure sign that you're on your way, you know. I began to say that to my mother, and she was crying, so

were my uncle and my aunts, and they were trying to tell me I'd be okay, even though they were crying.

“I believe in the power of God, and I've always had some kind of relationship with my father even though he's not here on earth, I feel his presence all the time, and I know when he's there. My uncle passed away when I was five. I've always believed my father and my uncle Ron are in heaven. I've also believed his parents greeted him in heaven. To me, that meant there's something good out there, and that his parents came to him. So I was lying there, and I felt my body was being pulled. You know, when you vacuum a rug and you put your hand over the open hose to be sure the suction's working, and you feel that pull, it felt like my whole body was being pulled forward. I thought, 'Here I come, this is it, I'm dying.'”

“And then I saw my father and my uncle. They were just standing there, and I was thinking, 'Okay, God, I'm dead.' There weren't lights, I think you have to go all the ways to get the lights. Well, I really believed that either they came to me or I came to them, and my mother tells me I was saying, 'Bill, Ron!' Of course, I never called my father Bill and I never called my uncle Ron when they were alive, which makes me think things must be different in the afterlife. But I did say, 'Bill, Ron,' and my father put up his hand in front of him, and he said, 'No, not yet.' And he sat back. And then I looked up my mother and said, 'I'm going to live,' and those were the last words I said.”

True to their plan, the anesthesia team got Grace to sleep very rapidly. With the surgical resident and a medical student assisting me, I made a long up and down incision in the middle line of Grace's very distended abdomen. As I opened the innermost layer, the peritoneum, a gust of malodorous yellowish fluid poured out onto the drapes. When we had finished sucking it into several trap bottles, the nurse told us it amounted to some six pints. With Grace positioned on her back, the gas-filled gut had been floating on top of the fluid, explaining the drumlike resonance produced by percussion.

We inspected the small bowel. Although most of it was alive, there was a length of about 15 inches near its origin that was either dead or barely viable. It was suffused with a dusky bluish hue and was completely without peristalsis, even when I tried to stimulate it into some kind of action. The discoloration gradually faded out at the upper

and the lower margins of the involved segment, so that there was no definite line of demarcation between healthy and sick tissue. The vessels entering the darkened piece looked normal, and the arteries pulsated vibrantly. When the electronic listening device called the Doppler was applied, we heard the healthy whooshing sound of good circulation. And yet the bowel looked asphyxiated.

I explored every portion of the abdominal cavity, seeking an instigating factor for the imminent intestinal gangrene, but when I had concluded my probing peering, I knew no more than I had at the outset. No obvious cause revealed itself that might explain the rapid death of an otherwise normal-appearing length of intestine in a youthful, pristine-looking abdominal cavity. The gut's blood supply appeared perfect, there were no adhesions or similar fibrous bands that have might pinched off the involved segment, and the bowel wall seemed free of inherent pathology, nevertheless, it was near death. In a sentence of the operative note I dictated shortly after the conclusion of the surgery: "It is very difficult to know the cause of this ischemic (lack of blood) pattern, which is of a form that no member of the operating team has seen before."

I fired a surgical stapler across the intestine an inch above and then an inch below the dying segment, divided its blood supply, removed the specimen, and handed it off to the pathology resident, whom I had summoned to the OR on the slim chance that he could add something of value. He looked at the piece of gut, made a few cuts into it, and pronounced himself as stymied as we were.

As soon as I was satisfied that we had made a good reconstruction of the gut and its blood supply, we poured at least ten quarts of warmed antibiotic-laced saline into our patient's gaping abdomen, in order to rinse out as much bacterial and other debris as possible. We sucked it clean and ascertained that we had stopped any oozing of blood. Then we removed all sponges and instruments and began to close. I passed a heavy polypropylene stitch through all layers under the skin of the topmost part of the incision, and then whipped it quickly all the way down the length of the wound until I reached the bottom. I stepped back from the table, and the resident placed a row of some 30 staples into the skin. Not until one of the nurses began untying my gown did I realized that I was exhausted.

I went out to the waiting room to tell Anne that the operation had gone well, at least from the technical point of view. Grace was still septic and not much further from death than she had been when we wheeled her into the OR suite. Anne asked the obvious question, and I had no answer for it. “No,” I said, “we have no idea why this happened to her intestine. Maybe the pathologist will be able to tell us, after he puts it under the microscope.”

The specimen I had handed to the pathology resident had the appearance of a segment of organ that had lost its blood supply, and yet I knew that the flow into it was normal right up to the very wall of the gut. I expected the explanation to be found in the microscopic vessels that traverse the bowel wall. I received a phone call from Brian West, the pathologist in our hospital whose specialty is diseases of gastrointestinal tract.

“Do you have a minute to come over the lab?” he asked and there was a hint of expectant promise in his rising rhythm that told me it would be well worth my while to get there right away. The words weren’t said with any sense of urgency but more in the tone he might have used to invite me in for a pint of some long-awaited brew just arrived. “I want to show you what I’ve found in the specimen you sent me yesterday.”

Anticipating his discovery, I burst in before he could continue: “What do the microscopic vessels look like?” His answer surprised me. “The vessels are fine. What I think she has is enteritis necroticans, the thing they call Pig Bel.” “Okay, Brian, what’s that?” He gave me a brief explanation, but it wasn’t until I got down to lab a few minutes later that I really began to understand what he was talking about.

Peering down the twin barrels of West’s microscope, I could see that all the entire mucosa, the inner lining, of the specimen was dead, although most of the main layer of encircling muscle, called the muscularis propria, was still within the definition of being viable. The most striking structures on the slide were thousands upon thousands of rod-shaped bacteria forming a lengthy rank along the surface of the mucosa, palisaded like an irregular picket line of soldiers standing at attention. Their appearance and lab tests showed that they were a genus of bacillus called *Clostridium*, closely related to the organisms that cause tetanus and gas gangrene. In fact, microscopic gas-filled spaces were visible within the layers of the bowel wall. The toxins produced by these particular

microbes are capable of causing inflammation and necrosis (death and decay) of intestine wall, hence the process is called enteritis necroticans. Grace's sepsis was caused by the clostridia, and all the bowel, neurological, and skin symptoms were the result of the bacterium and its toxins.

By this time I knew that Grace had begun to exhibit various signs indicating destruction of the cells of some of her voluntary muscle tissue, a process called rhabdomyolysis. This too was attributable to the toxins. The combination of massive clostridial growth in her intestine, sepsis, rhabdomyolysis, and the resultant diabetic chaos were the explanation for entire spectrum of destructive events that our patient had been experiencing. We could only hope that the removal of the nonviable bowel and the consequent diminution in the volume of bacteria load would enable our antibiotic and other treatments to reverse the process.

Clostridia in moderate numbers are normal inhabitants of the gut. Ordinarily they live in harmony with other bowel organisms and with the various physiological substances with which they come into contact. Unless some events occur to disrupt the balance among the gut's organisms and chemicals, the clostridia do not become sufficiently numerous to be source of danger. For those of us involved in Grace's care, the clinical challenge was to pull her through; but the intellectual challenge was now to figure out what had so upset the intestinal homeostasis that a massive overgrowth of clostridia occurred. For this, Brian West didn't have a definitive answer, but he had identified a disease model that so closely resembled Grace's that I was persuaded they were one and the same. Within a few days, and especially after West's diagnosis was confirmed by an expert in Southampton, England, the evidence had become inescapable.

It's not easy to tell the mother of an attractive young American Girl that her daughter has a disease whose name is pidgin English for "pig belly," but no more likely diagnosis has appeared in the four years since Grace's narrow escape. Except for the complications added by diabetes, the microscopic appearance of the excised tissues are exactly the same as they are in the thousands of New Guinea tribespeople who have die of the same process. Acute "Pig-Bel" is a major cause of premature death in the highlands of Papua New Guinea, with a mortality rate among those contracting the

disease of almost 85 percent. Second only to respiratory disease, it is a leading killer of children in the area. Its prevalence is highest at times of the year when ceremonial pig feasting takes place, and the disease has been so carefully studied that it is possible to describe its evolution with considerable certainty.

The pig feast is an integral part of many of the ceremonials attached to various kinds of highland celebrations and sacrifices. The meal is always prepared in a traditional manner. After the animals are clubbed to death, their intestines are removed, washed, and wrapped in leaves. Alternating layers of filleted carcass, guts, fern fronds, banana leaves, and breadfruit are placed into earth pits along with sweet potatoes or bananas, chopped greens, and stones that have been preheated. Tier by tier, a mound of the ingredients is fashioned, with insulation provided by a final packing of pig's quarter and flanks. After a large quantity of water is poured into the vapory, structured mass, more leaves and an outer layer of earth are added as a covering. In this way, a large steam oven is created whose internal mean temperature, when visiting health officers have tested it, has been 172 degrees Fahrenheit.

Not only does such a heating system result in inadequate cooking of the meat, it also provides plenty of opportunity for bacterial contamination. After all the service cooking is completed, the banquet takes place under conditions that would throw a sanitation inspector into fits of apoplectic convulsion. Those conditions are ideal for the proliferation of dangerous organisms, particular clostridia.

Ordinarily much of the clostridial toxin would be destroyed in the body by an enzyme called trypsin, to which it is very sensitive. Unfortunately, sweet potatoes contain a chemical that inhibits the action of trypsin, and sweet potatoes are not only a major constituent of pig feast but also a staple of the highland diet. The ingestion of large amounts of clostridia-rich meat accompanied by plentiful doses of trypsin inhibitor provide the perfect concoction to induce fulminating outbreaks of "Pig-Bel". The situation is made even more egregious by the common presence in local children of the intestinal roundworm *Ascaris lumbricoides*, a parasite that secretes its own brand of trypsin inhibitor, adding to what is already in the poisoned food.

As for the clinical aspects of the disease, they are precisely those that were exhibited some 10,000 miles away in New Haven, Connecticut, by Grace Lopat, minus of course the components attributable to diabetes.

If massive overgrowth of clostridia is the cause of enteritis necroticans, the disease might be expected to occur in places other than Papua New Guinea, and without the necessity for ingesting a witches' brew quite so potent as the one cooked up during pig feasting. This is in fact the case. An epidemic disease of identical nature made its appearance in northern Germany shortly after World war II. It was called Darmbrand, or fire bowels, and the doctors who studied it concluded that it was caused by unaccustomed intake of excessive amount of protein-rich food by a malnourished population. Outbreaks of the same thing have been reported sporadically in several African countries, China, Bangladesh, the Solomon Islands, and at an evacuation site for Khmer children in Thailand.

A contributing factor in such areas is that chronically undernourished people do not ingest enough protein to make sufficient quantities of trypsin. When access to meat is suddenly provided, the meal may for one reason or another be contaminated, and then the level of clostridial toxin become very high in the body of people with not enough trypsin to counteract it. This is consistent with an observation made by several of the first investigators of Darmbrand, which was that it seemed to have made its appearance when the diet was suddenly changed. The German patients were indeed chronically malnourished during the terminal phases of the war and for an extended period afterward. Those who became sick had very likely overeaten on occasions when meat, perhaps contaminated, was made available to them.

Although there have been scattered reports of individual patients dying of enteritis necroticans in prosperous Western countries, no real epidemics have occurred among populations living in areas where sanitation levels are high. But a few single cases are instructive because they illustrate some of the most dramatic aspects of the disease. In 1983, for example, a surgeon and a pathologist at England's Royal Liverpool Hospital described in the *Journal* (the British tend to be quite direct in their medical terminology, and this is the name of their most highly regarded gastroenterology journal) the case of a

23-year old photographer's model who walked into their hospital's emergency room at eight o'clock one Sunday morning complaining of abdominal pain and bloating. She told the staff doctor that she ordinarily tried to remain very thin but periodically went on an eating binge. Between midnight and four that morning she had eaten the following: 2 pounds of kidney, 1 and a half pounds of partly cooked liver, 1/2 pound of steak, 2 eggs, 1/2 pound of cheese, 2 large slices of bread, 1 whole cauliflower, 1 pound of mushrooms, 2 pounds of carrots, 10 peaches, 4 pears, 2 apples, 4 bananas, 2 pounds of plums, and two pounds of grapes. She had then gone to sleep for a few hours and been awakened by the abdominal pain.

As the medical staff tried unsuccessfully to empty the young woman's stomach with a wide-bore tube, her condition rapidly deteriorated, and she had to be rushed to the operating room. On opening her abdomen, it was seen that a section of the upper small bowel appeared to have lost its blood supply. As the surgical team watched doubtless horrified, the area of ischemia gradually extended until it involved most of the length of the gut. Soon the small gas bubbles became visible in the intestinal wall. Their patient died shortly afterward. Autopsy revealed massive clostridial overgrowth in the esophagus, stomach, and the upper portion of the small intestine.

The unanswered question about Grace Lopat is not whether she was the victim of enteritis necroticans, it seems almost certain she was. What is not known is the underlying reason for the unchecked growth of clostridia in her intestine. The amount of pork she had eaten before her earliest symptoms was not excessive; she was not malnourished; she did not ingest any significant volume of food containing a trypsin inhibitor. The only possible clue is her diabetes. The disease is well known to be capable of causing a degree of immunodeficiency, which is one of the reasons diabetics are more infection prone than the rest of us. But any indictment of a diabetic immunodeficiency is weakened by the absence of previous or subsequent evidence that she is particularly susceptible to abscesses, inflammations, or other manifestations of decreased resistance to bacteria. In searching for some underlying cause, we were left with the succinct summarizing comment entered in Grace's chart by Ann Camp, one of the interns who



took good care of her in the MICU. She called her patient's disease "interesting and mysterious."

Another of the few individual case reports of Pig Bel involved a man in the Netherlands who died 24 hours after being admitted with characteristic symptoms, in 1984. He had eaten an unspecified quantity of pork at a party the day before becoming sick, but no other guests were affected. As the paper's authors write, "It is well known that diabetic patients have a lower resistance to infections. It is therefore tempting to speculate that this may have been a contributing factor." Neither the Dutch doctors nor those of us who treated Grace can go any further than that.

Grace had improved sufficiently so that her breathing tube could be disconnected from the respirator. Twenty four hour later, in her first fully alert moment since admission, she opened her eyes. Within minutes she saw her mother looking down at her, holding a large card printed with the alphabet, which Anne had made ready for just such use. Grace gestured for the card, and pointing very slowly to each letter, she spelled out, "I have a history exam on Friday." Eleven days had passed since the operation, and she had lost every moment of them.

The improvement continued, although very slowly. It took almost three more weeks in the MICU before Grace was ready to be transferred to an acute-care floor. She stayed there an additional two months and then moved to the hospital's rehabilitation unit. She had lost a great deal of weight and considerable muscle mass in her legs, but she knew that everything was recoverable with hard work. She was finally ready to discharge from the hospital 18 weeks after she had entered it.

It would be another four months before Grace regained enough strength to return to college. Her mother considers her graduation two years later to have been the final step in a triumph not only of perseverance and luck but of Bill's protecting spirit, too. A few hours after Grace's return to wakefulness on that joyful morning four years ago, a rainbow appeared in the sky, even though there had been no rain. Anne remembers looking at it and being sure it was a good omen.

**The “big ideas” of the case “Pig-Bel”:**

The case “Pig-Bel” is mainly concentrated on the following physiological concepts:

1. Purposes of the blood. The crucial roles of white blood cells and body immunity.
2. The interaction between blood glucose, diabetes and body immunity.
3. Homeostasis. The body fluids maintain homeostasis. Body temperature regulation a phase of homeostasis. Causes of homeostasis disorders.
4. Electrolytes and their functions.
5. Regulation of respiration and oxygen therapy.
6. Digestion and absorption of digestive system. The functions of trypsin in digestion, in body protection against parasites, and in body immunity.

**Group discussion’s questions:**

1. Why the patient’s abdomen was swollen and her body was bloated?
2. Could you find out the reasons for the blood stool and the paralyzed legs and arms?
3. Could you clarify the functional interactions of white blood cells, diabetes, trypsin, and body immunity?
4. There is any possibility of this disease occurring in Vietnam? How can we prevent this disease?

## **Appendix D**

### **Group Observations**

#### **Group 1**

Group members:

1. Ms. Tran Thi Cam Thuy (Group Leader)
2. Ms. Tran Thi Kim Dung
3. Ms. Nguyen Ngoc Hue (Secretary)
4. Mr. Bui Tan Doi
5. Mr. Mai Ngoc Trung
6. Ms. Tran Thi Kim Cuc
7. Mr. Nguyen Van Thuy
8. Mr. Le Van Dai

#### **Observations of group discussion**

When the play stage started, all the members of the group moved immediately to the first row of benches on the left side of the class. The students sat side by side, face-to-face randomly with 4 students on one bench. They took about 3 minutes to get started, preparing to answer the questions which I proposed and then one female student, who was usually a little quiet in class discussion, raised her left hand suggesting the leader allow her to express her ideas. The group began discussing the case.

Dung: "Based on the first question, I think that the patient's abdomen became larger quickly just because the bacteria *Clostridium* concentrated on the intestine system causing capillaries to break, and then bleeding happened. There also was a effect on nervous system resulting in mental disorders."

Another female student immediately raised her hand, ready to join the discussion.

Hue: “I think the “Pig Bel” disease is caused by *Clostridium perfringens*. This is an obligate anaerobic endospore-forming, gram-positive rod, strong gas producing bacteria. This bacteria is very commonly found in soil, aquatic sediments and the intestinal system. Because of its spores, food that has not been heated sufficiently could not kill contaminating *C. perfringens*. In a favourable environment, especially in a rewarmed meat dishes if large amount ingested, the endospores can germinate, and an enterotoxin produced during sporulation in the gut, causes hypersecretion. Severe diarrhea comes from this symptom. I think that *C. perfringens* produces neurotoxin so it causes disorder in nervous system. The patient’s very large abdomen is caused by gas produced.”

Four students nodded meditatively, and then one of them start to talk. This time it was a male student who had shared many good ideas during class discussion.

Doi: “I completely agree with Hue. The enterotoxin is a kind of neurotoxin that depending on the amount could cause nervous disorder. Intestinal bleeding is mainly caused by bacteria’s production of gas; the intestine’s capillaries were broken due to being strongly expanded, the intestinal wall, I mean.”

The female student who started the group discussion seemed to be impatient to wait for the leader’s permission, and began speaking immediately afterwards.

Dung: “About the patient’s skin with great purple-gray blotches appearing every where, I am guessing that the large amount of enterotoxin in blood resulted in difficult circulation of blood; her skin became blotched.”

The third female student of the group promptly added:

Thuy: "I think so. Her blood could not flow smoothly because of the bacteria toxin, blood stayed still in skin capillaries and besides, intestinal bleeding was caused by the same reasons when her abdomen was in muscle spasm."

It was the last female's turn to join the group discussion.

Cuc: (Her voice a little weak) "I am thinking that the patient's skin symptom probably caused by skin gangrene. The bacteria's toxin was responsible for this. And I also believe that the toxin blocked intestinal peristalsis and rhythmic contractions that normally push along the intestine's contents. Water in intestine could not be absorbed into blood and it came out from intestine's wall into her abdominal cavity."

The female student finished her speaking with relief, her voice becoming stronger at the end of her statement. There was a short pause. One of the male students suggested the group allow him and other males to smoke.

"OK. Go ahead". A female responded. All members smiled. A male with loud voice and north country accent, the second of the male students spoke out.

.Dai: "In my opinions, in order to bring all these symptoms about, the human body needs a sufficient amount of bacteria, of their toxins. I am thinking that maybe the toxin caused the blood to be infectious, appearing through skin's blotches. It is not easy at all to treat diseases caused by endospored bacteria."

The whole group became noisy and discontented, I guessed. Some female students whispered something and then a male student interrupted with his strong and clear voice.

Doi: "I don't think so. The bacteria did not cause blood infection yet. Her skin blotched just because of difficult circulation."

Dung: "It is impossible to treat infectious blood diseases."

A stronger conflict among these students appeared clearly. Dai's face became red, his voice seemed to be excited.

Dai: "Not all infectious blood diseases are incurable. The infection of green-rod bacteria, for example, causes infectious blood but there are very few incurable cases reported."

The discussion changed the topic. Now the third male student who kept silent started to participate.

Trung: "This kind of Clostridium lives naturally in a human's intestine. The small amount of pork she ate the night before seemed not to be a cause of the terrible "Pig-Bel"."

Dung: "Because of her diabetes, the patient had very weak immunity to Clostridium."

Again all members nodded their heads. Suddenly, the last male student brought the group back into the discussion.

Thuy: "This Clostridium caused gangrene. Gas production came from the environment where they lived so it is not correct if we say blood circulation blocked. Due to lack of oxygen, gangrene happened just within certain areas."

The group became excited. Dissent appeared.

Doi: "I don't think so. Air production came from the blood's oxygen."

Thuy: "Why had the patient almost no problems with respiration?."

There was no solution to this question. The group moved to another topic.

Dung: "The English model also had very weak immunity so she died immediately after a few hours of eating contaminated food."

Doi: "It was caused by an excessive amount of the bacteria."

Thuy: "The model ate so many kinds of foods especially undercooked meat so the bacteria produced excessively but she had no problems with mentally disordered symptoms. In Grace's case things seemed different."

Hue: "The case study mentioned some tribes in New Guinea with a high annual mortality rate. Their way of cooking helps the *Clostridium perfringens* multiply rapidly."

Trung: "The case study did not say that this disease happened in our country but in my experience, through many years working at QN hospital, we have had many similar cases, if not exactly the same. We call the disease enteritis necroticans. The clostridial toxin causes the lack of oxygen in certain areas of the intestine. Cutting off the infectious parts of intestine through emergency operation is the only method that we got to treat enteritis necroticans."

Dung: "Through this case study, we learned that in order to avoid this deadly disease food, especially meat, must be cooked well, preventing clostridial multiplying in our body."

Hue: "Roundworm *Ascaris lumbricoides*, which is usually found in our children, is a parasite that secretes its own brand of trypsin inhibitor adding to what is already in the

poisoned food. So we have to protect our children from this parasite by feeding them well-cooked and sanitary food.”

The group seemed confused about Hue’s statement. Some opened the case to read it again. The silence was interrupted by a male student.

S.Do: “Yeah. I agree with Hue that trypsin secreted by the pancreatic gland is a very important enzyme for hydrolyzing protein. In this case trypsin can fight against *Clostridium perfringens*’s toxin to destroy the invaders. Through this case study we could learn many useful ways to understand the basic knowledge in the course and to make our daily life safer.”

The group was going to end the discussion by chatting some thing more about their own experiences from workplace. Relaxed conversation lasted ten minutes more and then the whole group went back to class for the “debrief” stage.

## **Group 2**

### **Group Members:**

1. Mr. Nguyen Quang Chieu
2. Mr. Le Quang Chanh (Group leader)
3. Mr. Nguyen Van Vinh
4. Ms. Hoang Thi Thanh Vy
5. Mr. Tran Van Tung
5. Mr. Cao Van Anh
6. Mr. Dang Thanh Xuan
7. Ms. Nguyen Thi Chung
8. Ms. Le Thi Lan (Secretary)



### **Observations of group discussion**

Even though there were fewer female than male students (3 females, 5 males), the discussion starter also was a female.

Chung: “ We could relate the case study to our citizens’ health and diseases. Through more than 8 years working at LD hospital as a clinical technician I think that the “Pig-Bel” disease is widespread in Vietnam. We are often confronted with the slightly different symptoms, however, patients’ bodies are not bloated and swollen as Grace’s was. It usually happens with people living in the countryside eating undercooked food, with malnourished children attacked by parasites. In almost all cases we found a lot of parasites and Clostridium. This is an obligate anaerobic bacterium which is spore forming. In our country, it is expensive to culture this bacteria in anaerobic condition so it is not easy to determine their species. Incubation period is about from 24 to 48 hours. Enterotoxin causes diarrhea and vomiting. An intestine infected Clostridium would be swollen with blood. Stools are sometimes bloody. Its toxin causes intestinal paralysis; no contractions results in necrosis. In hospitals, patients with enteritis necroticans often have to undergo operations to cut out the inflammation intestine after the whole intestinal system has been washed completely. Antibiotics must be taken.”

The group kept silent for a while. Maybe they were thinking the ideas presented by Chung.

Chieu (a student who always had many good contribution to discussions in class): “I propose that we should focus on the big ideas of the case from the 3 sections we have just studied: blood, cardiorespiratory system, and ingestive system.”

Anh: “I’m wondering whether enteritis necroticans could be the “Pig-Bel” or not. Symptoms of the two diseases are very similar to each other. In my own opinions, the “Pig-Bel” is enteritis necroticans.”

One decision-making process appeared strongly. Some other students showed their agreement by nodding their heads. The leader of the class at that time was a member of the group, and he started to talk.

Tung: "I fully agree with Chung about this case. In Vietnam, however, we could hardly find other symptoms like skin blotches, and mental disorder."

Chanh (His peers call him Robert Chanh because of his sideburns and thick beard so they usually laugh a lot whenever he speak out. This discussion is an exception; the group kept silent when he started): "I think that the case study could cover the three sections of the physiology course we just finished in its pathology. Usually there are about 6000 - 8000 / mm<sup>3</sup> white cells but in this case white cell count to 28000/ mm<sup>3</sup>. This means that there were foreign invaders in the patient's body. This bacteria could produce two kinds of toxin. One an exotoxin, the other an enterotoxin. Enterotoxin is a neurotoxin that blocks acetylcholine release at neuromuscular junctions by binding to the synapses of motor neurons and preventing the release of the neurotransmitter acetylcholine. As a consequence, muscles do not contract in response to motor neuron activity, and flaccid paralysis results. This activity of the enterotoxin could be considered to explain why Grace, the patient can not walk and or feel her hands and her legs within nearly 48 hours after eating the Chinese food. (pause for a while) Besides, the bacteria's enterotoxin produces a large amount of gas, mainly CO<sub>2</sub>, blocking blood circulation in the intestine because CO<sub>2</sub> enlarges the vein system. With diffusion and absorption functions through intestine wall blocked, fluid went out to her abdomen cavity. Gangrene set in. Enterotoxin also causes skin capillaries to disfunction; blood vessels could not contract so the patient's skin became blotched."

Some students seemed to be deep in thought, while others discussed Chanh's ideas.

Vinh: (His voice very strong and full of confidence ) “I do not agree with Chanh’s ideas. I think this Clostridium has no exotoxin. All the symptoms could be caused by enterotoxin. CO<sub>2</sub> causes the intestine to expand resulting in low blood pressure, weak pulses and finally fatality.”

The group discussion’s atmosphere became more seriously discontented. Chanh probably felt a little hurt, he tried to defend his ideas.

Chanh: “CO<sub>2</sub> make blood vessels expand for sure. Clostridium could release enterotoxin and exotoxin for sure. Exotoxin is often a special protein.”

Tung: “Yeah. 0.2 ml of clostridial toxin could kill an adult.”

Chieu: “I agree with Chanh about clostridial toxins. This bacteria has both enterotoxin and exotoxin and because of positive gram bacteria, toxins could be released directly to the environment around. I also wonder whether or not the “Pig-Bel” is our common enteritis necroticans but to my knowledge, only Clostridium perfringens can cause gangrene.”

Chanh: “I am sure that only an exotoxin could cause mental disorder, I mean neuron functional disorder. The patient could not control herself from screaming, and complaining loudly.”

Chung: “I am thinking about the production of a vaccine that could prevent this disease. What do you guys think?”

Chanh: “I do not think that we have to produce a special vaccine for this disease because we can control it easily by eating only cooked meat.”

Anh: "Live clostridium secrete exotoxin, and dead clostridium corpses disintegrate and release enterotoxin."

Tung: "Yeah. And because of an excessive release of CO<sub>2</sub>, blood vessels expanded resulting in a swollen body."

Vi: (a female student who often spoke in class discussion, but who was rather quiet in case study's "play" stage) "I believe that with her chronic diabetes, the patient had very weak immunity to fight against the bacteria so she got terribly ill."

Chieu: "We did talk about how clostridial toxin causes mental disorder, the patient's distended intestine and her bloated abdomen too. These symptoms caused excessive fluid retention, mineral absorption failure and then kidney failure. The amount of urea, and potassium in her body resulted in disordered acid-base balance. This was also a reason for her bloated body, rapidly increasing from 125 to 185 pounds."

Lan: (who, as a secretary, rarely spoke) "One of my own children experienced the similar symptom when she was in daycare. I do not know what she ate over there but we had to send her to hospital immediately. Fortunately she did not undergo any operation, just antibiotic drugs and serum support. So I think we have to be careful with uncooked food."

Vi: "I agree with Lan."

The group became noisy talking about Lan's child. They asked many things about the child. Discussion seemed to be ended. Students were going to participate in the "debrief" stage of the case study. I heard them assigning a group representative for the next stage.

### **Group 3**

Group members:

1. Mr. Tran Duc Tho (Secretary)
2. Ms. Phung Thi Tho
3. Ms. Dang Thi Thu Huong
4. Mr. Le Thien Phong
5. Ms. Tran Thi Ngoc Huong (Group leader)
6. Mr. Dao Huong
7. Ms. Dinh Thi Thuy Thanh
8. Mr. Tran Van Hung

### **Observations of group discussion**

Three male students did not attend class so only 8 group members showed up. Fortunately the number of males and females was equal in group discussion. Again a female student began to discuss first.

Thanh: "The case study has connections to the three sections of the physiology course we just finished. I found that the mechanism of diabetes has a very negative effect on the human body's immunity to fight against foreign invaders such as viruses, bacteria. The patient, who was very young, with her chronic diabetes got completely ill even after eating a small amount of pork. The case study indicates Clostridium and we have many species of Clostridium. What species causes the "Pig-Bel"? Do you have any ideas about this?"

D. Huong: "Clostridial toxin causes gangrene. The mechanism of gangrene is to cause a lack of oxygen, nutrients, minerals, and water which come from blood for tissues' consumption. Once gangrene has appeared, bleeding will be a consequence. In this case the bacteria produces gas, probably CO<sub>2</sub>, which causes veins to expand, blood pressure to

decrease, and then respiration to fail. We know about enteritis necroticans in our country but we are not sure whether the “Pig-Bel” is enteritis necroticans or not.”

N Huong: “The patient’s intestine was paralyzed because of acetylcholin blocking caused by clostridial toxin.”

T. Huong: “Yeah. Diabetes makes our body become too weak to resist harmful bacteria. That’s why the number of white blood cells increased so much: 28 thousand in this case. Clostridium toxin binds to the synapses of motor neurons and prevents the release of the neurotransmitter acetylcholin.”

Phong: “Because of enteritis necroticans, water and food could not go through the dead intestine. The blockage caused nausea, and vomiting and the liquid went naturally from intestine to abdominal cavity based on the mechanism of diffusion. The patient’s girth became larger not only because of intestinal gas but also because of the liquid in her abdominal cavity.”

Tho: “Yeah. And I want to add one more thing: the patient’s body became bloated which is also accounted for by her kidney failure; with her chronic diabetes, her kidneys were not strong enough to absorb and to secrete waste substances. The acid-base balance was disordered. Acid seemed to be accumulating at a too high level in her blood which finally brought her to coma.”

Hung: “I agree with you all, and we have one more important piece of information about the patient. Do you find it strange that her original weight was 125 pounds and just before the operation she gained 60 pounds (185 pounds) ? If this is true, I think that the gas production was very high but her girth, her whole body blew up, bloated on account of the blockage of liquid intake through mouth and veins.”

A female student opened her book, which was written in Vietnamese. She read for a while and nodded her head as if she found something interesting related to the case study. Others seemed to wait for her ideas collected from the book. And then she joined the discussion.

Thanh: (Hmm) “Listen to me, people. I just found something here. We can come to a conclusion about whether the “Pig-Bel” is enteritis necroticans. They say (read the book) about “Air producing enteritis necroticans”: Caused by *Clostridium*.” (She looked at her peers to see whether they were paying attention to her reading or not). “The dead tissues caused by protein destruction. The body bloated and gas produced. Toxic infection quickly prevails throughout the whole body. High temperature, fast pulse, vomiting, exhaustion, partial paralysis, and sometimes spasms occur. The color of the skin changes, sometimes appearing burnt, sometimes appeared bruised.”

She stopped reading the book, waiting for others’ response.

Tho: “There was one thing different, the patient did not have a high temperature.”

Thanh: “That is not important, sometimes it depends on individual.”

D. Huong: “I think that the “Pig-Bel” is enteritis necroticans. But I wonder why the case study did not mention Vietnam in the list of the countries where the “Pig-Bel” exists.”

Tho: “Usually we have more simpler cases than that of the American patient. If a person does not get seriously ill, a course of medicine is enough. If the case is more severe, intravenous fluid must be supplied quickly.”

Phong: “We have learned many things from the case study. In order to prevent this “Pig Bel” we must cook food well and under sanitary conditions.”

N. Huong: “Vietnamese people like raw and fresh bloody dishes very much. I think we have to educate people about this disease and recommend that they not to eat such dishes any more.”

Hung: “Quite a few of Vietnamese people get diabetes. Diabetic patients, however, should follow their doctors’ instructions about food.”

D. Huong: “We also should avoid of eating food at feasts or banquets. The more the variety of the cuisine is, the easier it is for them to acquire bacteria infection.”

Thanh: “Yeah. I agree with you. And our government should be concerned with public sanitary sources; clean water supply, good sewage system processing, good garbage disposal, etc.”

N. Huong: “And the government should also pay attention to food processing. Food must be clean.”

Phong: “The most important thing is for families have to take care of themselves, especially their children.”

#### **Group 4**

##### **Group members**

1. Ms. Nguyen Thi Kim Phuong
2. Ms. Do Thi Le
3. Mr. Ho Van Nam
4. Mr. Tran Ngoc Nhon
5. Mr. Van Thien Minh (group leader)
6. Ms. Nguyen Thi Nga (secretary)
7. Mr. Le Kim Ngan



8. Ms. Nguyen Thi Bach Ngoc

### **Observations of group discussion**

Phuong: “This is an interesting case raising many issues related to the course. First of all, the mechanism of homeostasis helps our bodies regulate and maintain the constancy of the internal environment at appropriate levels so that glucose blood, CO<sub>2</sub> and pH levels remain balanced. Kidneys, lungs, heart, sweat glands, salivary glands, skin, central nervous system, and endocrine glands are responsible for the homeostatic processes. The patient had chronic diabetes so the high blood glucose level brought her trouble. Let’s consider her bloated body.”

Nhon: “I think that the Clostridium produced air and toxin which made the patient’s intestine bloated.”

Ngan: “Yeah. And Clostridia in a high numbers would dominate other microcubes, increasing their population quickly, and releasing their toxin. This toxin is a kind of neurotoxin which binds to synapses of motor neurons and prevents the release of Acetylcholin, a kind of neurotransmitter that increases the intestinal contraction. Gas and other materials exchanged more slowly and finally the gut lacks of oxygen resulting in gangrene.”

Nhon: “I also think that the fluid exchange, I mean water, minerals, and electrolytes was blocked by that necrosis. The blockage of body fluids caused her body to become swollen.”

Ngoc: “Clostridia in moderate numbers are normal inhabitants of the gut, and not harmful. Usually they live in harmony with other bowel organisms and with the various physiological substances with which they come into contact forming a community of organisms in our gut. One thing we are sure that the patient’s intestinal homeostasis was

upset because a massive overgrowth of clostridia occurred. The clinical symptoms are very similar to enteritis necroticans frequent in Vietnam; blown-up abdomen, vomiting, bloody stools including with black feces, respiratory failure, weak vessel pulsing but no body bloating. I am wondering whether it is the “Pig-Bel” or not.”

Le: “Clostridia germinated rapidly, with their toxin release blocking the neurotransmitter acetylcholin so her intestine became inactive. Fluid went through from intestinal wall to abdominal cavity and made her abdomen swollen. I think this patient had diabetes so the symptoms were a little different from our enteritis necroticans. This “Pig-Bel” might be enteritis necroticans.”

Phuong: “Yeah. I think the author of this story did not come to Vietnam” (all laughing). “Actually in our country children get the disease more often than adults.”

Ngoc: “Yes. Because children have weak immune system to attack the invasion of the bacteria. Besides, our children’s guts in general are the habitat of parasites. Roundworm *Ascaris lumbricoides* release a special chemical that can be trypsin inhibitor. Trypsin is an enzyme that could destroy clostridia. And one more important thing is sweet potatoes in our country are still a main source of starch for meals for many families in the countryside which are too poor to get rice. So that’s why our children often get this disease more than adults.”

Nhon: “I completely agree with you.”

Ngoc: “Fortunately Vietnamese people still rarely have diabetes. But the organization of our public sanitary systems is quite poor; food, water, and sewage are still a big concern so we have been plagued by this disease.”

Nam: “Yes. I have one thing to add to our discussion. Hmm.. When our brain lacks of oxygen, we go into a coma.” (all laughing).

Phuong: "We still have many things to talk about regarding this case. I am hoping that we will have more cases to discuss. This is a way to get more understanding of the course."

Many said yes. Students got up and left the room to go back their class next door.

## Appendix E

### Background Survey with Consent Form

(Student's background with consent form written in Vietnamese)

#### THÀNH PHẦN SINH VIÊN VÀ SỰ TÌNH NGUYỆN THAM GIA VÀO CUỘC ĐIỀU TRA CƠ BẢN

Họ và Tên: HOANG THI MY LINH

Sinh viên năm thứ: 1  2  3  4

Sinh ngày 29 tháng 6 năm 1972 tại QUANG NAM

Dân tộc: KINH      Giới tính: NỮ      Tôn giáo: KHÔNG

Chỗ ở hiện nay: 13 DINH TIEN HOANG - TP. DA LAT

Trình độ ngoại ngữ

Anh: TRINH ĐỘ B

Pháp: \_\_\_\_\_

Nga: \_\_\_\_\_

Khả năng học tập: KHÁ

Môn học hoặc chuyên ngành đang theo: THỰC NGHIỆM

Môn học ưa thích nhất: HÓA SINH - VĨ SINH - ANH VĂN

Ước vọng sau khi học xong: CÁN BỘ NGHIÊN CỨU

Tình nguyện tham gia vào cuộc điều tra cơ bản với:

Bản thảo dò ý kiến của sinh viên

Phỏng vấn có ghi hình và thu băng

Đại Học Đà Lạt, ngày 20 tháng 9 năm 1995

Ký Tên



HOANG - THI - MY - LINH.

## Appendix F

### Course Evaluation

(Student's course evaluation written in Vietnamese)

Trường Đại Học Đà Lạt  
Ban Sinh Học  
Lớp Sinh Tại Chức K94  
Học kỳ I NK 95 - 96

#### BẢNG ĐÁNH GIÁ CÁC PHẦN ĐÃ HỌC THUỘC MÔN SINH LÝ ĐỘNG

Qua 20 tiết học với 4 chương đầu của giáo trình cơ sở môn Sinh Lý Động Vật do giảng viên Đoàn Thị Mỹ phụ trách tôi nhận thấy có những vấn đề cần đóng góp sau:

##### Phần I - Về Nội Dung Môn Học:

Nội dung môn học được giảng dạy có những ưu khuyết điểm sau:

Ưu điểm: Có các tài liệu in lên cho học viên đi chú ý trong  
vài lúc học. Nếu là tài liệu cũ và học viên đi mua  
Bảng hình ảnh và chương trình học rất tốt cho học viên.

Khuyết điểm: Cần thêm tài liệu tham khảo.

Những điều nên làm để cải thiện nội dung môn dạy tốt hơn:

##### Phần II - Về Giáo Viên:

Giáo viên có những ưu khuyết điểm trong quá trình theo lớp:

Ưu điểm: Đây là phương pháp dạy tốt, học tốt.  
giáo viên luôn kết câu hỏi - vấn đề để học viên giải quyết

Khuyết điểm: Cần tổng kết những câu hỏi sau khi đưa ra bài  
lập để biết kết quả sau khi thảo luận.

Đánh giá các phần đã dạy :

- Chưa đạt yêu cầu với mô hình giảng dạy yếu  
 Đạt yêu cầu với mô hình giảng dạy trung bình  
 Rất đạt yêu cầu với mô hình giảng dạy tốt

Dalat ngày 12 tháng 10 năm 1995

## Appendix G

### Self-Evaluation

(Student's self-evaluation written in Vietnamese)

Trường Đại Học Đà Lạt  
Ban Sinh Học  
Lớp Sinh Tại Chức K94  
Học kỳ I NK 95 - 96

#### TỰ ĐÁNH GIÁ HỌC TẬP VÀ THẢO LUẬN Môn Sinh Lý Động Vật

Sinh viên tự đánh giá sự học tập và thảo luận tại lớp và tại tổ của mình bằng cách chọn theo thang điểm từ 0, 1, 2, 3, 4, 5.

##### I \_ Học tập:

- |   |   |
|---|---|
| 1. Nghiên cứu kỹ giáo trình trước khi đến lớp   | 3 |
| 2. Tìm hiểu về môn học qua sự tham thảo các tài liệu khác (cho cả học tập và thảo luận) ngoài bài giảng và giáo trình đã có | 0 |
| 3. Vận dụng kinh nghiệm, kiến thức có sẵn qua quá trình công tác vào môn học  | 3 |
| 4. Liên hệ chặt chẽ các vấn đề thảo luận trong lớp và trong nhóm vào môn học  | 3 |
| 5. Chuẩn bị ôn thi nghiêm túc, kỹ và độc lập  | 4 |

##### II \_ Thảo luận:

- |   |   |
|---|---|
| 1. Tham gia trình bày ý tưởng rõ ràng, mạch lạc và có sức thuyết phục trước lớp và trong nhóm                   | 2 |
| 2. Đưa ra nhiều câu hỏi trước lớp để giáo viên và các bạn cùng giải quyết                                       | 2 |
| 3. Luôn tôn trọng ý kiến của bạn và mong được học tập nhiều hơn từ các ý kiến này                               | 4 |
| 4. Khiêm tốn và khéo léo phân tích quan điểm của các bạn để vấn đề được sáng tỏ hơn là làm cho bạn bị "mất mặt" | 3 |
| 5. Có thái độ cử chỉ lịch lễ, động viên bạn trong lớp và nhóm thảo luận   | 4 |

Tổng số điểm: 28

Trường Đại học Đà Lạt ngày 14 tháng 10 năm 1995

Họ và tên: Đặng Thị Thu Hương

Ký tên

## Appendix H

### Midterm Examination Questions

1. What is the main function of erythrocytes? leukocytes? platelets? Where does it originate?
2. What are the advantages of blood banks? Are there any disadvantages? If so, what are they, and is there a way of counteraction these disadvantages.
3. Describe the basic steps in the clotting process, and try to relate the facts to one of hemorrhage diseases if you know.
4. Trace a drop of blood through the shortest possible route from the capillaries of the foot to capillaries of the head.
5. What are some examples of disorders that cause hypertension of a persistent kind? Of what importance is diastolic blood pressure?
6. Describe normal breathing, including 2 phases, respiratory rates, mechanism of breathing and nerve control.
7. What are some possible causes of lung cancer?
8. Trace the path of an indigestible object from the mouth through all parts of the alimentary canal to the outside and tell what happens on the way.
9. Name and describe the functions of the enzymes in the stomach juice. How do they function in the small intestine?
10. Describe what happens in the formation of a peptic ulcer. Where does it occur?