

A STUDY OF THE IMPACT OF COOPERATIVE SMALL GROUP FACILITATED CASE  
STUDIES ON STUDENT LEARNING OUTCOMES

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## ABSTRACT

A cooperative small group facilitated case-based learning method has been used in the medical college at the researcher's educational institution since the 2003-2004 academic year. They were designed to be a supplement to a primarily lecture-based curriculum where it was believed that these cooperative cases helped students to develop a better understanding of the material taught in the lectures, although no rigorous investigations had been completed. The purpose of this study was to investigate the impact of these cooperative facilitated small group cases on five specific outcomes which included: 1) achievement, 2) knowledge confidence, 3) student satisfaction, 4) student's perceived time on task, and 5) the student's perceptions of the degree to which they believed a facilitator helped them to learn the material. These outcomes for cooperative learning (CL) were compared with individual learning (IL) outcomes. Quantitative data on student achievement and knowledge confidence were collected using a pre-test post-test 10 multiple choice question quiz. A brief questionnaire was also distributed to students to collect data regarding student satisfaction, time on task and perceived helpfulness of the facilitator.

Fifty-nine medical students were randomly assigned to either the CL or IL cohort (cooperative cohort,  $n = 32$ ; individual cohort,  $n = 27$ ). All students were blinded to the purpose of the study until all data were collected at the end of the investigation. Students completed the 10 multiple choice question pre-test. After each question they rated their level of confidence (on a scale from 1 to 10) that they had chosen the correct answer. Immediately after completion of the pre-test, they worked on the case, either cooperatively or individually. One week after the pre-test and case, the students completed the post-test quiz with the same questions, as well as the questionnaire.

A repeated-measures MANOVA was used to compare achievement and confidence in the CL (n =19) and IL (n =13) cohorts. An alpha level of .05 was used for all statistical tests. Effect sizes (d) were calculated for within-group and between-groups comparisons for achievement and confidence. Descriptive data on student satisfaction, time on task and facilitator helpfulness were gathered from the questionnaire and compared between groups.

Within-group results from the study showed that CL had a greater impact on student achievement and confidence than IL (achievement,  $d = 0.57$  vs.  $0.16$ ; confidence,  $d = 0.52$  vs.  $0.14$ ). The results for the statistical analysis did not reach significance for achievement or confidence. Between-groups effect sizes were calculated for average pre- to post-test change for achievement and confidence (achievement,  $d = 0.35$ ; confidence,  $0.40$ ). Students in the CL cohort reported spending more time on task before and during the case session and less after the session. They also reported greater levels of satisfaction with the learning experience than IL group. The majority of students (90.5%) in the CL cohort felt that the facilitator helped them to learn.

The findings from this study showed that this CL method had a greater impact on the five outcomes outlined above compared to the IL method. Students made greater gains in achievement and confidence. They also spent more time on task, and had higher levels of satisfaction with the learning experience. Students in the CL cohort also believed that the facilitator helped them to learn. Implications of the study include possible expanded use of the cases within the curriculum of this medical college although the demands of resources and curriculum content would have to be carefully considered.

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Two roads diverged in a wood, and I--

I took the one less traveled by,

And that has made all the difference.

- Robert Frost

## TABLE OF CONTENTS

	Page
Permission to Use.....	i
Abstract.....	ii
Acknowledgements.....	iv
Table of Contents.....	vii
List of Tables.....	xi
List of Figures.....	xii
<b>Chapter I Introduction.....</b>	<b>1</b>
Purpose.....	2
The Bahar-Ozvaris et al. Study.....	3
The Cooperative Case Process.....	5
Definition of Terms.....	9
Significance of Study.....	11
The Context of the Researcher.....	12
Limitations and Delimitations of Study.....	13
Summary.....	16
<b>Chapter II Literature Review.....</b>	<b>18</b>
What is Cooperative Learning?.....	18
Face-To-Face Promotive Interaction.....	20
Social Skills.....	23
Positive Interdependence.....	24
Individual Accountability.....	26

Group Processing.....	28
Theory and Rationale for Cooperative Learning.....	30
Social Interdependence Theory.....	30
Cognitive – Developmental Theory.....	31
Cognitive – Elaboration Theory.....	34
Constructivism and Other Cognitive Principles in Cooperative Learning.....	35
Social Loafing – An Obstacle to Cooperative Learning.....	37
Time on Task in Cooperative Learning.....	39
Cooperative Learning and Student Achievement.....	41
Meta-Analyses and Reviews of Cooperative Learning.....	42
Cooperative Learning in Health Sciences and Medical Education.....	45
Cooperative Learning and Student Knowledge Confidence.....	47
Cooperative Learning and Student Satisfaction.....	49
The Facilitator’s Role in Cooperative Learning.....	50
<b>Chapter III Research Methods.....</b>	<b>52</b>
Design.....	52
Participants.....	54
Identification of Variables.....	56
Procedure.....	56
Ethical Considerations.....	63
Data Analysis.....	64
<b>Chapter IV Results.....</b>	<b>68</b>
Description of Events for the Control Group Case Session.....	68

Control Group – Group Processing Comments.....	72
Type of Analysis and Breakdown of Experimental and Control Groups.....	73
Achievement – Cooperative vs. Individual Learning.....	77
Confidence – Cooperative vs. Individual Learning.....	80
Questionnaire Results.....	84
Student atisfaction – Cooperative vs. Individual Learning Groups.....	84
Time on Task – Cooperative vs. Individual Learning Groups.....	85
The Role of the Facilitator in the Student Learning Experience.....	90
<b>Chapter V Summary, Discussion, and Conclusion.....</b>	<b>92</b>
Summary.....	92
Discussion.....	93
The Effect of Cooperative Learning on Student Achievement.....	94
The Effect of Cooperative Learning on Student Confidence Levels.....	99
The Impact of Cooperative Learning on Time on Task.....	106
Cooperative Learning and Student Satisfaction.....	109
The Role of the Facilitator in Cooperative Learning.....	111
Discussion Summary.....	114
Limitations Revisited.....	115
Implications of Study.....	118
Possibilities for Future Investigation.....	120
Concluding Comments.....	122
<b>References.....</b>	<b>126</b>
<b>Appendix A – Application for Approval of Research Protocol.....</b>	<b>134</b>

<b>Appendix B – Diabetic Ketoacidosis Case .....</b>	<b>150</b>
<b>Appendix C – Diabetic Ketoacidosis Case Questions.....</b>	<b>153</b>
<b>Appendix D – Facilitator Briefing Package for Diabetic Ketoacidosis Case.....</b>	<b>155</b>
<b>Appendix E – Cooperative Small Group Student Roles.....</b>	<b>159</b>
<b>Appendix F – Pre/Post-test Questions for Study.....</b>	<b>161</b>
<b>Appendix G – Individual Accountability and Group Processing Sheet.....</b>	<b>165</b>

## LIST OF TABLES

Table	Page
1. Composition of Experimental and Control Groups.....	54
2. Correlations Between Dependent Variables.....	74
3. Number of Students Who Completed the MCQ and Confidence Rating Portions of the Pre- and Post-tests.....	76
4. Descriptive Statistics for Pre- and Post-tests and Average Pre- to Post-test Change for Control and Experimental Groups Using Repeated Measures.....	77
5. Summary of Repeated Measures MANOVA and Univariate ANOVAs for Within-Group and Between-Subjects Effects of Cooperative and Individual Learning on Test Score.....	78
6. Effect Sizes for Achievement Comparing Cooperative and Individual Learning.....	80
7. Descriptive Statistics for Pre- and Post-test Confidence and Average Pre- to Post-test Confidence Change for Control and Experimental Groups Using Repeated Measures.....	80
8. Summary of Repeated Measures MANOVA and Univariate ANOVAs for Within- and Between-Subjects Effects of Cooperative and Individual Learning on Confidence Ratings.....	81
9. Effect Sizes for Confidence Ratings Comparing Cooperative and Individual Learning.....	83
10. Frequencies for Student Satisfaction Questions by Group.....	85
11. Frequencies of Preparation Times for Experimental and Control Groups.....	86
12. Frequencies of Learning Resources Used for Pre-case Preparation by Group.....	87
13. Time on Task During the Case Session by Group.....	88
14. Time on Task After the Case Session by Group.....	89

## LIST OF FIGURES

Figure	Page
1. Orientation of Group A in the Individual Learning Cohort.....	70
2. Orientation of Group B in the Individual Learning Cohort.....	71
3. Comparison of Standard Error of the Means for Pre- and Post-Test Scores Between Groups.....	79
4. Comparison of Standard Error of the Means for Pre- and Post-Test Confidence Ratings Between Groups.....	83

## CHAPTER I

### Introduction

In 2003-04, the College of Medicine at the University of Saskatchewan introduced integrative cooperative facilitated small group case studies into the first year of the medical school curriculum to supplement the primarily lecture style presentation of content in the basic science courses. The purpose of these cases was to provide students with the opportunity to apply basic science concepts, taught initially through lectures, using relevant clinical scenarios to promote deeper learning and consolidation of concepts (Johnson and Johnson, 1999a). The problems presented to the students were either based on real clinical cases or fictional cases, but designed to be realistic in presentation, which helped to demonstrate the important relationship between basic science concepts and clinical situations. It was thought that this would help the students to recognize the relevance of the material being taught and help them to *use* the basic sciences material in a realistic scenario, which in turn would contribute to deeper learning.

The term “integrative” was used because the case questions addressed topics from the many basic science, professional issues, and ethics courses taught in the first year of medical school. These cases were not designed to facilitate students’ ability to make diagnoses or to develop treatment and management plans. These skills are taught in subsequent years.

Cooperative learning (CL) methods have been used extensively for students from K-12 and also in post-secondary education settings (Slavin, 1995; Johnson & Johnson, 1999b; Johnson, Johnson and Stanne. Multiple CL methods have been developed during this time (Johnson, Johnson & Stanne, 2000; Slavin, 1995) and at the heart of each method is the principle that the “students work together to maximize their own and one another’s learning” (Johnson & Johnson, 1990b, p.69).

The impact of CL methods on student learning outcomes or student achievement has been investigated extensively in the literature over the last century (Johnson, Johnson & Stanne, 2000). In the many studies and meta-analyses performed by various researchers, CL methods have consistently produced positive effects on student achievement (Johnson et al., 2000; Slavin, 1995). The focus of much of the research has been on the investigation of the impact of CL for K-12 students; however, progressively more research is being performed at the post-secondary level (Stockdale & Williams, 2004).

The CL method developed in the College of Medicine at the University of Saskatchewan was based on the model of CL developed by Johnson & Johnson (1999b) which consists of five essential elements – face-to-face promotive interaction, social skills, individual accountability, positive interdependence and group processing (these elements are defined and discussed in Chapter 2). There has been no description of the specific CL method used at this institution or research in the literature that has investigated the impact of this form of cooperative case-based learning on student achievement, which was why it was important to investigate its effectiveness.

### **Purpose**

The purpose of this study was to determine the impact of cooperative small group facilitated case studies on two student learning outcomes: a) student achievement; and b) student confidence with their knowledge of the material – this will be referred to as knowledge confidence. To do this, a pre-test post-test comparison (encompassing both achievement and confidence) of this CL method and individualistic learning (IL) was performed. It is important to

note that the impact of CL was the focus of this study, not the investigation of the impact of case-studies. The case-studies provided the context or the vehicle for studying CL.

Another purpose of this study was to collect information on three important areas of interest for this CL method. These included: a) a comparison of student satisfaction with the CL and IL methods; b) a comparison of the students perceived amount of time on task in the CL and IL groups before, during and after one case session; and c) student perceptions of the degree to which the facilitator helped them to learn the content discussed during the case session.

By studying these cooperative small group case studies the following questions were addressed. What is the impact of this CL method on students' achievement and knowledge confidence? Is there a difference in the perceived amount of time students spend on task during the cooperative case study method compared to the individualistic method? What is the level of student satisfaction with this CL method compared to completing case studies individually? Do the students participating in this CL method believe that the facilitator helps them to learn?

### **The Bahar-Ozvaris et al. Study**

Bahar-Ozvaris, Cetin, Turan and Peters (2006) presented research on the impact of Student Team Learning (Slavin, 1995), a specific form of CL, on student achievement compared to using lectures. Their study's purpose was very similar to the purpose of the present research study. Also, the methodology of the Bahar-Ozvaris et al. (2006) study was similar, in many ways, to the procedure designed for this researcher's investigation (the details of the differences in methodology will be discussed in Chapter 3). Incidentally, the purpose and design of the present study was decided prior to the discovery of the study by Bahar-Ozvaris et al. This study was, however, helpful in adding face validity to the researcher's study.

Although there were many similarities between these two studies, particularly for methodology and purpose, the researcher felt that the present study was not a replication for the following reasons. The study by Bahar-Ozvaris et al. used a CL method that was different from the method used at the researcher's institution. Johnson, Johnson and Stanne (2000) in their meta-analysis evaluated different methods of CL and their effect on achievement compared to individual and competitive methods. They found that different CL methods produced different levels of student achievement. The results favoured all CL methods studied when compared to individualistic and competitive methods; however, because the CL method used by Bahar-Ozvaris et al. (2006) was different, it was important to study the impact on student achievement of the CL method used at this institution.

A second important difference between these two studies was that Bahar-Ozvaris et al. (2006) used the Student Team Learning cooperative method in conjunction with a problem-based learning (PBL) curriculum. In this medical college, lectures have been the predominant instructional method. These CL exercises were a curricular addition to allow the students to apply the information provided in the lecture with the intention of facilitating learning through the cooperative discussions. No new information was taught. This important difference in educational methodology between these two studies was highlighted in order to reinforce the necessity to investigate the method used at this institution.

The premise of PBL is that the *problem* or case scenario stimulates the learning (Colliver, 2000). In PBL, all of the learning occurs through active discussion and information seeking among the students independent of faculty direction; there are very few lectures, if any. The discussion of the problem and identification of learning issues by the students guides and creates the learning experience. PBL is a commonly used collaborative educational method in many

medical schools throughout the world and has also expanded into non-medical education curricula (Albanese, 2000). However, its effectiveness as a learning method has been debated widely in the literature (Colliver, 2000; Albanese, 2000). Bahar-Ozvaris et al. (2006) reiterated the comments of Albanese (2000) when they suggested that, in PBL, it may be the absence of some of the essential elements of CL that produced the ambiguous results for student achievement.

With the possibility of the absence of certain elements of CL within PBL and because of differences in instructional methodology between PBL and the specific CL method used at this institution, the researcher has limited the discussion of PBL to studies that specifically investigate it as a *cooperative* activity.

### **The Cooperative Case Process**

The cooperative facilitated small group case studies were a supplement to the existing curriculum which consisted mostly of more conventional lecture-style presentations of information. By using the cooperative small group cases, an active learning component to the course was added. Also, the case study format raised the students' awareness of the important relationship between basic science concepts and clinical medicine, which increased the relevance and motivation for students to learn (D'Eon & Crawford, 2005). Finally, by having the students meet in cooperative small groups, it gave them an opportunity to teach and learn from one another through discussion in a safe environment, which allowed them to solve problems and apply the information they received in class. The cases were designed by collaboration of basic science content experts with some input from clinicians. There are 14 cooperative small group cases throughout the academic year.

The cases are organized as follows. The students attend regularly scheduled lectures and laboratories as outlined in their course syllabus. The cases are scheduled such that the students are taught the related content in the lectures and labs prior to discussing the assigned case in their small groups. All cases are made available to the students to read online or download through their internet course management system at the beginning of the academic year (Appendix B). The cases are accompanied by a list of pre-session reading topics. The pre-reading topics help to guide the students in their preparation for each case. The students are told that they may use any source or set of resources available to them during their preparation with the advice that any source should be scientifically or medically reliable. The students do not receive any more information than this and they also do not receive any of the designated discussion questions ahead of time.

The discussion questions are not handed out with the case scenario prior to the discussion because there is the potential for students who are typically enthusiastic to complete the questions in great detail ahead of time; whereas the students who are not as keen to not attempt to answer the questions, or do so only superficially. As a result, when the group meets, the students with the answers simply read out their answers and the other students copy them down without any thought or learning involved. This has been referred to in the literature as “free-riding” (Slavin, 1995) or “social loafing” (Karau & Williams, 1993), which will be discussed in Chapter 2. By waiting to hand out the questions, whether students are prepared or not, they still need to read the questions and integrate the information that they acquired (whether it was just from attendance at the lecture or from independent study) to solve the problem presented by the case. It was hoped that this would lead to increased levels of discussion and learning; however, it had not been formally studied in the context of these cases.

Prior to each face to face case discussion session, the students are randomly assigned to small groups of seven or eight students with one facilitator per group. Students are also randomly assigned to different groups for each case. The facilitators are volunteer fourth year medical students, faculty, or basic science graduate students. The fourth year medical students and graduate students have knowledge of the subject area from previous experience from either undergraduate or earlier medical school courses. It is required of all facilitators to attend a facilitator briefing meeting to explain their role within the group and to understand the group process. It is made clear to the facilitators that these sessions are not small group tutorials or lectures; rather, the facilitator's role is to act as a *guide* to help the students when they are struggling with an answer by giving them hints, probing questions, or alternative hypotheses to encourage further discussion (Appendix D).

On the day of the case each group of students and the facilitator meet at their assigned location where they have 60 minutes to complete the discussion and group de-briefing. The facilitator asks for volunteers for some basic group roles: *manager*, *timer*, *checker*, *encourager* and *contributor* (Appendix E). The manager is the leader and assigns simple tasks, for example, asking a group member to read questions out loud to the group. The timer ensures the group finishes on time. The checker is responsible for making sure that each student in the group is confident that he/she understands the answer to each question before moving on to the next question. This is an important role and its exercise often leads to important clarifications or recognition of misconceptions within the group. The encourager and contributor roles are most often assumed by all students within the group. By having one student take on each role it emphasizes the importance of these roles by making them explicit.

Next, the questions for the case (Appendix C) are distributed and at this point the students take control of the session. They discuss each question in turn and come to a consensus regarding the answer. They are encouraged to bring in and use any resources that they feel would be helpful during the discussion session. Most students bring their notes and course textbook, while a few others bring a computer with internet access or handheld personal digital assistants (PDA) containing medical encyclopedias and/or dictionaries.

Once all of the questions are have been answered the students are asked to fill out a group processing form (Appendix G) which encourages the students to consider what made the group function well and what could have made it function better. This information is also practically useful because it provides feedback for the coordinator who can use the specific student comments to make any changes to the administration of the cases.

After the group processing portion is completed, the students are asked to answer the “mystery” or individual accountability question, which was one of the questions the students had already discussed in the group. This question is selected ahead of time by the content expert and addresses one or two basic science concepts that the content expert feels are important for the students to understand. It is important that the students not know which question is selected otherwise they might focus their time on this question and put less emphasis on discussing the other questions. Furthermore, keeping this question secret means they have to ensure that they understand all questions discussed in the case. The written responses are handed in and marked as pass/fail and given back to the students with feedback regarding their answers. The feedback is useful for the students as formative evaluation to assess their learning. Correcting the individual accountability question is also useful for the evaluator to assess the level of

understanding of the concepts of that specific question, with the possibility for review of misunderstood concepts later.

### **Definition of Terms**

A number of terms and concepts that relate specifically to this study must be clarified. The College of Medicine at the University of Saskatchewan has a four year Medical Degree program that enrolls approximately 60 students per year. This is a smaller class size in comparison to other medical schools across Canada, which is important if one is considering the use of these cooperative small group case studies as a potential instructional strategy.

The first year of the curriculum (Phase A) consists of mainly basic science courses (discussed below). The students are also introduced to basic interviewing, communication and physical exam clinical skills. The second year (Phase B) and first half of third year (Phase C) focuses on teaching the clinical aspects of medicine in all of the organ systems of the body; for example, the cardiovascular, respiratory, and gastrointestinal systems. The other major focus is on the continued advancement of clinical skills. In the second half of third year and all of the fourth year (Phase D), the students work full time in the hospital and physician clinics, where they rotate through many specialties in medicine. Some examples include; emergency medicine, family medicine, pediatrics, neurology, obstetrics and gynecology, and surgery. This gives students the opportunity to practice what they have learned, in a real-world environment.

Basic Sciences – This term refers to the courses taught in the first year of the Medical Degree program. They include Physiology, Anatomy, Biochemistry, Histology, Embryology and Cell Biology. These courses do not focus on the clinical aspects of medicine; rather, they provide the scientific knowledge base necessary for understanding pathophysiology and medical

therapies, which the students will learn in subsequent years. For example, a student will develop a better understanding of the signs and symptoms and treatment of a disease such as heart failure by first understanding the basic science principles regarding the relationships of pressure and volume, the mechanism of cardiac contraction, and the anatomical relationship of the heart to the lungs.

Integrative Case Studies – The term integrative is used because the case discussion questions attempt to incorporate as many basic science course topics as possible that are relevant to the case. This helps students to learn the concepts in context and to show the relevance of multiple basic science concepts in a clinical context.

Case-Based Learning – There are many forms and definitions of the term case-based learning. Case-based learning in this context means that the students are given cases with questions that are designed to facilitate application of the basic science and pre-clinical concepts that have been taught previously using another instructional method. Typically, this information is taught using lectures. The style of lecture may be different for each instructor, but it commonly involves a PowerPoint® presentation with handouts available to the students prior to the lecture. For case-based learning it is important that the students are taught the information prior to the case, because the focus is more on the application and explanation of concepts to develop a better understanding.

Cooperative Learning (CL) – defined as “the instructional use of small groups so that students work together to maximize their own and one another’s learning” (Johnson & Johnson, 1990a, p.69). CL involves more than placing students in groups and asking them to work together.

Elements of Cooperative Learning (Johnson & Johnson, 1990a, 1999a, 1999b) – these are the important elements that should be present in order for a cooperative small group exercise to be most effective: a) positive interdependence, b) face-to-face promotive interaction, c) social skills, d) individual accountability, e) group processing. These will be discussed in detail in Chapter 2.

Competitive Learning – students compete for a goal that only one or a few students can attain, and it is usually attained at the detriment of others (Johnson & Johnson, 1999a).

Individualistic Learning (IL) – the goals of each student are unrelated to and independent of other students in the class. The students strive to reach a criterion independently from the efforts of other students (Johnson & Johnson, 1999a, p.7)

Knowledge Confidence – refers to how confident the students are with their knowledge and understanding of the content required to solve the problems in the case. It is determined by asking the students, for each multiple choice question, to rate their confidence (on a scale from 1 to 10) in their answer.

### **Significance of Study**

The results from this study may have implications at the theoretical and practical levels. Johnson (2003) stated,

Ideally, theory guides and summarizes research, research validates or disconfirms theory (thereby leading to its refinement and modification), and effective practice is guided by validated theory yet reveals inadequacies that lead to further refinement of the theory and new research studies. Increasingly, however, the culture of the theoretical research

appears to be isolating itself from practical application while the culture of research in practical settings seems to be divorcing itself from theory. (p.934)

The CL method in use in this medical college is based on the theories and models of CL existing in the literature (Johnson & Johnson, 1999a). By investigating the impact of cooperative small group case-based learning on student learning outcomes it may help to further validate the theory and models that form the foundation of CL. It will provide important information regarding the extent to which CL as an instructional strategy contributes to medical student learning of basic science concepts.

Research into this instructional strategy may provide important information about any possible weaknesses or barriers preventing this strategy from being used to its full potential and provide insights into how to design and make improvements to this CL case study process to avoid any possible weaknesses. Finally, by improving the group process and studying the impact of this instructional method, it may be possible to expand its use beyond the College of Medicine into other disciplines and potentially beyond the University of Saskatchewan, at institutions with similar student populations and curricular organization.

### **The Context of the Researcher**

The researcher is a former graduate of the College of Medicine at the University of Saskatchewan, and has a particular interest in medical education and teaching. The researcher teaches first year medical and dental students in a number of different areas including physiology, human gross anatomy, embryology, neuroanatomy and clinical skills. The researcher is also the co-coordinator of the cooperative facilitated small group case studies, which provides the motivation for investigating the impact of these cooperative case studies on

student learning outcomes. Because of the researcher's connection with the students and the case studies, every reasonable effort will be made to remove the researcher from the study design when appropriate (see the Ethics Application – Appendix A).

### **Limitations and Delimitations of Study**

There were a number of limitations and delimitations of this study that must be noted. The sample size for this study was the first limitation. Also, these cases only involved medical students at the University of Saskatchewan. These limitations reduced the power and generalizability of the results. However, within the context of this medical college, this study provided important and useful information regarding the impact of this cooperative method. This study was strengthened by its randomized control design.

Another important limitation of this study was that only one very specific form of cooperative small group learning was assessed. This limited the generalizability of the results, but to study other methods was beyond the scope of this study. It would be advantageous to compare multiple forms of small group CL methods because, as discussed, different CL methods may have a greater impact on student learning outcomes than others, although the results are generally positive for all compared to IL methods (Johnson, Johnson & Stanne, 2000).

Another limitation of this study was related to the amount of intervention by the facilitator. Each facilitator was required attend a standard briefing session where their role was made explicit – that they were to let the students lead the process and discussion and they were to act as guides and not lecturers or tutorial leaders. However, different facilitators may have had different thresholds for when they felt they should intervene and to what degree they structure their feedback. This also may have affected the group process and functioning, which may have

had an effect on learning. Also, some facilitators will be *better* than others. For example, some facilitators may be better at asking deeper probing questions to guide student discussion. Some may find it difficult to act as a guide when students are not on the right track and end up giving the students the answers. Some facilitators may establish a more comfortable environment, where the students feel free to discuss their ideas. All of these factors may have had an influence on the type of discussion during the session which may have impacted the student learning potential.

That there was no study of the overall usefulness of the facilitated integrative case method for individual students was another limitation. Some individual student experiences may not be positive or may differ from the group's general experience. Some students may not find this method of learning helpful or productive, which may differ with the results of the group.

Another limitation of this study was that many of the students in the IL cohort ended up working in small groups. As a result, it may have influenced the outcomes for the students in the IL cohort. This issue will be discussed in detail in Chapter 3.

A final limitation of this study was that the reliability of the test questions was found to be low at 0.35. However, consistency between questions was not expected because the questions on the quiz were testing a broad range of concepts. If there were more questions on the exam, or if the questions tested similar concepts, then the reliability coefficient may have been higher.

There were some delimitations to this study that should be noted. It was decided that the concepts of educational relevance and student motivation, although important factors affecting student learning outcomes (Sharan & Shaulov, 1990), would not be included in this particular study. There were many independent variables and with such a small sample size it was thought

that this may negatively influence the results by creating too many specialized groups of small sample size.

Another delimitation of this study was that only one instance of an integrative case study was examined. Within the scope and time frame of this thesis, it was not possible to collect data for a series of integrative case studies. It would be useful to study this CL method for a series of case studies because a trend of its impact on student learning outcomes would likely develop. It is possible that the results from this study are idiosyncratic for this single case study. Also, this study took place over a short period of time. Consequently, relatively short term retention (one week) was investigated, rather than retention a year or more later when the students were involved in their clinical organ system courses.

A final delimitation, although not one of considerable concern, was that the researcher decided not to include in this study a comparison of cooperative and competitive learning methods on learning outcomes. The researcher felt that, although the academic environment may be occasionally competitive at this institution, the predominant learning environment was individualistic in nature. Therefore, it was most appropriate and convenient to investigate CL and IL environments.

In spite of these limitations and delimitations, this study should provide some valuable insights into the impact that this approach to cooperative small group learning has on student achievement, student confidence in their knowledge and understanding of the course material, and student satisfaction that warrant its inclusion and continued use within the medical curriculum.

## Summary

In this chapter, the background behind the development of the cooperative facilitated small group case studies as well as an in-depth description of the actual cooperative case process was given to establish the context of the research study, which also helped to define the purpose and research questions of this investigation. There was a brief description and discussion of the Bahar-Ozvaris et al. (2006) study, which, in part, acted as a guide to this research study and also provided this study with added face validity. Definitions of terms used frequently within this document and that may be unique to this study were provided, as well as a disclosure of the context of the researcher within the study as a means of clarification. Finally, the (limitations and) delimitations of this research study were provided so that they could be placed in context with the methods and results to follow.

Chapter 2 will consist of a discussion of the literature on CL, which will help to define CL, its basic elements, as well as factors that can affect its successful application. There will be a discussion of the theory and rationale for how CL can be a successful educational strategy. Also, studies will be presented that show the significant effects that CL can have on various educational aspects, specifically, student achievement, confidence, time on task, and student satisfaction.

In Chapter 3, the researcher will discuss the research design, the participants of the study and how they were assigned to groups, and the procedure for how the study will be carried out. A section will be dedicated to describing the ethical considerations relevant to this study. Finally, a description of the types of data analysis proposed for this study will be given, as well as a rationale for each.

Chapter 4 will consist of the presentation of the results from the study. First, the qualitative data collected by the researcher's observations will be presented, which will provide a context for much of the quantitative results presented thereafter. The quantitative results will be broken down into four major sections: a) the effect of CL on student achievement; b) the effect of CL on student confidence with their knowledge; c) a comparison of the CL and IL cohort with respect to student satisfaction; d) a comparison of CL and IL with respect to time on task. Results will also be presented from data collected about the CL student's perceptions of the degree to which they believe the facilitator helped them to learn.

In Chapter 5, the researcher will discuss the results of Chapter 4. There will be a discussion of the limitations of the study related to the final data collection and results, as well as a discussion of the implications of the results, conclusions and possible areas for future investigation.

## CHAPTER II

### Literature Review

This literature review is arranged into eight major sections. In the first section, the definition of CL and, specifically, a description of the essential elements that are required for effective CL activities will be discussed. One of the strengths of CL methodology is that it is based on well established psychological and sociological theories (Johnson, 2003; Johnson, Johnson & Stanne, 2000; Slavin, 1995); therefore, the second section of this chapter will be an overview of the theories that build and support CL methodology as well as key rationales explaining why CL is effective and successful as an instructional method.

Researchers of CL describe a common obstacle to the use of CL – “social loafing” (Slavin, 1995; Karau & Williams, 1993; Webb, 1993). This is a significant issue in CL methodology and will be discussed in section three. In section four, there will be a discussion of the existing literature regarding this important factor.

Researchers have clearly demonstrated the benefits of CL. In section five of this chapter, the researcher will elaborate on the impact of CL on achievement. In section six, the researcher will discuss some studies that have investigated student knowledge confidence on multiple choice examinations, and the implications for CL. There will be a discussion of relevant research on the impact of CL on student satisfaction with the learning method in section seven. Finally, in section eight, the researcher will elaborate on research related to student perceptions of the role of the facilitator.

### What is Cooperative Learning?

Johnson and Johnson (1990a) defined cooperation and cooperative learning as “...working together to accomplish shared goals and **cooperative learning** is the instructional

use of small groups so that students work together to maximize their own and one another's learning" (p.69). In the literature on CL, it has been emphasized that the essential element of this definition was that *all students* in cooperative groups contributed to the academic and social benefit of the group (Johnson & Johnson, 1990a; Slavin, 1995; Kagan, 1992). An individual's success within the group is dependent on the group's success (Slavin, 1995). Without this, these experiences become either individual or competitive learning activities imbedded in small group activities.

Competitive classroom environments encourage students to compete for grades, and ultimately, one or a few students succeed to the detriment of others. In the individualistic classroom, each student works individually to achieve pre-determined standards which are independent of the other student's goals (Johnson & Johnson, 1990a). These two learning strategies are not necessarily wrong nor do they always produce negative learning outcomes, however, they can create a classroom environment that does not encourage high academic achievement as a desirable behaviour (Slavin, 1995). Slavin explained that in competitive environments students competed for individual successes at the expense of the other students. As a result, the *unsuccessful* students reduced their effort because their chances of success were decreased.

CL environments help to eliminate this perception that high academic achievement is unattainable and makes academic achievement a classroom norm. By having students work together cooperatively, the only way that an individual student can succeed is if all the members of the group succeed. Thus, students begin to encourage one another to work hard and strive for maximal achievement together and these attributes become the norm for student behaviour (Slavin, 1995).

There has been much discussion in the literature of the elements that are required in order for a small group learning activity to be considered cooperative (Johnson & Johnson, 1999a; Slavin, 1995; Cooper et al., 1990; Kagan, 1992). Kagan (1992) presented six specific required elements for CL – teams, cooperative management; will to cooperate; skill to cooperate; basic principles; and structures. Slavin (1995) proposed three essential elements for CL – individual accountability, equal opportunity for success, and team rewards. After extensive review of these models for CL, the elements presented by Roger and David Johnson (1999a), appeared to be the most comprehensive and inclusive of the models developed by Kagan and Slavin. Also, the cooperative integrative case studies used at this institution were based on Johnson and Johnson’s model; therefore, these elements will be the focus of the description of CL.

According to Johnson and Johnson (1999a), the key elements that must be present in order for a small group learning activity to be cooperative included face-to-face promotive interaction, social skills, positive interdependence, individual accountability and group processing. These basic key elements are explained below.

#### Face-To-Face Promotive Interaction

Face-to-face promotive interaction (Johnson & Johnson, 1999a), also known as group interaction, involves having students work together and, most importantly, promote each other’s learning. Students do this by helping and encouraging one another to learn and understand concepts discussed during the cooperative small group interaction. Promotive interaction has improved learning through explanation and elaboration of concepts, discussion of ideas and misconceptions, and building on previous knowledge. The theory explaining how promotive interactions can contribute to learning will be discussed later in the chapter. Promotive

interaction has also helped to strengthen the relationship between students, which will further enhance learning because students care about the successes or failures of their group mates and will work harder to support those struggling group members (Johnson & Johnson, 1999a).

Increased support from peers led to increased motivation to learn compared to the traditional large classroom environment. The traditional classroom environment often inhibited many students except for the few that knew the material and liked to show their status (Sharan, 1990). Students who were less knowledgeable about the material feared being selected by the teacher, feared the social comparisons made by their peers and feared failure, which created an environment that was not conducive to learning (Sharan & Shaulov, 1990). Sharan (1990) stated,

The cooperative small-group approach to learning fosters a great deal of interest in the task in a variety of ways, including shared goals and task interdependence, mutual encouragement and assistance, a sense of academic optimism (i.e. potential success at carrying out the task), the opportunity to contribute to the group's progress regardless of one's academic status in the class, the relative absence of debilitating social comparison processes, etc. (pp. 37-38)

In order to create an environment that is conducive to promotive interaction, it is necessary to break up the larger class into smaller groups. The ideal number of students per group in order to facilitate positive group interaction to promote learning has not been clearly defined. Johnson, Maruyama, Johnson, Nelson and Skon (1981), in their meta-analysis comparing the effectiveness of CL with competitive and IL found that CL environments promoted higher achievement than competitive and IL environments. Specifically, groups of two and five members had the greatest effect on achievement compared to other group sizes,

although, it was not fully understood why these specific sizes were better than others (Johnson et al., 1981). They did note, however, that groups larger than five still improved student achievement, although no numbers were provided with regard to an acceptable maximum number of students before the CL group was no longer effective.

Cooper et al. (1990), recommended group sizes of four or five students to produce the best promotive group interaction. In larger groups, students may not have or take the opportunity to participate in the discussion, which may impact their learning potential and may also affect their level of satisfaction with the activity (Mebane & Galassi, 2003; Fuchs et al., 2000). Related research on the amount of oral interaction during small group discussions has demonstrated that vocalizations (such as explaining and elaborating) had a greater influence on student achievement compared to listening to the discussion within the small group (Johnson, Johnson, Roy & Zaidman, 1985). Webb (1993) explained that giving and receiving explanations promoted learning for both the explainer and the receiver; however, the impact was greater for the explainer because that individual needed to organize his or her thoughts and have a clear understanding.

In groups smaller than four, there was concern that students were not able to generate an adequate “diversity of opinion and experience” to create an effective learning environment (Cooper et al., 1990, p. 12), although there has been controversy regarding this subject. Johnson et al. (1981) and Fuchs et al. (2000) demonstrated that cooperative pairs had among the highest achievement levels when various group sizes were compared. Fuchs et al. noted, however, that the effectiveness of the group size may have been influenced by the type of task the group was performing, where complex tasks with cognitive conflict may have favoured larger groups (4-10 students). Johnson and Johnson (1999b) explained that there may not be an *ideal* cooperative

group size and that it may be dependent on such factors as amount of time for the activity, the students' past experience working in cooperative groups, resources available to conduct CL exercises and the age of the participants (p. 19).

Another factor that has affected promotive interaction was the gender composition of the cooperative group. Webb (1993) investigated the impact of gender groupings on academic achievement using CL methodology. She noted that males tend to dominate discussions particularly when groups were unbalanced in terms of gender, either in favour of males or females. Females directed requests for help to their male counterparts, and the males tended not to give help in return to the females (Webb, 1993, p.21). This male dominance within unbalanced groups had a negative effect on learning for females. Webb explained that the best way to reduce or avoid this inequality was to create gender-balanced groups, which maximized promotive interaction and enhanced the CL experience. Although this research on gender interaction in small groups was somewhat dated, it was thought best to have gender balanced groups.

### Social Skills

In order to facilitate promotive group interaction the students must practice the basic social skills required for effective CL interaction (Johnson & Johnson, 1999a). Understanding the proper social skills required for a small group to function optimally is essential in order to maximize learning. Knowledge and application of appropriate social skills such as effective communication skills, trust building, decision making and conflict management is as important to the CL exercise as learning the content itself, because the learning that occurs is dependent on the functioning of the group (Johnson & Johnson, 1999b).

Social skills are not innate; students need to be taught and reminded of these skills (Johnson & Johnson, 1990a), therefore, it has been important for teachers to be knowledgeable and prepared to manage cooperative groups to maximize the important attributes of well-functioning groups (Webb, 1993). It has also been important for the teacher to model these behaviours and attitudes and give recognition to groups who practice them appropriately to reinforce them in all groups (Cooper, 1990; Webb, 1993). Cooper (1990) suggested that important social skills can be added to the course syllabus as requirements for the successful completion of the course (p.10).

Steinert (2004) used focus groups to investigate medical students' perceptions of qualities of effective small groups. The students identified positive group atmosphere as a significant contributor. A positive atmosphere requires that students respect, encourage and listen to one another. If these skills are absent from the small group interaction, it can break down relationships and hinder the functioning of the group. Appropriate emphasis and application of social skills and group dynamics in CL had a positive impact on achievement compared to cooperative groups that did not emphasize social skills (Johnson & Johnson, 1999b).

### Positive Interdependence

Johnson and Johnson (1990a) explained that “students must believe that they are linked with others in a way that one cannot succeed unless the other members of the group succeed (and vice versa)” (p. 77). Positive interdependence, which developed from social interdependence theory (Johnson, 2003) (described below), has formed the backbone of CL, because without it, students tended not work together to achieve success. As a result, it became difficult to put into

practice all other essential elements of CL because the students adopted either an individualistic or competitive approach to their learning. Positive interdependence facilitates promotive interaction in CL because students recognize that they are dependent on each other for success. Its absence creates an individualistic or competitive learning environment because the students no longer rely on each other for success, even though they may be working on a common task (Slavin, 1995; Johnson & Johnson, 1990b).

Johnson and Johnson (1999a) explained that with positive interdependence students developed an awareness that they needed to help each other to ensure that all members had an understanding of a concept before moving on. Group members act as knowledge resources and partners in learning (Tanner, Chatman & Allen, 2003). They take the time to help each other, because they are concerned about the success of all group members. Those students who are struggling with a concept will reach out to the group for help. The group will also work harder, even in frustration, to help one another to learn because they genuinely care about their own and their group members' success (Johnson & Johnson, 1990a).

Two elements ensure positive interdependence: outcome interdependence and means interdependence (Johnson & Johnson, 1990a). There must be a clearly defined group goal, outcome or reward outlined for the cooperative activity or it will not succeed as a CL experience – this is outcome interdependence. Rewards may be given to recognize the success of the group or it may be to recognize individual gains within the group (Johnson & Johnson, 1999a). However, Johnson and Johnson (1990a) have emphasized that caution should be taken in structuring reward interdependence to ensure that all group members feel that their contributions are important and necessary.

Means interdependence is the approach or manner in which the group interacts in order to achieve the outcome. Through means interdependence “each group member’s efforts are required and indispensable for group success...[and]...each group member has a unique contribution to make to the joint effort because of his or her resources or role and task responsibility” (Johnson & Johnson, 1999a, p.75). Examples of means interdependence include: creating unique roles for students, distributing different resources among individuals within the group, creating progress goals where the group cannot proceed to another stage until all members are successful (Kagan, 1992).

Positive interdependence is created in the cooperative integrative cases by having the students volunteer for specific roles – manager, timer, checker, encourager and contributor (see Chapter 1 for an explanation of these roles). Progress goals are also established where, after each question, it is the role of the checker to ensure that each student understands the concepts covered, before moving on to the concept. Finally all students are encouraged to bring resources to the case session. Students will often bring different resources – one student might bring a computer with internet access and another will bring a textbook, and others will bring class notes. The students share all of these resources to help the group answer the questions interdependently.

### Individual Accountability

Individual accountability is an assessment of the IL that occurs as a result of cooperative group interaction. It is an important element of CL because it holds the individual accountable for their own learning. As a result, students work hard to learn the content during the

cooperative activity, because they know they will be responsible for it at an individual level, even though the content is discussed by the group.

Depending on how individual accountability is structured and assessed, it may be a means to facilitate positive interdependence. Slavin (1995) described a method within CL where a group's success was based on the averages of the individual accountability scores of all the group members. As a result of this method, the group must work together and help each other to learn the material and make every effort to obtain a high level of achievement. If one or more members have difficulty understanding a concept, it affects the entire group. Therefore, the group must work together to address that conceptual misunderstanding in order to achieve success.

Cooper (1990) and Kagan (1992) emphasized, however, that caution must be exercised when using this type of assessment. Resentment of the low achievers may develop if this form of assessment significantly lowers the average of the high achievers. Williams, Carroll and Hautau (2005) demonstrated that the most effective use of individual accountability, producing the highest achievement at all learner abilities, occurred when a combination of group and individual rewards was used compared to group-only rewards.

Individual accountability may also function as a form of feedback to the student, the cooperative group, and to the teacher. It allows the teacher to assess whether an individual has developed an appropriate understanding of the material discussed in the cooperative small groups (Webb, 1993). Individual accountability also gives feedback to students regarding any misconceptions they may have, which can then be revised.

Finally, individual accountability helps to prevent the "free-rider effect" (Slavin, 1995) or "hitchhiking" (Johnson & Johnson, 1990a) where individuals within a group exert observable

minimal effort, but reap the rewards of those individuals who exert maximal effort within the group. A similar concept, known as “social loafing” occurs when “individual members...reduce their effort *without* [italics added] other members realizing that they are doing so, [as a result] many people tend to work less hard” (Johnson & Johnson, 1999a, p.74).

Emphasis is placed on the *inequality* of effort by *some* individuals, which makes the cooperative group dysfunctional. A reduced effort by *all* individuals may not, itself, be considered social loafing, or a negative phenomenon. In fact, it may be that, as a result of CL, all individuals within a group are able to reduce their effort because of effective communication and elaboration of ideas, teamwork, and distribution of workload. The free-riders and social loafers within a cooperative group who produce an inequality in effort create a dysfunctional cooperative group. These individuals learn less and disrupt the maximal functioning of the group, which in turn impairs the group’s ability to learn (Slavin, 1995). Individual accountability is one method that can help to reduce and possibly eliminate social loafing, by ensuring that each student is accountable to themselves and the other students to contribute and learn the material. The concept of social loafing is one of the significant barriers to effective CL in the literature and merits further elaboration. It is discussed later in this chapter under the sub-heading *social loafing – an obstacle to cooperative learning*.

### Group Processing

In forming cooperative groups, great effort has been made to establish productive group dynamics through positive interdependence, promotive group interaction, and effective social skills. According to Johnson, Johnson, Stanne and Garibaldi (1990), it has not been enough to assume that by putting these elements in place the group will achieve them all in each

cooperative session and that they will be maintained in future sessions. Successful CL has been accomplished through group processing (Johnson et al., 1990). “Such processing (a) enables learning groups to focus on group maintenance, (b) facilitates the learning of social skills, (c) ensures the members receive feedback on their participation, and (d) reminds students to practice collaborative skills consistently” (Johnson & Johnson, 1999b, p. 28). Johnson et al. (1990) acknowledged that there has been controversy regarding the necessity of group processing in CL, and noted that this was an area of their CL model that required further investigation.

It is important that students reflect on the functioning of the group because if the group does not function well it will affect student relationships and interactions. This, in turn, will negatively impact their ability to help and challenge one another, which places constraints on their ability to learn. Group processing involves having the students reflect on the things that contribute to positive group functioning and those things that contribute to negative functioning (Johnson & Johnson, 1999b). There is an important interplay that occurs during group processing where students use “their social skills to help maintain effective working relationships within the group” (p. 28). Teacher involvement in group processing is also important, where the teacher notes group interaction and productivity (Johnson & Johnson, 1999b).

Johnson and Johnson (1999a) emphasized that this process be integrated as a key element to any CL session by allocating time for it to happen and having the students discuss it openly. Small group CL works best when the group is functioning effectively and efficiently. By incorporating a reflective component it is possible to discuss possible improvement strategies if the group is dysfunctional or to simply ensure that proper group functioning is maintained.

## **Theory and Rationale for Cooperative Learning**

One clear strength of CL as an educational strategy is that it is based on accepted theories from multiple disciplines (Johnson, Johnson & Stanne, 2000). Some important theories from the literature that underpin CL include the social interdependence theory, cognitive developmental theory, controversy theory, and cognitive elaboration theory (Johnson & Johnson, 1999a; Slavin, 1995). These theories have their origins in constructivist ideology.

### Social Interdependence Theory

This theory, originally developed and refined by Kurt Koffka, Kurt Lewin, Morton Deutsch and David and Roger Johnson (Johnson, 2003; Johnson & Johnson, 1999a), is one of the essential theories underpinning successful CL. These theorists explained that the type of interdependence that existed within the classroom determined the type of student interaction, which, in turn influenced their level of achievement (Johnson & Johnson, 1999a). Positive interdependence, as discussed above, encouraged cooperative behaviour by creating an environment of *promotive interaction*. Negative interdependence fostered a competitive learning environment because it encouraged *oppositional interaction* (Johnson, 2003, p. 935) where individuals opposed other's attempts to learn effectively in order to secure their success. All students competed for a goal that only one student could obtain (Tanner, Chatman & Allen, 2003). Finally, where there was no interdependence, an individualistic learning environment was created, where the goals and actions of each student were independent of all other students (Johnson, 2003).

The social interdependence theory formed the foundation for the element of promotive interaction within CL. It posited that “positive interdependence (cooperation) results in

**promotive interaction** as individuals encourage and facilitate each other's efforts to learn" (Johnson & Johnson, 1999a, p.187). Slavin (1995) explained that in order "...to meet their personal goals, group members must help their groupmates to do whatever helps the group to succeed, and, perhaps more important, encourage their groupmates to exert maximum effort" (p.16). Students invested in their learning and the learning of their groupmates which had a positive impact on learning outcomes (Slavin, 1995).

### Cognitive – Developmental Theory

According to Johnson and Johnson (1999a), cognitive– developmental theory as it applied to CL was based on the theories of Piaget, Vygotsky and Johnson and Johnson, among many others. A combination of the concepts provided by these influential individuals, this theory posited that when individuals worked cooperatively on a task, inconsistencies and cognitive conflicts developed, which, in discussing and reaching consensus, promoted cognitive development (p.187).

Vygotsky (as cited in Johnson & Johnson, 1999b; Slavin, 1995) emphasized the social cooperative nature of learning. He proposed that an individual's cognitive development was based on, and was often dependent on, the construction of information initially established in a collaborative social context. Pradl (1990) stressed that learning cannot occur in isolation – who we are as individuals depends largely on our experiences and interactions with others and their validation and interpretations of their interactions with us. Subsequently, these experiences and interactions are internalized and integrated into an individual's knowledge framework (Vygotsky, 1978).

Vygotsky underscored the importance of an individual's *zone of proximal development* in cognitive development, which was "the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers" (Vygotsky, 1978, p.86). Vygotsky explained that an individual's current cognitive ability was strongly influenced and enhanced through interaction with, and being challenged by, individuals of higher cognitive ability within a given subject.

From this, it might be expected that, in a group with heterogeneous levels of achievement, individuals with lower achievement would likely benefit the most from CL because they would be challenged the most through interaction with their higher achieving peers. High achieving students may still benefit in a number of ways. First, within a group there may be other high achieving students that through discussion and debate provide the intellectual challenge (Webb, 1993).

Second, Nyikos and Hashimoto (1997) noted that if students with less experience or knowledge about a topic asked for clarification or asked challenging questions to more experienced students, it challenged the high achieving students to reconsider their understanding and subsequently provide clear explanations, which provided intellectual challenge and vocalization that fostered learning. In return, the less experienced students learned from their more experienced peers at a level that was closer to their *zone of proximal development*. Finally, the facilitator may also provide the intellectual challenge for the high achieving students through content expertise and by seeking clarification and elaboration of understanding from them.

In Piaget's theory of cognitive development, he presented the concept of *cognitive dissonance*. Piaget explained that knowledge reconstruction involved recognition that conflicts

developed between the information currently in one's knowledge network and newly acquired information (Choi, Land & Turgeon, 2005). Nyikos and Hashimoto (1997) discussed that Piaget's idea of cognitive development focused on a more individualized context; however, a highly effective method to facilitate recognition of cognitive conflict was to have students discuss and elaborate their ideas in a CL environment. In doing so, individuals may recognize flaws or misconceptions related to their original understanding and work to correct them through discussion with the group (Choi et al., 2005).

Students are able to learn concepts better as a result of seeking clarification, defining terms, debating and defending different perspectives and creating new solutions. Despite the individualistic nature of Piaget's original theory for cognitive development, it has applications in CL. Johnson and Johnson (1999a) have incorporated the social nature of cognitive development with their controversy theory.

Johnson and Johnson's controversy theory was closely related to Piaget's concept of cognitive dissonance. "**Controversy theory** posits that being confronted with opposing points of view creates uncertainty or conceptual conflict, which creates a reconceptualization and an information search, which results in a more refined and thoughtful conclusion" (Johnson & Johnson, 1999a, p.187). Johnson and Johnson (1997; 1999a) outlined five key steps necessary to operationalize cooperative constructive controversy in the class. Students must (a) research the topic and prepare a position, (b) advocate that position, (c) refute opposing views and rebut criticisms against their views, (d) take a reversal of perspectives, and (e) synthesize all arguments to establish a conclusion with which all can agree.

Pradl (1990) noted that learning occurred in a cooperative environment not only when students were in agreement, but also when they were in disagreement, so long as there was

acknowledgement of each other's points of view. This cognitive conflict forced the students to reconsider their understanding and actively seek more information. As a result of defending, justifying, listening to opposing arguments, and investigation, a better understanding of the concepts developed (Johnson & Johnson, 1999b).

### Cognitive – Elaboration Theory

Slavin (1995) made a subtle distinction between cognitive developmental and elaboration theories. From the developmental perspective, interaction between individuals created cognitive conflict that led to discussion and investigation, which enhanced cognitive development. From the cognitive elaboration perspective, cognitive development occurred as a result elaboration or explanation of concepts.

Effective elaboration may not be dependent on interaction with other individuals, as is requisite for cognitive development theory. It may involve an individual summarizing the notes taken during a lecture (Slavin, 1995, p.18). De Grave, Boshuizen and Schmidt (as cited in Dolmans & Schmidt, 2006) demonstrated that verbalizations among students in small groups were only one component of elaboration. High level mental elaborations, such as theory-building and metacognition, also occurred in students who were less vocal (pp. 325-326). However, many researchers have suggested that elaboration was often *most* effective when it involved verbal interaction (Slavin, 1995; Webb, 1993; Johnson, Johnson, Roy & Zaidman, 1985).

Wells, Chang and Maher (1990) explained that learning can occur at the level of the individual where knowledge was constructed through interaction with the environment. However, interaction between groups of individuals involved the added elements of expression

of knowledge constructs, be it orally, verbally, or graphically, as well as feedback from others regarding the appropriateness and consistency of these constructs in relation to others. Following this feedback, an individual may then modify their knowledge constructs, which may not always occur when only interacting with the environment.

Sharan (1990) made a connection between cognitive developmental and elaboration theories when he discussed the historical background to CL as an educational method,

Students make knowledge their own, not by repeating what they hear, but by exploring ideas through intense conversations with others with whom they quite often disagree. These discussions afford the participants the opportunity to think and re-think, formulate and reformulate their ideas, using what they know, that they think, and what they hear, until they reach some sense of completeness about their own thoughts and understanding.

(p.30)

With respect to CL, it is difficult to separate the developmental and elaboration theories. Both rely heavily on discussion, explanation and clarification of thoughts generated by students as they participate in a cooperative activity. If structured correctly, CL should stimulate discussion that results in elaboration of concepts, which should result in cognitive development for all participants.

### Constructivism and Other Cognitive Principles in Cooperative Learning

Constructivist psychologists, as it relates to cognition, have stated that “individuals actively build or construct their own notions of reality out of their experience, and that these constructions result in knowledge” (Sharan, 1990, p.35). Individuals gather information, interpret it and relate it to what they already know and have experienced and integrate it into

their existing knowledge network. Sharan noted that CL provided the environment and opportunity for students, with their teachers, to engage, explore and integrate concepts with previous knowledge and help each other to construct new meaning and understanding. Discussion with other individuals will more accurately reflect the concept being studied than if students study it individually.

Often the model for teaching is that students' minds are more like empty vessels that can be filled with information, which becomes knowledge (Sharan, 1990). This is a common scenario in medical schools, where a content expert imparts knowledge to the students who must then acquire that knowledge. In this environment, the student is not able to interact with the expert and peers to determine if the new information is being appropriately integrated into existing knowledge networks. A more appropriate model involves a collaborative experience between the learner, expert and peers so each may make a contribution to understanding the concept even though the expert still has greater knowledge of the content (Wells, Chang & Maher, 1990).

Furthermore, in small group learning, when students engage in cooperative discussion, they each bring their own expertise from their previous knowledge and experiences and from this they can learn from each other through the processes of expression, feedback and modification (Mann, 2002). The teacher becomes the facilitator and the guide to ensure proper emphasis of key concepts or to ask probing questions to get the group to think more in depth about a concept or help them when they are having difficulties (Mann, 2002).

### **Social Loafing – An Obstacle to Cooperative Learning**

Although an effective strategy for individual accountability will help to eliminate social loafing, it is still a significant constraint on, or barrier to, effective CL. Therefore, it is important to discuss the factors that can contribute to social loafing within cooperative groups. Karau and Williams (1993) in their meta-analysis of the research on social loafing defined social loafing as “the reduction in motivation and effort when individuals work collectively compared with when they work individually or coactively” (p.681). This meta-analysis described many factors that influenced and predicted the presence of social loafing in cooperative small group learning environments. The following are brief explanations of the contributing factors to social loafing and how they influence motivation and effort in cooperative groups. A close look at these underlying factors suggests the importance of ensuring that all the basic elements of CL are practiced in order to reduce the presence of social loafing.

Latané’s research (as cited in Karau & Williams, 1993) revealed the impact of group size on social loafing. The effort of each group member decreased as the number of members increased because the impact of the motivation to perform well was diffused among more individuals. Jackson and Williams (as cited in Karau & Williams, 1993) discussed the influence of within-group motivation and task complexity on social loafing. They explained that individuals within a group increased their effort only if other group members acted as motivating sources rather than “cotargets” of a request to perform a task. They also noted that individual motivation and effort within a group would increase if the task was challenging enough to warrant increased effort (p. 683).

Karau and Williams (1993) noted evaluation potential as another contributing factor to social loafing. In cooperative groups, it became more difficult to identify and evaluate the

performance of individuals. Two problems developed: first, students were able to hide behind the work of others, therefore they reduced their effort. Second, students felt that their hard work was not recognized and appropriately evaluated, which reduced their motivation and effort.

Kerr (as cited in Karau & Williams, 1993) proposed the concept of dispensability of effort as a contributor to social loafing. In this case, individuals did not put forward their greatest effort because they felt that their contributions were not necessary because the group was already succeeding at the task. This concept was similar to evaluation potential. However, Karau and Williams (1993) noted the difference between these two concepts was that the reduced effort was present regardless of whether or not that individual's effort could be recognized or evaluated.

Jackson and Harkins (as cited in Karau & Williams, 1993) proposed the model of matching of effort as a factor that contributed to social loafing. In this model, individuals only performed to the level of their coworkers. Therefore, if the coworker did not put in a maximal effort, or if it was *expected* that a coworker would not try hard for a task, then the observing individual would loaf in order to match the actual or expected effort of the loafing coworker. In this model, if a maximal effort was given by a coworker, then social loafing would be minimized or eliminated. Jackson and Harkins (Karau & Williams, 1993) also found that the perceived value of the activity confounded the amount of effort produced such that if individuals within a group felt that the activity was boring or not useful, they did not put in their maximal effort, even if a maximal effort was requested.

### **Time on Task in Cooperative Learning**

Research has shown that CL leads to an increase in time on task compared to competitive or individualistic learning methods (Johnson, Johnson & Stanne, 1986; Slavin, 1978; Slavin, 1995). Slavin (1995) explained that CL increased time on task because it engaged student attention and increased their motivation to learn. There was increased motivation to learn because the success of the group was dependent on the individual success of each group member.

The study by Bahar-Ozvaris, Cetin, Turan and Peters (2006) investigated the amount of time the students spent working cooperatively outside of class. Students in the treatment (cooperative) group reported spending between 30 minutes and 2 ½ hours working *cooperatively* outside class. This had a moderate correlation with achievement ( $r=0.52$ ), however it was not statistically significant. Few conclusions can be made from this data because Bahar-Ozvaris et al. (2006) did not ask the students in the control group the amount of time on task they spent outside of class. It would be useful to investigate this to determine if CL methods encouraged students to spend more time on task compared to individualistic learning methods and if this had an influence on student achievement.

Current research on independent study time as a predictor of individual student achievement indicates that increased *quantity* of study time is only a predictor of achievement when students engage in high *quality* study and have a high level of prior knowledge (Plant, Ericsson, Hill & Asberg, 2005). Seidel, Perencevich and Kett (2005) included amount of rehearsal or time on task as one the essential factors that influenced learning. They explained that the more time students spent rehearsing (studying) the material the better they would learn it. They also indicated that increased quality of time on task added value to the learning, beyond the quantity of time on task.

Elaboration is one important factor that increases the quality of time on task. Examples of knowledge elaborations range from simple tasks such as note taking, to more complex tasks such as active discussions, deeper explanations and applications of content. Dolmans, De Grave, Wolfhagen and van der Vleuten (2005) explained that such elaborations helped students to “relate new information to existing knowledge” (p. 733), which facilitated learning. Therefore, activities that enhanced knowledge elaborations also increased the quality of the time on task, which contributed to improved student learning.

In a study by Johnson, Johnson and Stanne (1986) they showed that students in cooperative groups generated more task-related student-student interactions than students in individualistic or competitive instructional settings. These students in the cooperative group also achieved higher scores. However, Johnson, Johnson and Stanne did not determine if there was an interaction effect between time on task and achievement, such that the increased time on task found in the cooperative group contributed to their increased achievement.

Makuch, Robillard and Yoder (1991) compared achievement and time on task levels between students who participated in cooperative computer-assisted instruction or individual computer-assisted instruction. Makuch et al. demonstrated that cooperative pairs, using computer assisted instruction, spent a greater amount of time on task than students who worked individually. There was no statistically significant difference in the achievement between the two groups; therefore, they suggested that the extra time on task that the cooperative group spent might not be practically useful for the students in order to make gains in achievement (p.207). However, one important limitation of the study by Makuch et al. may provide a possible explanation why the CL group’s achievement level was the same as the group assigned to the individualistic method. There was no structured positive interdependence in their cooperative

pairs. The students were only *encouraged* to help each other. Without positive interdependence, the pairs may not have relied on each other for success. As a result, the cooperative nature of the activity would be reduced and possibly eliminated.

### **Cooperative Learning and Student Achievement**

Numerous studies have been done that have investigated the impact of CL methods on student achievement compared to either individualistic or competitive learning environments, at the elementary, secondary and post-secondary level (Johnson, Johnson & Stanne, 2000). Although with each study there were differences in the sample (elementary, secondary or post-secondary), sampling methods, study methodology, type of CL method, and effect sizes for CL, the consistently positive results with respect to student achievement have strongly supported CL methods compared to individualistic or competitive learning methods (Johnson, Johnson & Stanne, 2000; Slavin, 1995; Springer, Stanne & Donovan, 1999).

This positive effect of CL applied to students at all achievement levels. Many researchers have investigated the impact of CL on low-, medium- and high-achieving students (Stockdale & Williams, 2004; Williams, Carroll & Hautau, 2004; Webb, 1993). The results were mixed, where some studies revealed the highest achievement gains for high-achievers, and some reported the highest gains for low-achievers (Webb, 1993; Slavin, 1995). However, the more important conclusion for many of these studies was that low-, medium- and high-achieving students, who participated in CL activities had higher levels of achievement than corresponding students in control groups (Slavin, 1995).

As discussed previously, there has been extensive research that has investigated the specific basic elements of CL, such as, individual accountability and group processing. The

results of these studies demonstrated that the application of these basic key elements in CL environments produced a positive effect on student achievement compared to individual or competitive environments (Yager, Johnson, Johnson & Snider, 1986; Johnson, Johnson, Stanne & Garibaldi, 1990; Williams, Carroll & Hatau, 2005). The results of these studies have reinforced the importance of ensuring the incorporation of the basic elements of CL when any CL activity is implemented.

In this section on student achievement, the researcher will first present data from a number of meta-analyses and reviews that encompass CL studies from Kindergarten to University education. This will provide an overview of the impact of CL on student achievement. The researcher will then focus attention on studies investigating the impact of CL on student achievement in the area of health sciences and medical education.

### Meta-Analyses and Reviews of Cooperative Learning

Meta-analyses and reviews of primary studies have been carried out, which have investigated various outcomes of CL, in particular, individual student achievement. As mentioned, there have been many different CL studies performed, and meta-analyses have allowed us to integrate the findings from these multiple studies with common themes to better understand the overall effects of the intervention – in this case, the effect of CL on student achievement. Effect sizes have commonly been used in meta-analyses, which have demonstrated the magnitude of the impact of an educational intervention on specific student learning outcomes.

Johnson, Maruyama, Johnson, Nelson and Skon (1981) and Slavin (1995) performed meta-analyses that investigated the effect of various commonly used CL methods on individual

student achievement compared to competitive and individualistic learning methods. Johnson et al. reviewed 122 studies of CL and found that CL methods produced larger effects on student achievement compared to competitive and individualistic learning methods. The effect sizes measured when CL was compared to competitive and individual learning, were the same at 0.78. Therefore, students who participated in CL methods performed at the 75<sup>th</sup> percentile compared to an individual at the 50<sup>th</sup> percentile in either the competitive or IL environment. Hojat and Xu (2005) discussed Cohen's guidelines for classification of effect size estimates for mean differences. An effect size of 0.20 is considered small and of negligible practical significance. An effect size of 0.50 is considered medium and of moderate practical significance. Finally, an effect size of 0.80 is considered large and of crucial practical significance. It is important to note that these set points are guidelines and one should consider other factors such as the results of similar previously completed studies, underlying theory, and existing sample and research conditions when interpreting effect size measurements (Callahan & Reio, 2006).

Slavin (1995), in his review of the impact of CL on student achievement, found that CL had a greater effect compared to control groups, which were either competitive or individualistic. The overall effect size for all included studies ( $N = 77$ ) was 0.26. Slavin argued that few educational interventions, with the exception of one-to-one tutoring, have produced effect sizes as large as 1.0 and, therefore, effect sizes between 0.20 and 0.25 should be considered "educationally significant" (p.21).

According to Slavin (1995) there were some key components to CL that consistently contributed to improved learning outcomes for students. He described motivational aspects as well as cognitive aspects that contributed to higher student achievement. Slavin demonstrated that CL strategies that incorporated the motivational aspects of group rewards and individual

accountability produced better learning outcomes compared to control groups who learned the same material, independently. Moreover, studies that incorporated these two elements produced better learning outcomes than those studies of CL that did not or only had one of the two elements (p. 42).

Slavin's explanation for these findings was that, in the traditional classroom setting, where learning was either independent (one student's success had no relationship to the other students' success) or competitive (one student's success was to the detriment of the other students), students either did not care or they hoped that their classmates did not succeed. In this environment, high achievement was viewed as a negative attribute. As a result, students did not exert maximal effort to achieve. In the CL environment, because students were encouraged to help one another to succeed and had a vested interest in the success of all group members or classmates, high achievement became accepted as a positive attribute.

Multiple CL strategies have been developed over the years as the theory, research and practical applications of CL have expanded. As a result, it was necessary to compare each strategy as well as the overall impact of CL. Johnson, Johnson and Stanne (2000) performed a review that compared many of the most commonly used CL strategies. Slavin's (1995) review also compared the effects of different CL strategies on student achievement. A range in effect sizes for each of the various cooperative strategies was found in these reviews. However, the results still showed that the various CL strategies had a greater effect on student achievement than competitive or IL strategies. Furthermore, these different CL methods were based on closely related and established theories; therefore, the results of these meta-analyses have continued to support the underlying theory of CL.

### Cooperative Learning in Health Sciences and Medical Education

Much research on educational interventions has been done in the field of medical and health sciences education; however, few studies have investigated the impact of CL methods. PBL, an extensively researched technique developed at McMaster University (Norman, 2004), is a facilitated small group learning method that does incorporate some, but not all, of the elements of CL (Albanese, 2000; Colliver, 2000).

PBL has been integrated into the curricula of medical schools around the world; however, there has been considerable, and unresolved debate about its effectiveness compared to more traditional lecture-style approaches to teaching and learning (Albanese 2000; Colliver, 2000). PBL uses a different approach to learning than the cooperative method used at this medical college. In PBL, working through phases of an ill-structured case and deriving learning issues drives the entire learning experience, whereas the CL cases are an *application* of previously taught content to facilitate learning and understanding. Therefore it is difficult to compare these very different methods. For these reasons, problem based learning will not be detailed any further in this review.

The study by Bahar-Ozvaris, Cetin, Turan and Peters (2006) provided important information about CL and student achievement in a medical school curriculum that related to the present study in both purpose and methodology. Bahar-Ozvaris et al., investigated the impact of a specific CL method – Student Team Learning (Slavin, 1995) – on student achievement compared to individualistic learning using a pre-test/post-test design. A brief description of their study is given because of its important relationship to the present study.

Students were randomly assigned to either cooperative problem-based or individualistic learning groups. They were given a 10-item multiple-choice pre-test at the beginning of the

course. The students then participated in either the cooperative or the individualistic learning method during a two week block of a psychiatry course. At the end of the two weeks all students completed a multiple choice post-test and a student satisfaction questionnaire.

Bahar-Ozvaris et al. (2006) demonstrated a statistically significant increase in student achievement from pre-test to post-test for the CL group compared to the control group ( $p < 0.05$ ). They also showed that CL had a greater impact for low achieving students (i.e., those who score low on the pre-test). The proportion of pre-test low achieving students in the cooperative group who subsequently achieved high scores on the post-test was greater than that seen in the control group and also greater than the proportion of pre-test high achievers in the cooperative group who maintained their high post-test scores (p. 555).

Rao and DiCarlo (2000) investigated the effect of a CL method (peer instruction) on medical student achievement. Each 50 minute class was divided into three 12-20 minute presentations. Between each presentation, the students were given one minute to answer one multiple choice question, individually, and hand in their answers. The students were then arranged into groups of four to discuss their answers. They were allowed to change their answer after the discussion, if they desired. The second results were collected and the answer was then discussed as a large class with the teacher. The level of difficulty of the multiple choice questions ranged from easier, simple recall questions; to intermediate, comprehension and application questions; to more difficult, evaluation and synthesis questions.

Rao and DiCarlo (2000) found a statistically significant increase in student achievement after the students had the opportunity to discuss the answers within the small group compared to when they answered the question individually. They also found that the students made increases in achievement for all difficulty levels of multiple choice questions, with the greatest gains seen

for the questions with the highest level of difficulty. Rao and DiCarlo (2001) and Cortright, Collins and DiCarlo (2005) published similar studies of the same peer instruction technique where they also found a statistically significant improvement in student achievement.

### **Cooperative Learning and Student Knowledge Confidence**

To the best of the researcher's knowledge, there has not been any research conducted that has investigated the impact of CL techniques on student knowledge confidence. As defined in Chapter 1, knowledge confidence referred to a student's confidence in the knowledge of the content determined by asking the student to rate how confident they were (on a scale of 1-10) that they had selected the correct answer for each multiple choice question. There have been numerous studies that have investigated student confidence on exams, but not before and after an educational intervention and not comparing two methods.

Research on confidence and multiple choice exam performance has shown that students tended to overrate their confidence in relation to their test score results (Zakay & Glicksohn, 1992; Flannely, 2001; Smith, 2002). Koku and Qureshi (2004) explained that this overconfidence may be because when students selected an answer, they only searched their memory for evidence that supported or confirmed their answer selection and ignored contradictory evidence. Overconfidence had a relationship with test performance, where the greater a student's overconfidence, the lower the student's performance was on the exam, which could be because they only searched for confirmatory evidence to support their selection (Smith, 2002; Koku and Qureshi, 2004).

Similarly, studies have shown that students with lower levels of achievement were less capable of calibrating their confidence levels on exams compared to high achieving students

(Smith, 2002; Flannelly, 2001). Lundeberg, Fox and Puncochar (1994) discussed that this was likely because low achieving students were less aware of what they did and did not know compared to high achieving students. Flannelly (2001) explained that confidence ratings were also dependent on the difficulty of the exam questions, where easier questions led to lower levels of confidence. This relationship was confirmed in the study by Koku and Qureshi (2004). They found that confidence scores increased with question difficulty. Their interpretation of this finding was that because the question was perceived to be easy, the students read into the question more than necessary, which led them to doubt their confidence.

Zelevnik et al. (1988) performed a study that investigated the confidence level of medical students on multiple choice examinations. The results of this study were consistent with the results of the studies above. They found that students who were highly overconfident tended to perform lower on exams, which was consistent with previous findings. However, they also found that students who rated themselves as underconfident performed consistently better on exams, which they were not able to explain. It appeared as though medical students tended to report lower confidence ratings than the students of the previously discussed studies. The other studies seemed to show a trend towards overconfidence in the majority of students and the greatest factor that contributed to underconfidence was if the test questions were easy. The multiple choice exam used for the Zelevnik et al. study was an Introduction to Clinical Medicine examination. The difficulty of this exam was not known, which would help to understand this finding. It will be interesting to discover if the results of medical student confidence ratings from the present study will be similar to those found in the Zelevnik et al. study.

### **Cooperative Learning and Student Satisfaction**

As discussed, many studies have shown the significant impact that CL has had on student achievement (Slavin, 1995; Johnson, Johnson & Stanne, 2000). However, fewer studies have investigated student perceptions of their CL experiences (Gillies, 2003). This information is also very important for our understanding of the effectiveness of educational strategies because it can help to explain how these strategies facilitate student learning.

Draskovic, Holdrinet, Bulte, Bolhuis and van Leeuwe (2004) showed that if students believed that small group learning helped them to learn, then it would increase their satisfaction with the educational strategy. They posited that quality collaborative task related interactions would lead to increased knowledge elaboration, which would increase students' perceptions of enhanced knowledge acquisition by improving their insight into their level of understanding, or *metacognition*. As a result of this process, students would feel as though the small group session helped them to learn, which would lead to increased in student satisfaction. Draskovic et al. noted an important factor that can influence student interaction and knowledge elaboration was the facilitator. They discussed that the role of a facilitator was to stimulate discussion by using questioning techniques as opposed to "mini-lecturing", which stifled discussion and negatively affected the learning process. Steinert (2004) investigated student perceptions of small group exercises and also found that students believed that group interaction as well facilitators who promoted thinking and encouraged interaction contributed to effective small group learning.

The five essential elements of CL (positive interdependence, promotive interaction, individual accountability, social skills and group processing), developed by Johnson and Johnson (1990), all help to foster the learning environment discussed by Draskovic et al. (2004) and Steinert (2004). The students depend on each other to learn and be successful; therefore, they

interact, elaborate on ideas, clarify misunderstandings, and give feedback to each other. As a result, they perceive that they have learned and feel satisfied with their learning experience (Draskovic et al., 2004).

### **The Facilitator's Role in Cooperative Learning**

The role of the facilitator in cooperative small groups is to act as guide as opposed to the leader and content expert within the group (Gillies, 2006). Examples of appropriate facilitator behaviours during CL exercises include: a) reducing their role within group to give greater control to the students, b) asking students open-ended questions to stimulate discussion and knowledge elaboration, c) building problem solving skills and social skills, d) ensuring students remain on-task, and e) providing appropriate feedback to students regarding content and group functioning (Gillies, 2006; Steinert, 2004; Draskovic, Holdrinet, Bulte, Bolhuis & van Leeuwe, 2004). Gillies and Boyle (2005) explained that students modeled these same behaviours in their interactions with group mates. They also noted that when teachers used CL methods in their classrooms, it caused them to change the way that they interacted with the students. Their interaction with the students became more personal, informal, friendly and supportive; whereas, in the large group lecture-style environment they tended to be more directive, formal and disciplinary (p. 244). The interactions of the cooperative teacher were far more conducive to student-student engagement, interaction and elaborated discussion, which facilitates learning and understanding.

Draskovic et al. (2004) explained that when the facilitator took on a smaller role within the group, the students engaged in more task related interactions and knowledge elaborations. This did not mean that the facilitator had no role; rather, the facilitator asked open-ended

questions at appropriate times and provided the necessary feedback regarding content and group functioning, which stimulated discussion and problem solving and positive group dynamics, respectively. When the facilitators acted as guides, it was more effective than when they lectured to the students, which had a negative impact on students' perceptions of their learning experience (Draskovic et al., 2004). Leikin and Zaslavsky (1997) noted the importance of ensuring that the interactions were *task-related*. Students interact in a number of ways, many of which are off-task or unrelated to the content of the small group exercise and can be dysfunctional to the group. The facilitator can intervene at these times to refocus the group in order to maximize their effectiveness and maintain the appropriate learning environment. For this reason, the presence of a facilitator to monitor the group discussion and dynamics was important and had a positive impact on student learning.

## **CHAPTER III**

### **Research Methods**

The research methods addressed the purpose of this study, which was to investigate the impact of facilitated cooperative small group case-based learning on student learning outcomes. The null hypothesis was that there would be no significant difference in achievement and knowledge confidence of students using cooperative small group case studies and those students who worked on the same case individually. Achievement and knowledge confidence were assessed by performing a pre-test/post-test comparison between groups. Pre-test/post-test multiple choice questions were developed based on the topics covered in the associated lectures presented prior to the case (Appendix F).

#### **Design**

This study used an experimental design, which was described by Vogt (2005) as a study where the researcher had control over the independent variable(s) being studied and the subjects were randomly assigned to either a control group or an experimental group (p.112). In this study, the control group included those students who answered the case questions individually and the experimental group included those students who discussed and answered the case questions in cooperative small groups. Vogt (2005) explained that experimental designs help to increase internal validity which can be defined as the degree to which the results of the study can be attributed to the independent variable and not to flaws in the study (p.157).

The students were also blinded to the nature of this study comparing independent and CL strategies. The reason for keeping the students uninformed of the purpose of the study was to attempt to maintain the integrity of the data to be collected. If the students were made aware of

the nature of the study, the quality of their participation in *either* of the groups, might be affected (positively or negatively), which could contaminate the results. It might be possible, for example, that a student in the control group could contaminate their answers because they preferred learning in a small group environment or vice versa. By blinding the students, a more natural and unbiased intention on the part of the student will likely occur.

To achieve this blinding of the student participants a modification to the regular procedure of cooperative small group activities was made (please refer to Chapter 1 for a detailed description of the normal organization of these cases). During the second term of the academic year for phase A of the medical school curriculum, all students were given short pre-tests consisting of five multiple choice questions prior to every case session, which were administered immediately before the students began their discussion. The students had approximately five minutes to complete the quiz. One week after each case session, the students were given approximately five minutes to complete a post-test, which consisted of the same five multiple choice questions that were on the pre-test.

By administering these tests regularly, the students became conditioned to writing pre- and post-tests. When they were given the pre- and post-tests to complete for the actual research study, the tests seemed normal and common. The students were told that these tests were not worth any credit within the curriculum, but that they were designed for individual formative assessment and feedback, where the desired effect was to ensure that the students would attempt to answer the questions honestly and to the best of their ability. The pre- and post-tests were marked with the correct answers revealed and given back to the students. The marked pre-tests were not given back to the students until they had completed the post-test one week after the pre-test. In other years and in the first term for this cohort of first year medical students, pre-and

post-tests were not administered. This relatively minor change in the procedure for the case discussion process was initiated solely to disguise the actual research situation and blind the students to the experiment.

For each question in all pre- and post-tests preceding and during the experiment, the students were also asked to rate, on a scale from 1-10, how confident they were that they had selected the correct answer, with 1 being the least confident and 10 being the most confident. A comparison of confidence scores between the pre-test and post-test within the groups and between the groups was made.

### **Participants**

A stratified random sampling technique was used to distribute 59 medical students (27 females and 32 males) from the medical college into the control group (n=27), who answered the case questions individually and the experimental group (n=32), who discussed the case questions in cooperative small groups (Table 1). All students were stratified based on prior academic achievement and gender. The students in the experimental group were further subdivided and stratified into four heterogeneous groups of eight students (based on level of prior academic achievement and gender). All sessions, whether performed individually or cooperatively were completed simultaneously, in order to prevent any communication between students of the two cohorts.

Table 1. Composition of Experimental and Control Groups

Group	Experimental	Control
Number of Students	32 (divided into 4 groups of 8 students)	27

Prior academic achievement was based on student grades from the first term of their introductory Biochemistry course and introductory Human Form and Function course. This was done so that there was an equal distribution of high, medium and low achievers in the control and experimental groups and also within each of the experimental cooperative subgroups. Sharan and Shaulov (1990) proposed that an individual's prior level of academic achievement might have an influence or be predictive of future achievement, so it was important to account for this potential confounding variable through equal distribution of student achievement levels in both groups.

Webb (1993) showed that heterogeneous groups produced the greatest impact on student achievement for the broadest range of students. Specifically, Webb noted that heterogeneous groups had the most significant impact on low achievers. She found that high achievers could perform well in groups with students of any achievement level. Webb noted that results for medium level achievers were complex. Medium achievers performed best in homogenous groups with other medium achievers or heterogeneous groups that had a narrow range of achievement levels (p.18). Despite this finding the researcher decided to remain consistent with the arrangement of heterogeneous groups in the cooperative sub groupings, with respect to achievement level, as this is also most representative of the natural classroom environment where there is a wide range of student achievement levels.

The students were also stratified based on gender so that there was an equal distribution of males and females between the control and experimental groups and within the treatment subgroups. Webb (1993) noted that males tended to dominate the discussion when they outnumbered or were outnumbered by females; however, this was reduced by creating heterogeneous groups. A balance of student gender was sought by the researcher in all groups in

this study. Creating homogeneous groups based on specific characteristics (for example, race, gender or academic achievement) may be useful and interesting; however, it was not within the purpose of this particular study.

### **Identification of Variables**

The independent variables of this study were the type of instructional method used – CL or individual learning. The researcher wanted to investigate the impact of this independent variable on the dependent variables: student achievement, students' level of confidence with their understanding of the material, time on task, and student satisfaction with the learning method. As discussed in Chapter 1, the emphasis of the study was the comparison of CL and IL, not the impact of using case studies on the above mentioned measures of learning. To ensure this, students in both the CL and IL groups received the same case and answered the same questions.

It has been consistently shown that CL methods result in higher student achievement compared to individual and competitive methods (Johnson, Maruyama, Johnson, Nelson & Skon, 1981; Slavin, 1995; Johnson, Johnson & Stanne, 2000); however, the context and setting of this CL method used by the researcher was different, so it was important to investigate its impact on student learning outcomes.

### **Procedure**

Prior to the actual experimental case session, all students attended classes and laboratories as part of the regular course schedule and were provided with lecture notes and/or associated textbook assigned readings. The case that was chosen for this experiment was

associated with the Phase A Medical Biochemistry course. It was a fictional but realistic case which emphasized key biochemistry concepts involved in diabetic ketoacidosis (Appendix B). This case has been used for the least three years; however, this past year the case presentation and laboratory values was revised and updated with contribution from Internal Medicine to make the case as realistic as possible.

This case from the biochemistry course was chosen for this study for many reasons. First, the Human Form and Function course (an amalgamation of Anatomy, Physiology, Histology and Embryology courses) offered in the first year of medical training, with which the majority of the cooperative cases were associated, included Dentistry students, who were also in the first year of studies in their program. Aside from the Human Form and Function course, the academic schedules of the first year dentistry and medicine students were significantly different and the researcher did not want this to be a confounder for the study. The medical biochemistry course did not include the dentistry students.

The second reason for choosing this case was based on the timing. As the researcher considered which case to investigate, it was important to ensure that the students did not have any other exams or large assignments in any of their classes near the date of the experimental case session because this may have had a negative impact on the outcomes of the study. Having other exams or assignments scheduled close to the date of the experiment may have placed limitations on some students' ability to prepare for the case. Also, if this case was temporally close to the final exam in the Medical Biochemistry course, the students would have studied the material that was emphasized in the case thoroughly for the exam and it was possible that this could have confounded the results.

The third reason for using this case also related to timing. This case was scheduled closer to the end of the school year. By this time, the students and facilitators were experienced with this cooperative small group process. The researcher did not want unfamiliarity with either the *process* or the *other students* to confound the experiment which was largely investigating the cooperative process and its impact on other variables such as achievement and confidence. The students and facilitators became familiar with the process very quickly, however, ethics approval was granted on January 31, 2007 which limited the case selection to term two.

Fourth, it was important to choose a case that had greater relevance to the students in hope that it would motivate them to engage in the case and its content. Abraham, Upadhyya, Torke, and Ramnarayan (2004) and Koens, Mann, Custers and Ten Cate (2005) suggested that subject matter taught within a clinical context had the greatest impact on students' motivation to learn. Some of the diseases that were used in the case scenarios were not common conditions that the students would see when encountering patients in subsequent years or would have been aware of in their own life experiences. These less common conditions presented an opportunity to emphasize specific basic science concepts; however, it reduced the relevance for the students. The researcher wished to choose a topic that was relevant and realistic to maintain a reasonable level of motivation, which would also emphasize basic science concepts; therefore a diabetes case was chosen. The prevalence of diabetes continues to increase in the general population and, specifically, the Aboriginal Canadian populations (Lipscombe & Hux, 2007; Young, Reading, Elias & O'Neil, 2000), and it is possible that the students would encounter a case of diabetic ketoacidosis in their medical careers.

Finally, this case was chosen because the researcher felt that the associated questions were challenging and required the students to engage in a higher level of application and

elaboration of the basic science concepts than other cases within the curriculum and time frame. It also reflected the desired level of intellectual engagement for students at this point in their education. By having a case that was conceptually challenging, it was thought that this might help to elucidate any difference that may exist between individualistic and CL techniques.

All students, whether they were participating in the individual or cooperative cohort, had access to the diabetic ketoacidosis case (Appendix B) and pre-session reading topics on the course web-site since the beginning of the academic year; however, they were reminded of the case one week prior to the actual case session. They were also reminded and encouraged to bring outside resources (lecture notes, textbooks, computers, PDA's, etc.) to the session. The focus of this reminder was for the students in the IL cohort so that they would have something to refer to when working on the case, keeping in mind that even if one person in a small group brought a resource, it could be shared with the whole group. In the time leading up to the case session, the students were able to prepare as much (or as little) as they felt necessary, using the pre-reading topics as a guide for any review or preparation.

Immediately before the small group or individual study sessions, all students met as a large group to complete, individually, a ten question multiple choice pre-test (Appendix F). The actual pre-test had twice as many questions as the mock pre-tests in an attempt increase the reliability of the test. Students would not likely be suspicious that this case and these questions were part of a research study because there were suddenly more pre-test questions than usual. The students were also asked to use the same rating scale (1-10) as in previous pre-tests and post-tests to rate their level of confidence for each answer.

All ten questions were written and reviewed by three course content experts and were the type of questions that the students would expect in the Medical Biochemistry final examination,

which gave the tool content and face validity. All test items were written to ensure proper test item construction. Internal consistency of the pre/post-tests was not determined prior to the study.

Following the multiple choice quiz, the students who were previously randomly assigned to work in groups were distributed into their small groups to work on the selected case questions in the regular small group discussion format as outlined previously in Chapter 1. In order to blind the students to the study, those students who were randomly assigned to the individual study cohort were asked to stay behind in the large classroom as the students assigned to small groups left the room.

At this point, the individual study cohort was told a contrived story that their facilitators were not able to show up for the case discussion; however, the researcher never intended to book facilitators for these students. The “missing” facilitators were senior medical students. These senior students were in their third or fourth year of medical school and were performing clinical rotations on the wards in the hospital. They made up a significant size of the pool of volunteer facilitators for the cooperative cases throughout the year.

The first year students were told that the researcher, who coordinated the assignment of the facilitators, discovered on the morning of the case session, from an e-mail sent by one senior student scheduled to facilitate the case, that a mandatory academic half-day had been rescheduled unexpectedly and that the four senior students assigned to be facilitators would no longer be available. The first year students were told that the academic half-day normally scheduled for the senior medical students during the time of this case, had not been scheduled. Also, there had been no half-days scheduled for the past three weeks, which in fact was true. This helped with the credibility of the story. The senior students’ clinical schedules were quite

unpredictable; therefore, it was quite possible that these student facilitators could suddenly be unavailable to facilitate a case session. In fact, this had happened already for other cases earlier in the academic year. The first year medical students were aware of this possibility, which made this contrived story more realistic.

The questions for the case (Appendix C) were distributed to the students in the individual cohort and they were asked to work on the same case questions as those assigned to the cooperative small groups, but answer them individually. They were allowed to use any resources available to them. The students were also allowed to leave the room to obtain any resources that they felt they needed and return to the large room to complete the case. The students were also told that the researcher would remain in the room to help them with any questions they may have as they went through the case questions. This was done to encourage the students to work individually and to stay to work through the case. It also allowed the researcher to remain in the room to observe the students as they worked through the case individually.

Upon completion of the case all students in each cohort answered and handed in an individual accountability question (Appendix G), which was to be marked and returned to the students, in one week, after completion of the post-test, just as in all other previous cases. The individual accountability question was the same for the individual and CL cohorts. After the students handed in the individual accountability question, the session was completed and they were allowed to leave.

The researcher scheduled a class meeting one week after the students completed either the cooperative small group discussion or the individual study of the diabetic ketoacidosis case. At this point the students were still blinded to the study; therefore, the researcher told them that this meeting was an important year-end feedback session for the cooperative cases and that the

post-test for the diabetic ketoacidosis case would also be administered. The meeting was scheduled during an open block of time in their schedule, and the students were notified of the meeting one week in advance. They were also given a second reminder of the meeting two days prior and also on the morning of the meeting. When the students arrived, they were asked to complete the post-test, which consisted of the same ten multiple choice questions as in the pre-test. The students also rated their level of confidence using the same scale parameters as mentioned above (scale of 1-10).

After administration of the post-test, the students were also completed a questionnaire which asked them a number of questions about the following general topics: a) general satisfaction with respect to aiding in learning and if it was worth the time spent; b) the amount time they dedicated to working on the case before, during and after the case session; c) in the case of the cooperative cohort, if the facilitator helped the students learn. It was decided that two separate questionnaires be distributed to the students – one for the cooperative and one for the individual cohort. This was done to ensure that the wording could be made clear for each questionnaire; although most of the questions were the same (Appendix A within the application for ethics approval).

The researcher consulted with one other faculty advisor to ensure that the questions were appropriately constructed. Also, the researcher distributed the questionnaire to 20 second year medical students to get feedback on the structure of the questions and if they were clear and understandable. With the information from the questionnaire, the researcher hoped to obtain a better understanding of the students' satisfaction with the cooperative small group case discussion method. The researcher was also interested in comparing the approximate amount of time on task between groups and its relationship to learning outcomes.

Full disclosure of the study and its purpose was given to the students (Appendix A) by the researcher to the students after the questionnaire was handed in. The students who were assigned to the individual cohort were offered make-up session using the cooperative small group format to be scheduled at a later date where juice and cookies would be offered during the make-up session. Only one student signed up, therefore no make-up session was arranged. A request for consent to release data was handed out to all students to sign (Appendix A). At this point, the researcher left the room and a third party assistant collected all consent forms and questionnaires.

### **Ethical Considerations**

The issue of deception was addressed in the application for ethics approval (Appendix A). The researcher felt that the risk of harm to the students was minimal, because the students who were in the individual study cohort would be offered an opportunity to participate in a make-up cooperative small group discussion at a later date. Also, these cooperative small group sessions were only a supplement to the course curriculum with the intention of reinforcing previously taught lecture material. All information discussed in the cases was first presented as a lecture or assigned reading, so the students were not receiving new material during these sessions, but only given an opportunity to apply their knowledge. Furthermore, none of the cases or questions were specifically evaluated on subsequent examinations, although the concepts discussed in the case would be assessed because they were objectives for the course and were previously taught in lectures. The cases and the associated cooperative small group discussions were a means for study and practice. They never did, nor were they designed to introduce any new material or learning objectives.

The researcher of this study was involved with the instruction of these students on a regular basis. Every reasonable effort was made to remove the researcher from contact with the students throughout the duration of this study. A third party representative from the Educational Support and Development unit, who had no connection to the students or this study, was responsible for obtaining informed consent from the students to allow their data to be included in this study. Ethics approval to perform this study was obtained on January 31, 2007.

### **Data Analysis**

The purpose of the study was to determine the impact of one cooperative small group case-based discussion method on student specific outcomes compared to an individual case-based learning method as determined by scores on pre- and post-tests and self-assigned confidence levels and data from a questionnaire.

The results of the pre-test/post-test scores between the two groups were compared using a repeated measures two-way multivariate analysis of variance (MANOVA). Two-way multivariate analysis was used because this study investigated two independent variables, cooperative versus individual learning, and two dependent variables, student achievement, and confidence with their answers in the multiple choice test. Repeated measures was used because the students wrote the same pre-/post-test, and therefore were their own matched controls.

For the purposes of this study, an alpha level of .05 was used to establish statistical significance. The reason for choosing a slightly higher alpha level was because with a small sample size, it may be that the intervention would produce a statistically significant result that may be missed with a lower alpha level. In other words it was important to eliminate as many false negatives as possible (incorrectly accepting the null hypothesis that there was no difference

in the impact of the CL method compared to individual study when, in fact this was not true) even though it may increase the likelihood of a false positive.

This study used effect sizes to compare the pre- and post intervention confidence levels, and pre-and post-test scores of the two conditions in order to determine the presence of practical significance. It was important to measure effect sizes to determine if the intervention was practically useful or valuable – in other words, if it produced an effect on learning that was worth the effort to continue or perhaps implement in other settings. Effect size is the “quantitative expression of the magnitude of the difference between the scores of the experimental and control groups” (Gall, Gall & Borg, 2003, p.107). Effect sizes were calculated by taking the difference between the mean scores of the control and treatment group and dividing by the pooled standard deviations of the control and experimental groups. Effect sizes were calculated for the within group effects for the experimental and control groups as well as between groups comparing the average change in score from pre- to post-test. Hojat and Xu (2004) discuss Cohen’s recommendations for defining the significance of effect sizes, where effect sizes of 0.2, 0.5, and 0.8 represent small, medium and large effects, respectively. A small effect represents an effect of negligible practical significance. A medium effect represents a moderate practical significance. A large effect represents a crucial practical significance.

Callahan and Reio (2006) cautioned against the rigid use of Cohen’s effect size guidelines and recommended that effect size results be interpreted on the basis of the underlying theory and the results of prior studies. They also discussed the possibility that the outcome for an intervention may have a small effect size, but it still may be an *important* outcome, or for a large effect size to be associated with an outcome of little importance. Albanese (2000) gave examples of various medical interventions that have resulted in improved quality of life or

reduced mortality – very important outcomes – that generated effect sizes that were considered small under Cohen’s classification.

Slavin (1995) performed a meta-analysis that compared the effect sizes of different CL methods. Seventy-seven of the ninety studies that met the inclusion criteria for the meta-analysis included enough information to calculate effect sizes. The mean effect size for the seventy-seven studies was 0.26, with a range from 0.04 to 0.86.

Slavin argued that effect sizes of 0.20 to 0.25 for educational interventions should be considered “educationally significant”, and that the effect size can be influenced by study characteristics (p.21); for example: a) studies that do not compare CL to a control group, b) studies where the groups are treated differently, resulting in advantages for one group, c) studies where the groups may not have been equal from the beginning (non-random assignment), d) studies of short duration, and finally, e) studies where the control and experimental groups were not taught the same material. These factors can artificially inflate effect sizes by giving unfair advantage to one group or by creating an artificial environment that favours the intervention. By adhering to more rigorous study standards, effect size measures may reflect significant differences, even if the differences are small.

Johnson, Johnson and Stanne (2000) also performed a meta-analysis comparing various CL methods. The inclusion criteria for this meta-analysis were much less rigorous than in Slavin’s (1995) meta-analysis. The main requirements were that the study had to use a specific method of CL and it had to investigate the impact of CL on achievement compared to competitive or individual learning methods. There were 164 studies that met the inclusion criteria. The mean effect size when comparing CL to individualistic learning was 0.51 with a range from 0.13 to 1.04.

In an attempt to clarify the effect size standard for educational interventions, Slavin (1995) discussed that an effect size of 1.0, which would be equivalent to moving a student approximately one standard deviation on a normal distribution, occurs infrequently for educational interventions with the exception of one-to-one expert-to-student tutoring. Based on this knowledge and the basic structure and theories of CL, it seems appropriate to place CL somewhere near the midpoint on a continuum between traditional individualistic educational practices and one-to-one tutoring; therefore Cohen's set-points for a small, medium and large effect seem reasonable as *guidelines* for interpreting effect size measures for this study.

## **CHAPTER IV**

### **Results**

In this chapter, the researcher will present the results from the data collected during the study which will address the research questions outlined in Chapter One. This chapter will be organized as follows: a) a detailed description of the researcher's observations of the behaviours and responses of those students who were asked to complete the case individually; b) presentation of the results of the repeated measures MANOVA, standard error measures, and effect sizes for student achievement; c) presentation of the results of the repeated measures MANOVA, standard error measures and effect sizes for confidence; d) a comparison of student satisfaction in the CL and IL methods, where satisfaction refers to whether or not the method helped the students to learn and whether or not it was a good use of time; e) a comparison of the amount of time on task in the CL and IL cohorts before, during and after the case session; and finally, f) an analysis of the students' perceptions of the impact of the facilitator in the cooperative cohort, in terms of how much the students felt that the facilitator helped them to learn the material in the case.

#### **Description of Events for the Control Group Case Session**

Before presenting the results of the data analysis, the researcher felt that it was important to describe the events that transpired, and the interactions with and observations of the students who were assigned to the IL cohort. It was important to describe these first, these observations should be taken into account when considering the results of the data analysis. These events are described below.

10:20 – Fifty-one of a possible 60 first-year medical students met in a common large lecture theatre – as previously arranged – to complete the 10 multiple choice question pre-test associated with the diabetic ketoacidosis case.

10:25 – The pre-test was handed out to all the students present. They could begin to work individually on the pre-test as soon as they were given a pre-test sheet.

10:30 – As all of the students were completing the pre-test, they were told that the four senior medical student facilitators would be unable to facilitate the case because of a newly scheduled academic half-day. All students in the four affected groups were asked to remain in the large classroom. Meanwhile, the students in the four unaffected groups (ie. groups with a facilitator) were allowed to disperse to their assigned break-out rooms where their facilitator was waiting to begin the session.

10:35 – All pre-tests were handed in and students in the CL cohort were in their break-out rooms. The students in the individual cohort remained in the classroom and they were given a more detailed explanation of why the senior medical students were not able to facilitate this case (see Procedure section in Chapter 3, p. 61). As a result, the first year students were asked to spread out in the large classroom and complete the case individually. They were told that it would be useful to answer the questions in the case because the case addressed many biochemistry concepts. Most of the students were observably upset about still having to do the case, and that they could not work on the case in groups. The students asked questions, which the researcher anticipated, to try to find ways to either distribute themselves to the four groups that were not affected or to form new groups within the large classroom. The researcher told the students that it would be too difficult to coordinate distributing so many students to the other groups within the time frame, as well as distribute all the necessary paperwork to each group.

Also, the students were told that having such large groups would be very ineffective for their learning. The researcher told the students, again, to try their best to work through the questions individually. To encourage this, the students were told that the researcher would be available for help, and that this case was useful and important for understanding basic biochemistry concepts. All students then began to work on the case.

10:40 – Students in the IL cohort began answering questions 1-8 for the diabetic ketoacidosis case, which were the same questions the cooperative cohort was answering. This time was marked as the beginning of the case session. The students were told that they would have one hour to complete the case from this starting time.

With the beginning of the case session, four students immediately formed a group (Group A). They arranged themselves to face each other, so that they could discuss each question with one another and maximize crosstalk. Figure 1 shows a schematic configuration of the four students as they worked on the case. All other students in the room started working on the case individually.

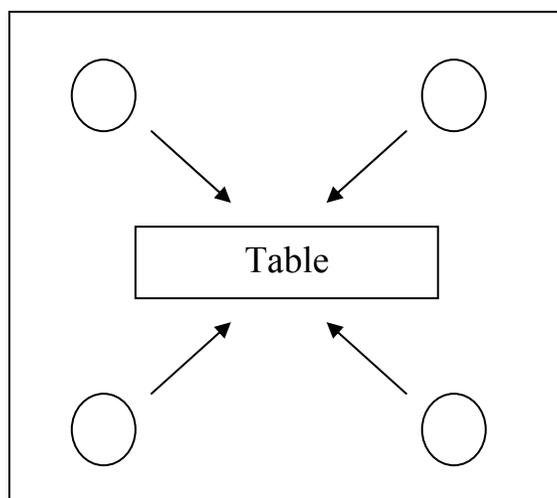


Figure 1. Orientation of Group A in the Individual Learning Cohort

10:45 – Four other students formed themselves into a group (Group B). These students remained seated in linear fashion. Figure 2 shows the schematic configuration of these students. The researcher observed that this orientation limited cross talk between all individuals within the group. The students worked as a group of four, but shared their answers mostly through the adjacent student with less discussion among non adjacent students.

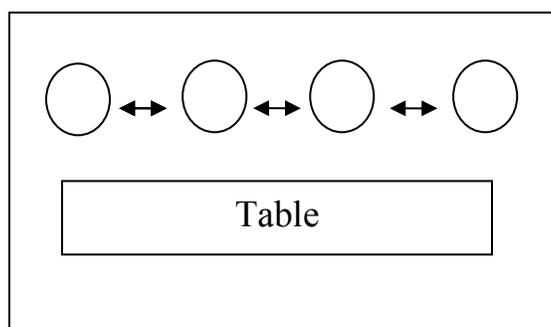


Figure 2. Orientation of Group B in the Individual Learning Cohort

10:50 – The first student in the individual cohort completed and handed in the individual accountability sheet. Also, 6 students started to form 3 sets of informal pairs throughout the room, approximately ten minutes after the case session began. Nine students continued to work on the case individually. All students that formed these small informal groups, with the exception of the students in Group A, still worked very quietly and with limited discussion among students. It appeared as though the objective of the students working in these small groups was to confirm answers that were first determined individually. Many of the comments overheard by the researcher were “is that what you got for number...?” and “what did you get for number...?” Group A, although quiet, was involved in significant discussion for each question, and they were working together to answer the questions, rather than merely confirming answers.

11:10 – All students in the individual cohort had completed and handed in the individual accountability sheet. At the very most, these students used half of the total time available to them to complete the case. One student completed the case in ten minutes and all other students between 15 and 30 minutes.

During the session four students came to the researcher to ask questions. The researcher used a series of guided questions to allow the students to develop their own conclusions much the way a facilitator in a small group would guide the students with the exception that the researcher could not promote group discussion.

The researcher also observed that very few students brought in resources to help them answer the case questions. Two students had laptop computers with wireless internet access. The researcher was not able to determine the exact number of students with related lecture notes, or textbooks, but it appeared that very few students brought resources, which followed the trend of previous case sessions. No students took the opportunity to get resources at the beginning of the session when allowed. Those students who did have resources shared them with others; however, it was observed that the student borrowing the resource would use it for individual purposes, and then give it back. This was in spite of the fact that many of these students were working in pairs.

### **Control Group – Group Processing Comments**

On each individual accountability sheet, there was a section dedicated to group processing. In this section the students commented on what made the group function well and what could have made the group function better. The students in the individual cohort were not required to fill this out, but of the 23 students in this cohort, 18 students provided comments. Of

the four students in Group A (refer to Figure 1), two perceived themselves as not actually being in a group. One Group A member felt that discussion contributed positively to group functioning, but stated that it would have been a better learning experience if there would have been a large group discussion.

All four students in Group B (refer to figure 2) completed the group processing and perceived that they were working as a group in spite of the researcher's observations that communication between *all* group members was limited. Some comments from the students in Group B regarding positive contributions to the group included "everyone contributed", "good group work", "consultation [with group members]", and "adaptability of the team". Two remarkable comments for what might improve the group functioning included, "actual groups", and "if we could actually work in groups and discuss things with each other more".

All of the six students who worked in pairs commented that the group processing section was "not applicable" with three of the students also adding that they had worked individually. Of the nine students who worked on the case individually, five did not enter any comments. The remaining four stated that the group processing section was either "not applicable" or that they could not comment because they worked individually.

### **Type of Analysis and Breakdown of Experimental and Control Groups**

As described in Chapter 3, a 10 multiple choice question pre-test – post-test was used to compare the impact of CL and IL methods on student achievement. The post-test was written one week after the pre-test. The data were analyzed using repeated measures two-way multivariate analysis of variance (MANOVA) because the analysis investigated the effect of CL on two independent variables: cooperative or individual learning, and two dependent variables:

a) student achievement, as determined by the average scores on the 10 item pre- and post-tests, and b) student level of confidence with their knowledge (this will be discussed in the following section). Because the students wrote a pre- and post-test that contained the same questions, the students were their own controls; therefore, a repeated measures analysis was used.

One disadvantage to using repeated measures in this analysis was that there were a number of students from both cohorts who did not complete each component of the pre-and post-tests. As a result, their data could not be included in the analysis. This reduced the number of data sets available for comparison of the two groups. However, it was determined that a repeated measures MANOVA was the most appropriate test because a strong and statistically significant positive relationship by Pearson's correlation existed between the variables post-test score and post-test confidence ( $r = .751$ ;  $p < .01$ ), which explained 56% of the variance, and pre-test confidence and post-test confidence ( $r = .601$ ;  $p < .01$ ), which explained 36% of the variance (Table 2). A MANOVA takes these relationships into account when analyzing the data.

Table 2: Correlations Between Dependent Variables

		Pre-test Score	Post-test Score	Pre-test Confidence	Post-test Confidence
Pre-test Score	Pearson Correlation	1	.336	.283	.218
	Sig. (2-tailed)		.060	.116	.231
	N	32	32	32	32
Post-test Score	Pearson Correlation	.336	1	.317	.601(**)
	Sig. (2-tailed)	.060		.077	.000
	N	32	32	32	32
Pre-test Confidence	Pearson Correlation	.283	.317	1	.751(**)
	Sig. (2-tailed)	.116	.077	.32	.000
	N	32	32		32
Post-test Confidence	Pearson Correlation	.218	.601(**)	.751(**)	1
	Sig. (2-tailed)	.231	.000	.000	
	N	32	32	32	32

\*\* Correlation is significant at the 0.01 level (2-tailed).

Of the 60 students enrolled in the first year medical school class, 51 students were present on the day of the pre-test and case session that completed and handed in the pre-test (28 in the experimental group; 23 in the control group). As noted in Chapter 3, after each multiple choice question, the students were asked to rate themselves on a scale from 1-10 on how confident they were that they had selected the correct answer. Two students from the experimental and one student from the control group did not rate themselves on confidence level for the pre-test and their data were removed, even though 2 of the 3 students (1 from the experimental and 1 from the control group) completed the post-test and associated confidence ranking. This reduced the sample to 48 students (26 in the experimental and 22 in the control group).

One week after the pre-test, students met again to complete the post-test. Of the 48 students that completed the pre-test and associated confidence rating, 36 completed the post-test (21 in the experimental group; 15 in the control group). Many students chose not to attend this meeting (see Procedure section – Chapter 3), where they completed the post-test, questionnaire, and consent, even though they were strongly encouraged and reminded multiple times to attend.

One student from each of the control and experimental groups did not rate themselves on confidence level for the post-test. This reduced the sample size to 34 from 36 students (20 – experimental; 14 – control). Using repeated measures for the dependent variables of test score and confidence score, the data from 32 students were included in the analysis (19 students in the experimental and 13 students from the control group). Table 3 shows the breakdown of how the final sample size for the repeated measures was determined.

Table 3: Number of Students Who Completed the MCQ and Confidence Rating Portions of the Pre- and Post-tests

	Pre-test MCQ's	Pre-test Confidence	Post-test MCQ's	Post-test Confidence	# Available for Repeated Measures
Experimental	28	26	21	20	<b>19</b>
Control	23	22	15	14	<b>13</b>
<b>Total</b>	<b>51</b>	<b>48</b>	<b>36</b>	<b>34</b>	<b>32</b>

The test consisted of 10 multiple choice questions which were worth one mark each and marks were not subtracted for incorrect answers. The correct answers were added together to get the score out of 10 for each student. Reliability analysis of the test questions revealed a Cronbach's alpha of 0.35. This is a low reliability; however, a low internal consistency was expected because the questions on the exam were testing different concepts within the one subject area (ie. non-homogeneous questions). If the test questions had been designed to test the students on a central theme or concept, or if there had been more questions for each concept, the reliability coefficient would likely have been greater (See the Limitations Revisited section in Chapter 5). The instrument showed some construct validity (along with face validity) in that performance improved for both groups following the respective interventions (independent study and cooperative group work). This implies that there was adequate reliability since validity is not possible without sufficient reliability.

After each multiple choice question, the students were asked to rate, on a scale from 1-10, the confidence that they had chosen the correct answer, with 1 being the least confident and 10 being the most confident. An average confidence level was obtained for each student. Reliability analysis of confidence ratings revealed a Cronbach's alpha of 0.92. This is high and indicative of the fact that the items were all measuring a consistent construct, confidence.

### Achievement – Cooperative vs. Individual Learning

A repeated measures MANOVA was performed on two dependent variables: test score and confidence. The independent variable was learning method (cooperative or individual). The results of the comparison of the effect of CL and IL on achievement will be discussed first and they are shown in Table 4.

Table 4: Descriptive Statistics for Pre- and Post-tests and Average Pre- to Post-test Change for Control and Experimental Groups Using Repeated Measures

	n	Pre-test mean	SD	SE	Post-test mean	SD	SE	Pre to Post Change	SD	SE
Experimental	19	7.58	1.39	0.32	8.32	1.20	0.28	0.74	1.76	0.40
Control	13	7.85	1.46	0.41	8.08	1.50	0.42	0.23	1.24	0.34

The mean pre-test score for the 19 students in the experimental group was 7.58 out of 10, with the scores ranging from the lowest of 4 to the highest of 10 out of 10. The mean pre-test score for the 13 students in the control group was 7.85 out of 10, with the scores ranging from the lowest of 6 to the highest of 10. The mean post-test score for the 19 students in the experimental group was 8.32, and the scores ranged from the lowest of 6 to the highest of 10. The mean post-test score for the 13 students of the control group was 8.08, and the scores ranged from the lowest of 5 to the highest of 10. The average pre-test post-test change in score for the experimental and control groups was 0.74 and 0.23, respectively. This was calculated for the control and experimental groups by subtracting the post-test score from the pre-test score for each student, then taking the sum of the differences and dividing by the number of students in the group.

Wilk's Lambda was used for the multivariate analysis of test score and was found to be statistically significant, ( $F = 41.33$ ,  $p < 0.05$ ). Levene's test of equality of error variances was

not significant; therefore assumption of equal variances was accepted. Univariate analysis of within- and between subjects comparisons was then performed to determine which specific aspects of the multivariate analysis were contributing to the statistically significant result. The results for the multivariate and univariate analyses are shown in Table 5.

Table 5: Summary of Repeated Measures MANOVA and Univariate ANOVAs for Within-Group and Between-Subjects Effects of Cooperative and Individual Learning on Test Score

Repeated-Measures MANOVA	Univariate ANOVA Within-Group (Pre to Post)		Univariate ANOVA Between-Groups		
	Experimental	Control	Pre-Test	Post-Test	Pre – Post Change
Testscore	(F)3.06	(F).16	(F).27	(F).25	(F).80
(F)41.34*					

Note: \* =  $p < 0.05$

Within-subjects pre-test post-test comparison for test score for the experimental group approached but did not reach statistical significance ( $F = 3.06$ ,  $p = 0.09$ ). The within-subjects pre-test post-test comparison for test score for the control group was not statistically significant ( $F = 0.16$ ,  $p = 0.70$ ). Univariate between-subjects comparisons showed no statistical significance from pre-test to post-test. Also, there was no statistically significant difference between groups when the average change in score from pre-test to post-test was compared.

Statistical significance was not achieved for the univariate between-subject measures, which suggested that there was no statistically significant difference in the achievement of the CL group compared to the IL group. However, the within subjects univariate ANOVA appeared to favour a greater change in test score from pre- to post-test in the experimental group compared to the control.

The standard error of the means of the pre-test and post-test between groups was also calculated. Figure 3 shows that the experimental group produced a greater positive change in

test scores from the pre- to post-test than the control group. It can be seen, that when the standard error was included, the mean scores from pre-test to post-test for the experimental group did not overlap. This indicated that these two values for the mean score were truly different. It was most likely this difference that contributed to the statistical significance of the multivariate test. When the standard errors for the mean scores from pre-test to post-test for the control group were included there was considerable overlap of the values.

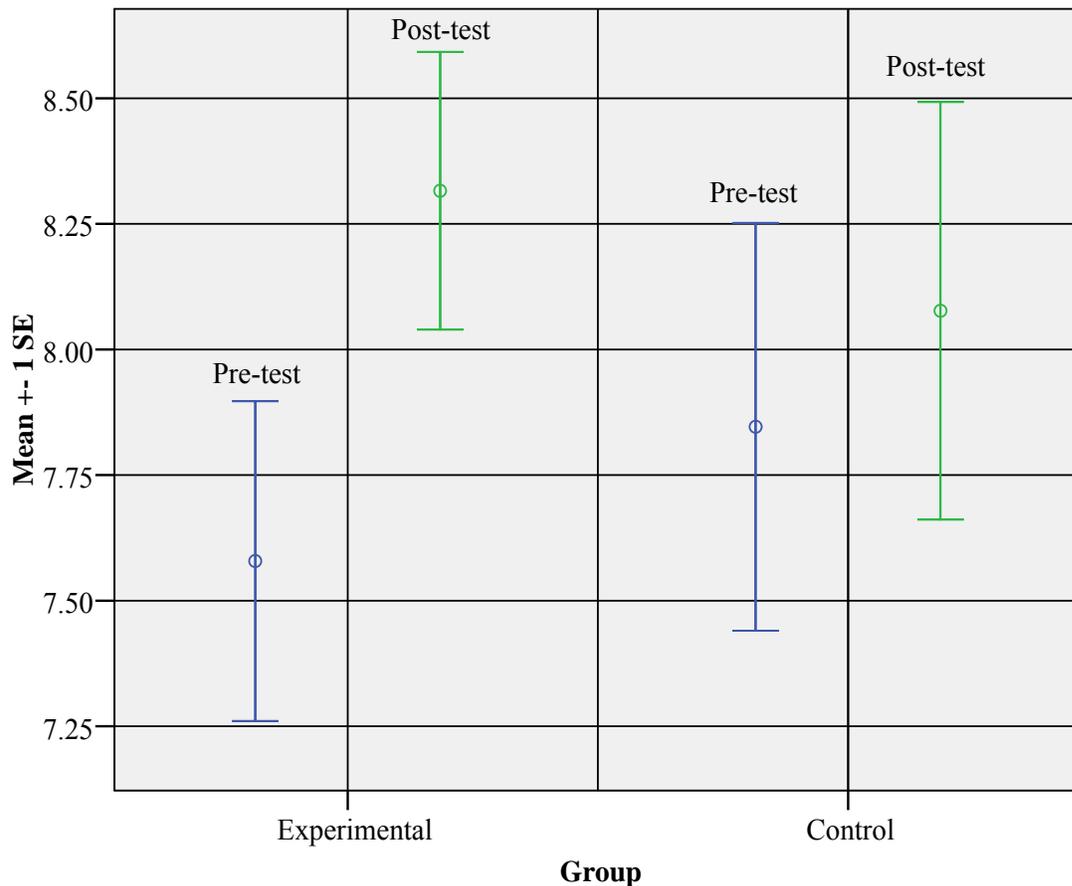


Figure 3: Comparison of Standard Error of the Means for Pre- and Post-Test Scores Between Groups

Table 6 shows the effect sizes that were calculated for achievement in the experimental and control groups for within-subjects effects as well as for average pre- to post-test change

between groups. An effect size of 0.57 was observed for the experimental group when comparing their pre- and post-test scores, which under Cohen's classification was considered a medium effect size and of moderate practical significance (Hojat & Xu, 2004). An effect size of 0.16 was found for the control group, which was considered a small effect size and of negligible practical significance. Finally, an effect size of 0.35 was observed when the average change from pre- to post-test was determined and compared between groups. This effect size under Cohen's classification was considered to be small.

Table 6: Effect Sizes for Achievement Comparing Cooperative and Individual Learning

Within-Group Effect		Between-Groups Effect
Experimental	Control	Average Pre- to Post-Test Change
0.57	0.16	0.35

Note:  $ES = M_1 - M_2 / \sqrt{(SD_1^2 + SD_2^2) / 2}$

### Confidence – Cooperative vs. Individual Learning

The second dependent variable measured in the repeated measures MANOVA was student confidence level, which was included in the study to determine if this case-based CL method contributed to an increase in student confidence with their knowledge of the material covered in the cooperative case compared to when doing the same case individually. The results of the comparison are shown in Table 7.

Table 7: Descriptive Statistics for Pre- and Post-test Confidence and Average Pre- to Post- test Confidence Change for Control and Experimental Groups Using Repeated Measures

	n	Pre-test mean	SD	SE	Post-test mean	SD	SE	Pre to Post Change	SD	SE
Experimental	19	4.89	2.05	0.47	6.05	2.41	0.55	1.16	1.28	0.29
Control	13	6.32	1.69	0.47	6.58	1.92	0.53	0.27	1.69	0.47

The mean pre-test confidence rating for the 19 students in the experimental group was quite low at 4.89, with ratings ranging from 2.0 to 8.6. The mean pre-test confidence for the 13 students in the control group was 6.32, with rating ranging from 4.3 to 9.8. The mean post-test confidence rating for the 19 students in the experimental group was 6.05. The mean post-test confidence for the 13 students of the control group was 6.58. The mean pre-test to post-test change in confidence for the experimental and control groups was 1.16 and 0.27, respectively.

As was previously mentioned, Levene's test of equality of error variances for the MANOVA was not statistically significant. Wilk's Lambda was used for multivariate analysis of confidence ratings and was found to be statistically significant, ( $F = 6.83$ ,  $p = 0.01$ ). Univariate analysis of within- and between subjects comparisons was then performed to determine which specific aspects of the multivariate analysis were contributing to the statistically significant result. Table 8 shows the results for the multivariate and univariate analyses. Within-subjects pre-test post-test comparison of confidence ratings for the experimental group did not reach statistical significance ( $F = 2.55$ ,  $p = 0.12$ ). The within-subjects pre-test post-test comparison of confidence ratings for the control group was also not statistically significant ( $F = 0.14$ ,  $p = 0.71$ ).

Table 8: Summary of Repeated Measures MANOVA and Univariate ANOVAs for Within- and Between-Subjects Effects of Cooperative and Individual Learning on Confidence Ratings

Repeated-Measures MANOVA	Univariate ANOVA Within-Group (Pre to Post)		Univariate ANOVA Between-Groups		
	Experimental	Control	Pre-Test	Post-Test	Pre – Post Change
(F)6.83*	(F)2.55	(F)0.14	(F)4.28*	(F)0.44	(F)2.88

Note: \* =  $p < 0.05$

Univariate between-subjects comparisons of confidence revealed a statistically significant result for the pre-test ratings ( $F = 4.28$ ,  $p = 0.047$ ). Although difficult to explain, it suggests that after random assignment and elimination of students through repeated measures, the students in

the experimental group were less confident with their knowledge than were the control group. This result should be interpreted with caution because the observed power was low (0.34), therefore, this finding may have been due to type II error. Interestingly, when all pre-test confidence scores were included, rather than only repeated measures, there was no statistically significant difference between the confidence ratings for the experimental and control groups ( $F = 1.59, p = .214$ ). Univariate between-subjects comparison of post-test confidence rankings was not statistically significant. Also, there was no statistically significant difference between groups when the average change in confidence rankings from pre-test to post-test was compared.

Statistical significance was not achieved for the univariate between-subject measures of post-test confidence and average pre- to post-test confidence change, which suggests that the difference in the confidence level of the CL group compared to the IL group may have been due to chance. However, changes in confidence from pre- to post-test in the within-subjects univariate ANOVA appeared to favour the experimental group compared to the control. Also, as was done for test score, by using the standard error of the means of the pre-test and post-test confidence ratings between groups, Figure 4 shows that the experimental group produced a greater and true positive change in confidence ratings from the pre- to post-test compared to the control group and it was most likely this change that contributed to the statistical significance of the multivariate test.

Effect sizes for confidence ratings were also calculated for within- and between-subjects comparisons. These results are shown in Table 9. An effect size of 0.52 was found for the experimental group when pre- and post-test confidence ratings were compared, which under Cohen's classification was considered a medium effect size and of moderate practical significance (Hojat & Xu, 2004). An effect size of 0.14 was found for the control group, which

was considered a small effect size and of negligible practical significance. Finally, an effect size of 0.40 was measured when the average change from pre- to post-test was determined and compared between groups. This effect size under Cohen's classification was considered to be small, but on the upper limit approaching a medium effect size.

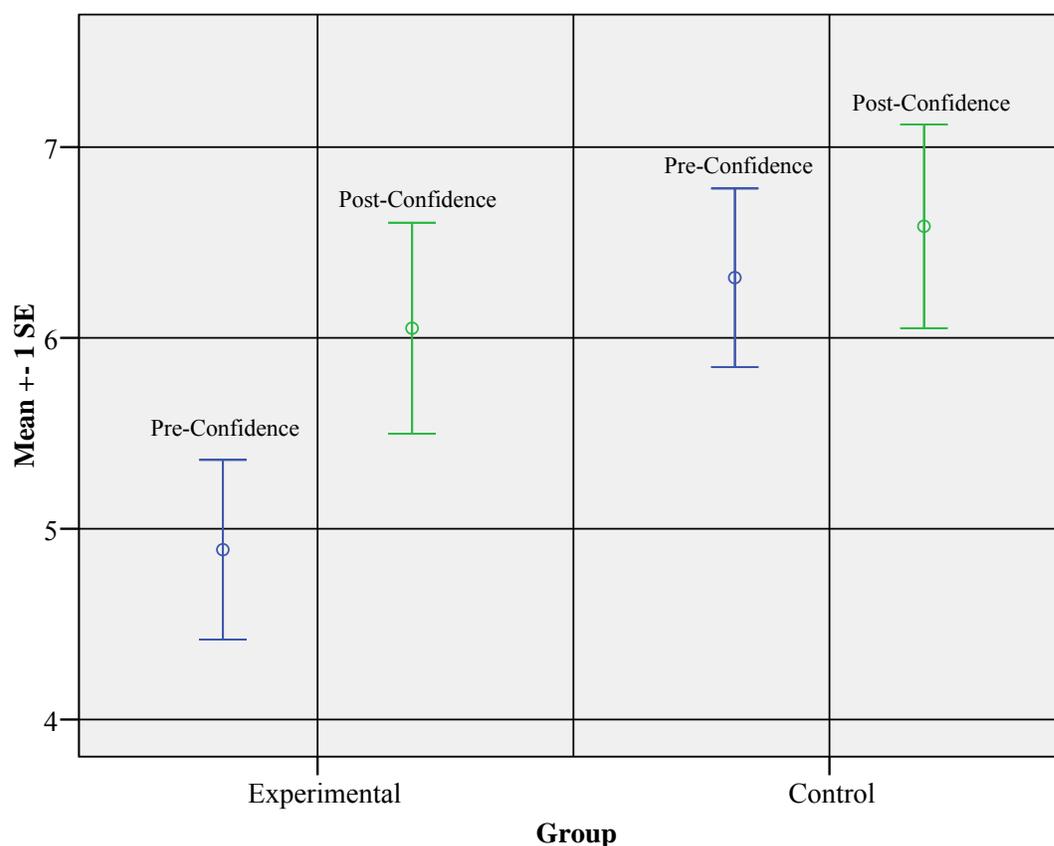


Figure 4: Comparison of Standard Error of the Means for Pre- and Post-Test Confidence Ratings Between Groups

Table 9: Effect Sizes for Confidence Ratings Comparing Cooperative and Individual Learning

Within-Group Effect		Between-Groups Effect
Experimental	Control	Average Pre- to Post-Test Change
0.53	0.14	0.40

Note:  $ES = M_1 - M_2 / \sqrt{(SD_1^2 + SD_2^2) / 2}$

## **Questionnaire Results**

A questionnaire was distributed to all students who completed the pre- and post-tests for the experiment (experimental = 21; control = 16) (Appendix A). This questionnaire was created to determine three things: 1) student satisfaction with their learning experience in either the cooperative or individualistic learning environment; 2) perceived time on task before, during and after the case; and 3) for the cooperative group, the perceived importance of the facilitator in enhancing learning.

### **Student Satisfaction – Cooperative vs. Individual Learning Groups**

Student satisfaction referred to how satisfied the students were with their learning experience, either in the CL or IL groups. This was assessed by asking the students to respond, using a 5-point Likert scale ranging from “strongly disagree” to “strongly agree”, to two questions: “working through the case questions was a good use of my time” and “I felt that I learned a lot by working through the questions during the session”.

Table 10 shows the frequencies of the responses to each of these questions. The students working in the cooperative groups were much more satisfied with their learning experience than the students in the IL cohort. Eighteen out of twenty-one students (85.7%) in the experimental group either agreed or strongly agreed that the case session was a good use of their time. Also, none of the students in the experimental group disagreed or strongly disagreed. In the control group, 7 of the 16 students (43.8%) agreed that the case session was a good use of their time. However, four students (25%) either disagreed or strongly disagreed.

Table 10: Frequencies for Student Satisfaction Questions by Group

		N	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Good use of Time	Experimental	21	0	0	3 (14.3%)	14 (66.7%)	4 (19.0%)
	Control	16	3 (18.8%)	1 (6.3%)	4 (25%)	7 (43.8%)	1(6.3%)
Learned a lot	Experimental	21	0	0	4 (19.0%)	14 (66.7%)	3 (14.3%)
	Control	16	1 (6.3%)	5 (31.3%)	6 (37.5%)	4 (25%)	0

Seventeen of the twenty-one students (81%) in the cooperative group felt that they learned a lot by working through the case. It is also important to note that none of the students either disagreed or strongly disagreed with this statement. Thirty-eight percent (6 out of 16) of the students in the control group either disagreed or strongly disagreed that working through the case individually helped them to learn. One quarter of the control group agreed that working through the case helped them to learn.

The perception for a large majority in the experimental group was that working through the case cooperatively helped them to learn the material. The perception for the majority of students in the control group was that working through the case individually, either made no difference or did not help them to learn. These results reflect the trend of the post-test score results mentioned above, where the gains in test score were larger for the cooperative students than the students who worked on the case individually.

### **Time on Task – Cooperative vs. Individual Learning Groups**

Time on task for this questionnaire referred to the amount of time that the students dedicated to working on the case before, during and after the case session. In the questionnaire, the students were presented with options that increased by 15 minute increments. They were asked to recall the amount of time they spent working on the case before, during and after the session by circling the most accurate option.

The time on task before the case, referred to the preparation time prior to the case. The questions were not available to the students ahead of time; however, the case description and a concise list of pre-session reading topics were supplied to guide self-directed learning. The students were also encouraged to define any unfamiliar terms presented in the case description.

As can be seen in Table 11, the amount of preparation time for this case for both the control and experimental group was remarkably low. This may not be surprising because the majority of the students had some science background prior to medical school, which allowed them to feel comfortable with the concepts addressed in the case. Other possible explanations could be that they were simply too busy to prepare, or they did not bother to prepare because they expected to learn the concepts during the small group discussions.

Table 11: Frequencies of Preparation Times for Experimental and Control Groups

	Time (minutes)				
	No Prep	<15	16-30	31-45	46-60
Experimental (n)	4	11	4	1	1
Control (n)	9	5	1	1	0

Just over 70% of the experimental group (15 out of 21 students) spent less than 15 minutes preparing for the case. Four students did not prepare at all. There were 6 students who spent more than 15 minutes preparing for the case. In the control group, 87.5% of the students (14 out of 16) spent less than 15 minutes preparing for the case. Nine students did not prepare at all. Considering the pre-test scores and confidence rankings for both groups, it may be possible that the students in the control group did not prepare as much as the experimental group because they felt more confident with their knowledge.

In the questionnaire, the students were also asked how they prepared for the case. They were given a number of options from which to choose and asked to check all options that

applied. The learning resources and their frequency of use by both the experimental and control groups are shown in Table 12.

Table 12: Frequencies of Learning Resources Used for Pre-case Preparation by Group

Learning Resource	Experimental (n)	Control (n)
Learned from lectures related to topic	14	9
Reviewed lecture notes	11	3
Consulted Textbooks	2	0
Used Internet Resources	7	3
Talked to Content Experts	1	0
Discussion with Peers	5	3
Used Prior Knowledge/Experience	13	9

The most frequently selected options checked by students in both cohorts were “learning from lectures”, and “used prior knowledge/experience”. This might help to explain why such a high percentage of students spent very little or no time preparing for the case, because these two categories, although forms of preparation, required no extra time. The students in the experimental group who did choose to prepare used a greater variety of resources to help them in their preparation compared to the control group. Because there was such a high percentage of control group students who did not prepare at all, or prepared very little, the number of alternative resources used to prepare for this case was limited.

Next, the students were asked to recall the amount of time spent working through the assigned questions during the case session. The students in the experimental group were asked to exclude any time that was spent assigning roles, completing the group processing, and answering the individual accountability section. Table 13 shows the results of the time on task during the session for the experimental and control groups. The majority of students in the experimental group spent between 31-45 minutes working on the questions during the session. Six students stated that they spent between 45-60 minutes and one student responded between

16-30 minutes. In the control group, almost half of the students stated that they worked on the questions for 16-30 minutes, while 37.5% recalled working on the questions for 31-45 minutes.

Table 13: Time on Task During the Case Session by Group

	Time on Task During Case Session (minutes)			
	<15	16-30	31-45	46-60
Experimental (n)	0	1	14	6
Control (n)	2	7	6	1
Researcher's Observation of Control (n)	1	15	0	0

It is important to note that the times for the control group do not coincide with the times that the researcher recorded while observing the control group. This may be due to recall bias by the students, because they were asked to complete the questionnaire one week after the case session. Because many students did not like the individual format, time may have seemed to drag on and seemed longer than it really was. The difference may also have resulted from differences in the students' impressions about when, precisely, the case session started and finished. The students did not know that it was from the time they received the question sheets to the time that they handed in the individual accountability sheets. They may have included the time taken to complete the pre-test or excluded the time taken to answer the individual accountability question. Also, some students remained in the class after they had completed the case to talk to each other or to the researcher and they may have included this time in their responses.

The beginning and the end of the cooperative group sessions were clearer and therefore it was easier to recall time on task for the experimental group. The facilitator started the session by handing out the case questions. The students worked in small breakout rooms, and so when they were done, they handed in the individual accountability sheets and left the room. However, the

week long interval between the case session and questionnaire would still have generated recall bias. Also, the students were asked to estimate only the amount of time working on the questions and not the group processing activities, which may have led to either an over- or underestimation of time on task. For these reasons, the results for the case session time on task should be interpreted with caution.

Next, the students were asked to recall the amount of time that they spent working on the case questions after the session, which included the questions that were not discussed or answered as part of the case session. Table 14 outlines the results of time on task after the case session.

Table 14: Time on Task After the Case Session by Group

	Time on Task (minutes)			
	None	<15	16-30	31-45
Experimental (n)	17	3	0	1
Control (n)	12	3	0	1

The majority of the students in both the control and experimental groups spent no time on the case questions in the one week interval between the case session and when the questionnaire was completed (81% - experimental; 75% - control). Three students from each cohort spent up to 15 minutes working the case questions and one student from each cohort spent between 31-45 minutes. The students were asked to complete questions 1-8 during the case session and encouraged to work on questions 9-14 on their own time. Only one student worked on questions 9-14 during the week; therefore, if students did work on the case questions after the session, their time was spent working on the questions covered in the case session.

To help further elucidate the time on task after the case session, there was one question in the questionnaire that asked the students if they had accessed the answers to questions 1-8 which were available to all students immediately after the case session on the course website. In the

experimental group, 8 of 21 students (38%) accessed the answers. In the control group 7 of 16 students (44%) accessed the answers within the week. Anecdotally, 3 students from the control and 2 from the experimental group commented on the questionnaire that they still planned to look at the questions in the future. Many of the students who said they accessed the answers online were the same students who said that they spent no time working on the questions after the case session. Therefore, even though they were not working on the questions, they were still going back to check their answers to compare them with the model answers. It appeared that the students in the control group were slightly more motivated to do so than the students in the experimental group.

### **The Role of the Facilitator in the Student Learning Experience**

One question was added to the experimental group questionnaire that asked the students to respond to the statement “the facilitator helped me to learn the concepts addressed in the assigned questions during the session”. Their responses were based on the same 5-point Likert scale as previously mentioned ranging from “strongly disagree” to “strongly agree” (Appendix A). The students appeared to perceive the facilitator as having a very important role in helping them to learn where 19 out of 21 students (90.5%) either agreed or strongly agreed with this statement. There were no students who disagreed or strongly disagreed with this statement.

There were a number of interesting findings that came out of the analysis of the test and questionnaire data. Although it is not possible to make any firm conclusions based on these results, they do show trends which could be the stimuli for further more focused research on these cooperative cases as well as useful information to help guide improvements to the cases. In the discussion section, these findings will be interpreted and the limitations of the study will

be addressed. Also, the implications of the study findings and areas for further research will be discussed in the next chapter.

## **CHAPTER V**

### **Summary, Discussion, and Conclusion**

#### **Summary**

The purpose of this study was to investigate the impact of cooperative small group case-based learning on two learning outcomes: a) student achievement, and b) student confidence. This study also compared CL and IL on two variables: a) student satisfaction with the learning experience; and b) the amount of time on task spent before, during and after one case session. Finally, information was collected from the students in the CL group about the degree to which they believed that the facilitator helped them to learn.

This study involved an experimental design where 59 first year medical students were stratified (based on gender and academic achievement) and randomly assigned to either the CL or IL cohorts. All students were also blinded to the nature of the study. A 10 multiple choice pre-test post-test tool was used for a within- and between-groups comparison of test score achievement. For each question, the students were asked to rate how confident they were (on a scale of 1-10) that they had chosen the correct answer. A questionnaire was also administered to all participating students which addressed student satisfaction with the learning experience, amount of time on task before, during and after the case session, and the cooperative students' perspectives on the degree to which they believed that the facilitator helped them to learn.

The students in the CL cohort made greater gains in achievement and confidence from the pre-test to the post-test compared to the students in the IL cohort; however, the gains in achievement and confidence did not reach statistical significance. Effect size measures revealed within-group differences in mean score for both achievement and confidence that were of moderate practical significance for the cooperative cohort. Within-group effect size measures

for achievement and confidence were of negligible practical significance for the IL cohort. Between-groups effect size measures for achievement and confidence approached but did not reach moderate practical significance. Measures of the standard error of the means also revealed the practical significance of this CL method. There was no overlap in the test scores or confidence ratings from the pre-test to the post-test in the CL cohort when accounting for the standard error of the means.

Most of the students in the cooperative cohort were satisfied with the learning experience and felt that they had “learned a lot” by working cooperatively. Most students also felt that the facilitator helped them to learn during the session. A large number of students in the IL group were not satisfied with the learning experience and felt that they did not learn much by working individually. The students in the CL cohort spent, on average, more time working on the case before and during the session than did the IL cohort. Both cohorts spent very little time working on the case questions after the session; however, a slightly greater percentage of students in the IL cohort worked on the case after the session and accessed the model answers to the case questions made available on-line compared to the CL cohort.

## **Discussion**

This section provides an interpretation of the results from this investigation of the effect of CL on student achievement and confidence with knowledge level compared to individual learning. There will also be a discussion and interpretation of the results of time on task, and student satisfaction and the possible relationship that these factors have with achievement and confidence. The first topic of discussion will be the effect of CL on student achievement. This will be followed by a discussion of the effect of CL on student confidence with their knowledge.

This section will also integrate these two main areas of focus of this investigation (confidence and achievement) because the findings in this study suggest that a statistically significant positive correlation exists between these two variables. In the third section, there will be a discussion of the impact of CL on time on task, with a discussion of a possible relationship between time on task and achievement and confidence. Next, there will be a discussion of student satisfaction with a particular emphasis on student perceptions of the ability of CL or IL environments to facilitate learning. In section five, there will be a discussion of the experimental students' perceptions of the importance of the facilitator in helping them to learn.

Following the discussion of the results from the study, the limitations to the study will be addressed in section seven. Implications for future practical use of these cooperative cases will be addressed in section eight. In section nine, there will be a discussion of possibilities for future investigation followed by conclusions emerging from the investigation in section ten.

### **The Effect of Cooperative Learning on Student Achievement**

The CL method used in this study was created in the researcher's institution in the College of Medicine. It was based on the five essential elements of CL developed by Johnson and Johnson (1999b); however, its design and structure was unique from any other CL method found in the literature. It has been used as an educational technique in the College of Medicine since 2003; however, its effect on student learning and achievement had not yet been rigorously investigated.

In Chapter 2, research was presented that showed the significant positive effects of CL strategies on student achievement. Johnson and Johnson (1999a) noted that there have been several hundred studies as that have provided convincing evidence of the positive impact of CL

on student achievement. A recent study by Bahar-Ozvaris, Cetin, Turan and Peters (2006), was of particular importance to the present study because it focused on CL in medical education. In that study, students were placed in either a CL environment or in an IL traditional lecture-style environment. It used a pre-test post-test design to compare the two groups on achievement for one two-week unit during the medical students' clerkship year and compared the average change in test score from the pre- to the post-test between groups. They found a statistically significant mean improvement from pre- to post-test for the students in the cooperative group than students who learned the same material individually.

Bahar-Ozvaris et al. (2006) did not determine the within-group change in achievement from pre-test to post-test, which would have helped to further illustrate the impact of CL on achievement. It would be important to confirm that the intervention caused a significant change within the experimental group and that there was no significant change within the control group. Measuring only the change in scores between groups does not provide this information. By including the within-group effects for the experimental and control groups, the researcher of the present study hoped to provide further insight into the effect of the CL intervention.

The results for student achievement in this study of CL do suggest a positive effect of CL on student achievement compared to IL in three ways.

First, effect sizes were calculated for within-group effects for the experimental and control groups as well as between groups comparing the average change in score from pre- to post-test. As previously noted, effect size is the "quantitative expression of the magnitude of the difference between the scores of the experimental and control groups" (Gall, Gall & Borg, 2003, p.107). Therefore, it is used as a measure of the practical significance or the usefulness of an intervention being studied and for this reason is a very important measurement when comparing

the effects of two interventions. Statistical significance tells us the whether or not the results of the intervention were due to chance. Effect sizes tell us whether or not an intervention is creating a change that is practically useful.

Hojat and Xu (2004) discuss Cohen's recommendations for defining the significance of effect sizes, where effect sizes of 0.2, 0.5, and 0.8 represent small, medium and large effects, respectively. A small effect size represents an effect of negligible practical significance. A medium effect size represents an effect of moderate practical significance. A large effect size represents an effect of crucial practical significance. These set-points for effect size were used as the guidelines for interpretation of the practical significance of the CL intervention in this research project. Also, effect sizes measured in other CL studies will be used for comparison.

The effect sizes for student achievement for the CL method used in this study were comparable to previous results for effect sizes obtained from meta-analyses of CL. The meta-analysis performed by Slavin (1995) described in Chapter 3 compared the student achievement effect sizes for different CL methods. The mean effect size for the seventy-seven studies included in the analysis was 0.26, with a range from 0.04 to 0.86.

As discussed in Chapter 3, Slavin (1995) argued that effect sizes of 0.20 to 0.25 for educational interventions should be considered "educationally significant", keeping in mind that effect sizes of 1.0 are seldom achieved for educational interventions and that effect sizes are influenced by study characteristics (p.21) which can artificially inflate effect sizes by giving unfair advantage to one group, or create an artificial environment favouring the intervention. By adhering to more rigorous study standards, effect size measures may reflect significant differences, even if the differences are small.

Johnson, Johnson and Stanne (2000) also performed a meta-analysis comparing various CL methods. The inclusion criteria for this meta-analysis were much less rigorous than in Slavin's (1995) meta-analysis. The main requirements were that the study had to use a specific method of CL and it had to investigate the impact of CL on achievement compared to competitive or individual learning methods. The mean effect size when comparing achievement in cooperative and individualistic learning was 0.51 with a range from 0.13 to 1.04.

The within-group effect size for the comparison of pre- and post-test scores in the experimental group for this study was 0.57. This measure compares well with effect sizes from the meta-analyses performed by Johnson, Johnson and Stanne (2000) and Slavin (1995). To add meaning to this number, it is often converted into a percentile ranking. What this means in practical terms is if a student at the 50<sup>th</sup> percentile received the intervention, in this case CL, it would move that student up to approximately the 75<sup>th</sup> percentile (Albanese, 2000) – an effect that is of moderate practical significance according to Cohen's guidelines. The within-group effect size comparing the pre- and post-test scores for the control group was 0.16. Therefore, a student at the 50<sup>th</sup> percentile would improve to approximately the 55<sup>th</sup> percentile when working through the case individually – an effect of negligible practical significance according to Cohen's guidelines. One can see that the effect that the CL intervention had on the students' achievement was much greater compared to students who worked individually.

Although effect sizes were not provided in the Bahar-Ozvaris et al. study (2006), sufficient data were available to calculate an effect size for the average change in test score from the pre-test to post-test, which was 0.37. The between groups effect for the average change in test score from the pre-test to post-test was also determined in the present study. An almost identical effect size of 0.35 was measured. Therefore, a student in the control group at the 50<sup>th</sup>

percentile for mean change in pre- to post-test score would improve to approximately the 64<sup>th</sup> percentile for mean change in pre-to post-test score if they received the intervention.

This effect size of 0.35 was exactly between Cohen's set-points for small and medium effects which made it slightly more difficult to interpret. However, considering the substantial difference between the within-group effects for the experimental and control groups, it appeared to support a conclusion of moderate practical significance. The comparable effect sizes of these two studies supported the findings of the present study that this CL method had a positive impact on student achievement. Data were not available in the Bahar-Ozvaris et al. (2006) study to determine the effect size for within-groups differences in the means from pre-test to post-test for further comparison of the studies.

The CL intervention used at this medical college produced a change in the students' achievement that was much larger in magnitude than when the students worked through the case individually. The magnitude of the change in scores in the CL group was large enough to support the argument that this educational intervention was useful and improved student achievement at a practical level significantly more than an IL strategy. Working through the case individually did lead to a very small improvement in student achievement; however, the magnitude of the effect was not large enough to consider it a worthwhile intervention to help students to learn, especially when compared to CL.

The second measurement indicating that CL had a positive impact on student achievement was the calculation of statistical significance for the within-group effects for each learning strategy. Although statistical significance was not reached for pre- to post-test change in achievement for the experimental group, the results do show a trend toward an improvement

in student achievement in the CL group compared to the IL group; however, no conclusive statement can be made because of the possibility that this result was a chance event.

A final measurement indicating that CL had a positive impact on student achievement was the comparison of the standard errors in the experimental and control groups. Standard error of means refers to the range of scores around the true score that accounts for measurement error (Gall, Gall & Borg, 2003). When the mean scores  $\pm 1$  standard error were compared for the pre- and post-tests of the experimental group, it was found that there was no overlap of the ranges. However, in the control group there was considerable overlap of the mean score error ranges from pre- to post-test. The fact that the pre- and post-test scores of the experimental group did not overlap when the standard error was included suggests that there was a true difference in the scores for the experimental group that was not present in the control group. This helped to strengthen the argument that CL had a greater effect on student achievement than IL despite the fact that statistical significance was not achieved.

### **The Effect of Cooperative Learning on Student Confidence Levels**

The purpose of asking the students to rate how confident they were that they had selected the correct answer after each multiple choice question was to determine their level of confidence with their knowledge of the material covered in the case – in other words – to ask them to consider how well they know what they know. The researcher sought to determine if the benefits of CL, such as promotive interaction, positive interdependence, active discussion and elaborated knowledge, would result in an increase in the students' confidence with their understanding of the material compared to individual learning. If so, could this increase in their knowledge confidence produce higher achievement?

Research on confidence ratings and multiple choice tests have shown variability in students' abilities to assess their confidence levels in multiple choice exams, with academically poorer students having greater difficulty than high achieving students (Smith, 2002; Koku & Qureshi, 2004). However, multiple studies on test confidence have shown that most individuals (high or low achieving) were overconfident when their ratings were compared to their actual performance on exams (Fischhoff, Slovic & Lichtenstein, 1977; Koku & Qureshi, 2004; Lundeberg, Fox & Puncochar, 1994). Low achieving students tended to be more overconfident than high achieving students, which suggests that they were less aware of what they knew and did not know. High achieving students, although still overconfident, were usually better at calibrating their confidence levels than low achievers (Zakay & Glicksohn, 1992).

Confidence ratings may also be influenced by the level of difficulty of the questions on the exam, where underconfidence was often seen with easy multiple choice questions (Flannelly, 2001; Koku & Qureshi, 2004). Although it is not well understood, it was thought that with easier questions students read more into the questions than was required and began to doubt their certainty about the correct answer (Koku & Qureshi, 2004). As the questions became more difficult, students tended to seek only confirmatory evidence from their memory to match what they had selected for their answer without considering the possibility that their selection may be incorrect, which possibly led to overconfidence (Koku & Qureshi).

Because medical students tend to be very high academic achievers (one criterion for medical school acceptance is academic achievement), and based on previous research findings (Fischhoff, Slovic & Lichtenstein, 1977; Koku & Qureshi, 2004; Flannelly, 2001) it might be expected that they would be able to adequately assess their confidence on a multiple choice quiz.

However, the students in both the experimental and control groups of this study had low pre- and post-test confidence ratings compared to their actual performance on the test.

The students in the cooperative group for this study had lower pre-test confidence levels compared to the IL group – a difference that was statistically significant ( $p < 0.05$ ). This difference is difficult to explain because the groups were randomly assigned and stratified for gender and previous academic achievement, which are two important factors affecting confidence (Smith, 2002; Lundeberg, Fox & Puncochar, 1994). The researcher performed a comparison of the average confidences of the students who were included in the repeated measures analysis (experimental group = 19; control group = 13) with the average confidences for all students without matching students for repeated measures (experimental group = 26; control group = 22). An ANOVA comparing the mean pre-test confidence scores without repeated measures revealed no statistically significant difference between the two groups ( $F = 1.59$ ;  $p > 0.05$ ), which suggests that the difference in pre-test confidence scores between groups using repeated measures was likely due to low power as a result of small sample size which produced a type II error.

One explanation as to why confidence was so low might be related to the level difficulty of the exam (Fischhoff, Slovic & Lichtenstein, 1977; Koku & Qureshi, 2004; Flannelly, 2001). Students in this study may have considered the quiz to be fairly easy and as a result read more into the questions than necessary and doubted the correctness of their answer. The researcher has no way of confirming this possibility from the data collected in this study.

Another possibility that might help to explain why all students rated their confidence lower was that, because medical students tend to be high achievers and the curriculum was very content heavy and more intense than what they have been previously exposed to, they may not

have felt as confident with their knowledge. They may have felt overwhelmed, to they point where they felt as though they knew very little. Similarly, they may have under-rated themselves in order to compensate for a fear that they may have been wrong even though they were likely correct. Zeleznik et al. (1988) studied test-taking confidence in undergraduate medical students and also found that many of the students rated themselves as underconfident, which was a shift in the norm from many studies in test-taking confidence. Zeleznik et al. were not able to offer any explanation for this finding, but noted that the students who were underconfident tended to score better on exams. Further, research is required to help explain why medical students tend to under-rate their confidence compared to other student populations.

The most important measure of confidence in this experiment was the pre-test to post-test within-group change in confidence ratings. There have been many studies, as discussed above that have investigated students' confidence ratings and exam performance. However, there was very little information available in the literature regarding the impact of instructional strategies, such as CL, on changes in student knowledge confidence, and none specifically for medical education, which was the primary focus of the present study.

The impact of CL on student confidence ratings on the multiple choice quiz was measured in three ways. The first measure used to show the impact of CL on confidence ratings was the calculation of effect sizes for within-group differences as well as for the average change in confidence from pre-test to post-test between groups.

The effect size for the within-groups change in confidence ratings from pre- to post-test was measured at 0.53, which under Cohen's classification is considered to be of moderate practical significance (Hojat & Xu, 2004). In other words, a student at the 50<sup>th</sup> percentile for confidence ratings would move up to approximately the 70<sup>th</sup> percentile with the CL intervention.

The effect size for the IL group was 0.14. With this effect size, a student at the 50<sup>th</sup> percentile for confidence ratings would move to approximately to the 55<sup>th</sup> percentile, which is considered to be of small practical significance.

The effect size for the average change in confidence ratings from pre- to post-test between groups was measured at 0.40. This effect size is considered to be of small practical significance under Cohen's classification; however, it approached moderate practical significance. Considering the within-groups confidence data available in this study which supported CL and its positive impact on student confidence, the researcher felt that this change in confidence reflected a more moderate practical significance.

A comparison of these effect sizes showed the considerable positive impact that CL had on student confidence ratings compared to individual learning. With an effect size of this magnitude, it supported the argument that this educational intervention improved student confidence in their knowledge, at a practical level, significantly more than IL strategies. Working through the case individually did lead to a very small improvement in student confidence; however, the magnitude of the effect was not large enough to consider it a worthwhile intervention to help students gain confidence in their knowledge especially when compared to CL. Students in both cohorts wrote the pre- and post-tests at the same time, received no feedback, and had no access to the quiz questions or answers in the week between writing each test. The major difference between the two cohorts in the week between writing the pre- and post-test was the intervention (either CL or individual learning). The students may have reflected on the questions individually or with other students; however, these quizzes were not a part of the student assessment in the curriculum, so it was not likely that the students would make it a high priority to reflect on these quizzes. Therefore, the researcher felt that the

differences in the gains made in confidence were more attributable to the interventions than other factors.

The second measure of the impact of CL was statistical significance. Although statistical significance was not reached for pre- to post-test change in confidence ratings for the experimental group, the results do show a trend toward an improvement in student confidence ratings in the CL group compared to the IL group; however, no conclusive statement can be made because of the possibility that this result was a chance event. Also, congruence with other studies suggests that the effect of CL in the present study was not due to chance.

Standard error of means for pre- and post-test confidence ratings was also calculated and compared within the groups. As was found for student achievement, no overlap of pre- and post-test confidence scores was found in the CL group. This lack of overlap of standard error of confidence scores suggests that the two values for the pre- and post-test confidence ratings within the CL group were different. By concluding that these values were different we can state with greater certainty that a change in confidence ratings occurred in the CL group from the pre-test to the post-test. This, however, cannot be said for the IL group, where considerable overlap of pre- and post-test confidence scores was found.

The data collected in this study did not allow for the discussion of what exactly produced this increase in confidence, although there were a number of possible explanations. It may have been that the students gained confidence in their understanding of the material through key elements of CL such as promotive interaction, positive interdependence and elaborated discussion. They discussed their ideas more thoroughly and sought clarification of misconceptions in an open, non-threatening environment. If there was a question that the group could not answer, there was a greater incentive to find an answer because it affected the group

(Slavin, 1995). The students received immediate feedback from a facilitator who was present during the entire session and listened carefully to the discussion. They were not only made aware of what they knew, but also what they did not know or needed to know, which helped them develop a better understanding of the material and greater confidence in their knowledge (Flannelly, 2001). It was possible that through all of these important factors, students were able to strengthen their confidence in their understanding of the material.

In the IL environment, students felt that they either knew the answer or they did not. If they did not, they either moved on, answered it to the best of their ability, or referred to their notes or textbook. There was no opportunity to ask for clarification, no feedback from other students or the facilitator, and any misunderstandings went unchecked. As a result, they may not have been as aware of what they knew and did not know. A student may also have been confident that they knew the answer, when in fact they were incorrect. This was more likely to have occurred when working individually, because there was no one to check or question the answer. This may have explained why the IL group still had high confidence levels without a corresponding improvement in achievement.

From this study it can be suggested that the form of CL used in the College of Medicine had a positive effect on student confidence in their knowledge. The argument has also been made that this CL technique improves student achievement. Although it could not be clearly shown, a case could be made that the increase in student confidence contributed at least in part to the increase in achievement. In Chapter 4, Table 2 showed that a considerable and statistically significant relationship existed between test score and confidence ratings. This was not necessarily a causal relationship; however, considering that the students in the cooperative group

made greater gains in knowledge confidence and test score compared to the IL group, it was possible that the increased confidence contributed to higher achievement on the quiz.

### **The Impact of Cooperative Learning on Time on Task**

Seidel, Perencevich and Kett (2005) explained that the greater the amount of time on task that an individual spent learning something, the greater the chance that he or she will learn that specific material. They also noted that time on task where students elaborated on the material had more positive effects than non-elaborated time on task. Similarly, Plant, Ericsson, Hill and Asberg (2005) explained that it was not simply the *quantity* of time on task that was important, but also the *quality* of the time on task that led to improved learning.

Information on students' perceived time on task before, during and after the case session for both the experimental and control groups was collected from a questionnaire. The students in the CL cohort reported spending more time on task before and during the case session and slightly less after the case session compared to the students in the IL cohort.

It is difficult to explain why the students in the experimental group spent more time on task before the case session. The data available from the study cannot provide any concrete clarification. It could have been argued that the students in the experimental group were more motivated to prepare because they would be working with others and did not want to feel unprepared; however, the students were blinded to the study and they all (including the control group students) thought they would be divided into their small groups in the normal fashion.

As discussed previously, the control group rated their confidence higher on the pre-test, so it may be that they felt they did not need to prepare as much for the case as the experimental students because they felt they knew the material well enough. It may also be possible that after

randomization of the groups this difference in the amount of preparation time was a chance occurrence and students who always prepared more than others ended up in the experimental group.

The students' reported amount of time on task during the case session was much greater for the experimental group than the control group. There were two factors that likely contributed to this difference in the amount of time on task. First, the basic elements of CL applied in these small group discussions encouraged students to elaborate on their ideas, seek clarification, talk to, depend on, be accountable to, debate with and receive feedback from each other so that all students learned more effectively. When these basic elements were incorporated effectively, students naturally ended up spending more time on task because more discussion occurred. In the IL environments there was no opportunity for any of these interactions. Students had to rely on their own understanding, which may or may not be adequate or correct. They may also have ended up skimming over the problems and answers and spent less time on task. Furthermore, if they did have a problem that they were unable to solve on their own or with any available resources, they had little choice but to move on, resulting in less time spent.

A second factor that could have increased the amount of time on task for the experimental condition was the presence of a dedicated facilitator in each of the cooperative small groups. Normally, students in a cooperative group are not actually required to stay for the entire scheduled time; however, in the researcher's experience the small groups have regularly stayed for the full session time and sometimes stay slightly overtime. The role of the facilitator during these sessions varies depending on the difficulty of the case or the level of participation by the group members, but it has always been intended to be minimal.

The facilitator was present to listen to the discussion and provide cues and clues to the group when they were having difficulties. Facilitators have often provided the stimulus for further discussion and elaboration, and guided the students if they went off track in their discussion. It has been through these actions that the facilitator contributed to increased time on task in the cooperative groups. For example, if the facilitator felt that a group had missed an important concept in their discussions, but the students felt they were ready to move on, the facilitator might ask an open-ended question to get the students to reconsider the completeness of their answer. Thus, the students spend more time on task than students in the IL environment where a facilitator is not present.

There is, however, a caveat to this point. If students are discussing issues that are not relevant to the case or that will not help them to better understand the content, then the facilitator may intervene and tell the group to focus their attention on more important and relevant issues. In this manner, the facilitator may actually increase the efficiency of the group and decrease the amount of time on task. Therefore, based on the findings in the present study, it was most likely the CL environment that contributed to the increased amount of time on task during the case session by encouraging student interactions and elaborated discussion and less likely because of facilitator intervention.

The amount of time on task after the case session was similar for both groups. Both groups spent very little time after the case reviewing the questions, with a slightly higher percentage of students in the IL group spending extra time afterwards working through the assigned questions. Also, a slightly greater percentage of students in the control group accessed the answers available on-line after the session. Although one can only speculate, this finding was interesting. It is possible that some students in the control group felt that the time they

spend during the session was inadequate for their learning, so they returned to work on the case after the session and study the on-line answers in an attempt to determine and clarify answers. The students in the experimental group did less work afterwards possibly because they had thorough discussions and received feedback immediately during the session, and as a result felt they did not have to put in as much time after the session.

The students in the experimental group improved their test scores and confidence ratings from pre-test to post-test. They also reported that they spent more time on task before and during the case session than the control group. Not only did the experimental group spend more time working on the case during the session, but the *quality* of the studying during that time was much better than in the control group. One could argue that this increase in both the quantity and quality of time on task contributed to the increase in both the achievement and confidence of the experimental group. Slavin (1995) noted studies that showed a relationship between CL and time on task. Also, there have been many studies investigating the relationship between CL and achievement (Slavin, 1995; Johnson, Johnson & Stanne, 2000); however, to the best of the researcher's knowledge, there have not been any research into the possible relationships between time on task and student confidence in their knowledge and achievement within a cooperative context. Further research into these relationships would provide closer perspectives on these issues.

### **Cooperative Learning and Student Satisfaction**

It was clear from this study that the students in CL cohort had a higher level of satisfaction with their learning experience than the students who worked individually. They felt that working through the case cooperatively was a good use of their time, whereas many of the

students in the control group felt that working individually was not. One must interpret this finding with some caution considering the design of the study which blinded the students to the nature of the study. The students in the control group thought they were going to work in cooperative groups in the normal way, but were suddenly asked to work individually. This unexpected change was disappointing for many of the students and this may have been reflected in the responses to the questionnaire. However, their negative response to the change, their desire to find a way to form their own small groups, and their comments on the individual accountability answer sheet about wishing they could have worked in groups showed that the students enjoyed and preferred using the CL method.

The large majority of the students in the experimental group felt that working through the case cooperatively helped them to learn. Conversely, the majority of the control group felt that working individually either did not help them to learn or made no difference. A relationship appeared to exist between the student's opinions about the usefulness of the each type of instructional intervention and their perceived learning. Draskovic, Holdrinet, Bulte, Bolhuis and van Leeuwe (2004) stated that when using CL strategies, student satisfaction increased when the students believed it contributed to knowledge gains. This appeared to be the case in the present study, although no firm relationship can be determined. In this study, there may also have been a relationship between perceived learning and actual achievement, where the increase in the test score results from pre- to post-test for the experimental group was larger than that seen in the control group. This seemed to suggest that the students in the experimental and control groups were able to fairly accurately assess methods that helped them to learn.

What was it that made students feel that they were learning more in a cooperative environment? Draskovic et al. (2004) found that there was a strong relationship between

students' perceptions of learning and the amount of task-related interactions and knowledge elaborations. When students were highly interactive in a given task, they engaged in more cognitive elaborations. Slavin (1995) and Johnson, Johnson and Stanne (2000) showed that increased interaction and elaborative discussion resulted in increased achievement. Draskovic et al. (2004) discussed the important role of the facilitator in ensuring maximal student interaction and elaboration. They stated, "the use of questioning (instead of mini lecturing) and stimulation of students own activity in finding answers has been assumed to have positive effects on knowledge elaborations, and ultimately on knowledge acquisition" (p. 454).

Along similar lines, Gillies (2003) discussed that students learned more when they gave elaborated help to one another as well as when they received elaborated help. Gillies emphasized that it was important to encourage students to develop "helping behaviours", especially in CL environments, because students were more likely to give help when they perceived that they were in fact being helpful and because "giving help is crucial to the learning that occurs in small-group settings" (Gillies, 2003, p.138). If the basic elements of CL are in place (positive interdependence, promotive interaction, individual accountability, social skills, and group processing), then it is very likely that students will help one another and ask for help. Students will ask questions, discuss possible answers, elaborate on concepts and give feedback to one another. As a result, students' perceptions of their learning in cooperative groups will be better than in an IL environment, where these interactions are not possible.

### **The Role of the Facilitator in Cooperative Learning**

The students in the CL cohort were asked for their perception of the importance of the facilitator in helping them to learn. Just over 90% of the students either agreed or strongly

agreed that the facilitator helped them to learn. Further research into the students' perceptions about why the facilitator helped them to learn is needed. Research investigating the role of the facilitator in CL has been done to help illustrate why students would perceive the facilitator to be so important for their learning (Leikin and Zaslovsky, 1997; Gillies and Boyle, 2005; Gillies, 2006; Draskovic et al., 2004).

A simple way that gives the students a larger and more active role in the CL setting is to ensure that the facilitator has a smaller role to play (Draskovic et al. 2004). In our cooperative cases, the students are in control of almost all aspects of the cases session – for example: assigning student roles, use of resources, determining how the case session is organized, who reads the questions, how the questions are answered, if the answers will be summarized, if they are ready to move on to the next question, checking to ensure that everyone is following the discussion. Even though the role of the facilitator in the session may at times be minimal, the facilitator's presence is very important: a) to ensure that the process and structure of the cooperative session is followed properly by the students; b) to listen to the content and focus of the discussion to make sure it is relevant to the case session; and c) to intervene at the appropriate time to give feedback and facilitate the correction of any problems with process or misunderstandings during the discussion when they occur. As one student commented in Steinert's (2004) study, students appreciate the opportunity to have some control and work together as a team and not have the facilitator dominate:

Sometimes it is seamless. We work as a group, we look to the tutor when we are stuck, he asks a question or helps us with the answer, and then we continue on our own. It is a fine line between leaving us alone and being involved.

Draskovic et al. (2004) and Gillies and Boyle (2005) emphasized that task related interactions were essential to allow for knowledge elaborations to take place and that the facilitator played an important role in establishing a favourable environment for group interaction. Placing students in a small group does not automatically mean that the group interaction will be meaningful and useful. In a social and informal environment students may get off task. Therefore, it is an important role of the facilitator to ensure that the students engage in *task related* interactions. This will increase the likelihood that effective learning can occur. Steinert (2004), in her study of student perceptions of small group teaching, indicated that the most effective facilitator was one who encouraged interaction among students. The facilitator can promote task related interactions among students by changing their role within the group from the more traditional content expert lecturer to that of a *guide* and process monitor. This will likely increase the students' responsibility and desire to interact with one another.

Another important role the facilitator plays, which may explain why the facilitator is perceived to be important for student learning, is to encourage an increase in elaborated discussion. Draskovic et al. (2004) explained that by asking challenging questions and encouraging students to find answers to problems as a group, the facilitator encouraged student-to-student interaction and elaborated discussion. This challenged the students to think about the concepts in the case and required them to better understand the material. As a result, there was an increase in achievement and an increase in the students' perceptions of learning. It was important for the facilitators to not turn the small group session into a mini-lecture, because this had a negative effect on learning by reducing elaborated discussion (Draskovic et al. 2004). Steinert (2004) found that students actually preferred to have a facilitator that encouraged discussion and did not lecture during the small group session.

### **Discussion Summary**

The results of the effect size measures for student achievement and knowledge confidence in this study showed that the impact of these CL cases was considerably larger than that seen in the IL environment. Although statistical significance was not achieved for univariate analysis for each of these factors, the standard error of the means for student achievement and knowledge confidence support the argument that there was a true difference in the means from the pre-test to the post-test. The majority of students in the CL cohort enjoyed the learning experience and felt that it helped them to learn the material as compared to the students in the IL cohort, who either disagreed or were neutral with the statement that working through the case individually helped them to learn. Also, the majority of the students in the cooperative groups believed that the facilitator helped them to learn during the case session, which suggested the importance of having a facilitator present during the session.

The students in the CL cohort spent more time working on the case before and during the session than the students in the IL cohort. This was likely due to the increased level of elaborated discussion, clarification and feedback between group members as well as guidance from the facilitator, although the facilitator may have also improved efficiency by encouraging the group to move on where appropriate. A comparison of the students' perceived time on task after the case showed that the students who worked individually spent slightly more time working the case afterwards compared to the cooperative cohort. This might be because the students in the IL cohort were unsure of their answers and were not able to receive immediate feedback.

### **Limitations Revisited**

There were a number of limitations in this study, as discussed in Chapter 1, that must be revisited with completion of the study. The sample size for this study was small with 19 and 13 students in the experimental and control groups, respectively. The small sample size limited the power of this study, which limited the ability to conclude that the relationships seen between CL and student achievement and knowledge confidence were not due to chance. That being said, the randomized experimental design helped to strengthen the study by reducing potential bias. Also, the trends of the results suggested that CL did positively impact student achievement and knowledge confidence in spite of not reaching statistical significance. It is important to note that a moderate effect size was found, which indicated the practical significance or usefulness of this educational strategy for the students for both achievement and knowledge confidence.

All students were blinded to the nature of the study, which was done to help reduce student bias for or against either intervention. However, the researcher felt that a consequence of blinding the students to the study purpose was a decrease in participation rates for the study compared to full disclosure of the study and volunteer participation.

Students were expected to attend the cases; however, they were not mandatory in the curriculum. As a result, for any given case some students may have been absent. This absenteeism negatively affected the sample size considerably. This study used a repeated measures design, which further reduced the sample size, because different students were absent on different days of the study so their data could not be included. It is difficult to speculate whether informing the students would have been better for this study because of possible biases associated with disclosure of purpose.

A convenience sample of medical students was used for this study. The College of Medicine class size at the University of Saskatchewan is small compared to other medical schools across Canada and around the world. This placed limitations on the generalizability of this study. However, it was not possible to expand the student sample because, to the best of the researcher's knowledge, this method of learning is not used anywhere else.

This was a study designed to help answer the question "Does this instructional strategy help students to learn?" It was not intended to answer questions about how or why it helped students to learn, although from the results, speculations can be made. It is important to note that these are only speculations based on the conclusions from previous research. These important questions were not within the scope of this study. It was felt that it was most important to first determine if these cooperative small group facilitated cases helped students to learn, and then to expand the existing research about why they help.

Another limitation was that only one cooperative case study was investigated. It would be better to investigate multiple cases in order to determine stronger trends in the results, because it may be that the results were idiosyncratic for this specific case. However, because it was decided to blind the students to the nature of the study, it would not have been possible or realistic to maintain these blinded conditions for more than one study while maintaining adequate participation from the students.

Another limitation of this study was that many of the students in the individual cohort ended up working in pairs or groups of four, but their data were added to the IL cohort. The reason for this is because although many students were working side-by-side, they were not actually working *together* to solve the problems and promote each other's learning – they were still working individually.

Another important limitation was that the internal consistency calculated for the multiple choice quiz used in this study was low (Chronbach's alpha of 0.35). However, a low internal consistency was expected because the questions on the exam were testing different concepts. If the questions had been designed to test the students on a central theme or concept, or if there had been more questions, the reliability coefficient would likely have been higher. A more appropriate measure of reliability would have been to administer a test/re-test to the students with no intervention between tests and then compare the results. This method was not considered prior to the study and, therefore is a limitation of the research. The students performed a pre-/post-test, however, the CL/IL intervention fell between the tests and therefore they could not be used for an analysis of reliability. The results from pre-test to post-test did show an increase (based on effect size calculations) which suggests that there was adequate reliability to detect a real change in student achievement.

Finally, the interval between the pre- and post-test was relatively short (one week). Within this short time frame, the students may still have remembered the questions from pre-test to post-test, which may have influenced the results of the quiz. The impact of this may be limited, because in the week interval, the students did not receive the answers to the quiz, or any feedback about the quiz. The cooperative or IL case was the only intervention during the week, and both groups worked on the quizzes and case simultaneously. Therefore, it is likely that the changes seen in achievement and knowledge confidence were more attributable to the intervention than recall bias.

The other limitation related to this short time frame of investigation was that no conclusions can be made about long term knowledge retention using the cooperative cases. This is an important issue to consider when implementing any instructional strategy, and warrants

further investigation within the context of these cooperative cases. If it were known that these cooperative cases led to improved long term retention it would strengthen the argument for their usefulness as an instructional strategy.

### **Implications of Study**

There were a number of important implications that arose as a result of this study. First, the results were similar to results seen in the many studies previous studies of CL. Although the results for student achievement and knowledge confidence did not reach statistical significance, they did suggest that the CL method used led to an improvement in achievement and confidence. The effect sizes found in this study revealed that this CL intervention produced a magnitude of change within the students' levels of achievement and knowledge confidence that indicated its usefulness as an instructional strategy and merits its continued use to help students to learn the course material and to be confident with the knowledge they have gained.

Not only was there an improvement in the students' achievement as a result of the CL experience, there was also a higher level of student satisfaction with the CL approach. Students felt that it was a good use of their time and they also perceived their learning experience to be better. These are important factors to consider when developing learning strategies for students. While the primary focus should be on ensuring that students learn the material, it is also important to develop educational strategies that the students will enjoy and perceive to be useful for their learning.

It is possible that each outcome investigated in this study would continually reinforce the others. A summary of the events might look like this: The students interact in a positive and safe environment, which allows them to enter into elaborated discussions. They help each other

and receive feedback from each other and the facilitator, who monitors their progress. Because of this environment, the students are willing and encouraged to spend more quality time in discussion. The students enjoy the exercise and feel that it helps them to learn the material better. As a result, they learn more effectively and gain confidence in their knowledge and perform better on examinations.

Because of the gains in achievement and knowledge confidence, the likely improvement in the quality of the time spent, and the higher ratings for student satisfaction, another implication would be to increase the number of cooperative small group cases in the undergraduate curriculum. Consideration would have to be given for the amount of time available in the curriculum as well the resources available to carry out an increased number of cases. Challenges already exist with regard to the time available to teach the massive content within the undergraduate curriculum. More cases would require more time, which means there would be less time available for lectures. This means that curriculum designers would have to pay close attention to reducing unnecessary content and identify and teach the most relevant content in the course (D'Eon & Crawford, 2005). However, with less content that is highly relevant and the cooperative cases to apply this knowledge, the students will likely learn the content better. Fewer lecture hours may also result in greater use of self-directed learning techniques, which could then be easily incorporated with the CL cases.

Another important factor to consider with regard to these cooperative cases is that they are fairly resource intensive. A case session with 90 students, which is often the situation at this institution, divided into 12 groups of 7 or 8 students requires 12 facilitators and rooms. At a larger institution with 300 students, this would be an even greater challenge. This challenge would be greater if more cases were incorporated into the curriculum. One possible solution

would be to use “roaming” or “shared” facilitators – that is, one facilitator for two or three groups that roams between the groups. Research into the effectiveness of “roaming” facilitators would provide very valuable information for this CL strategy. Also, having all groups dispersed in one large room with roaming facilitators would help to address the resource issue, although it would present its own set of challenges, such as noise levels and student seating arrangements.

### **Possibilities for Future Investigation**

As a result of this study, many possibilities for future research of the cooperative small group facilitated case studies developed that will not only help us to understand why these specific cooperative cases led to an increase in achievement and knowledge gains, but also contribute to the existing literature on CL.

As mentioned previously, one limitation of this study was that it occurred over a short time frame of one week, which meant that only short term knowledge retention could be studied. It would be very important to perform a study of these cooperative cases that investigated the impact of these cooperative small group cases on long term knowledge retention and compare it to the traditional lecture style approach.

The primary focus of this research was to determine the impact of cooperative small group facilitated cases on student achievement and knowledge confidence. It was not the researcher’s intention to investigate and explain *why* this improvement occurred. Future research on these cases to elucidate the reasons why this method improved learning and increased knowledge confidence, time on task, student satisfaction, and students’ perceptions of learning should be performed.

It would also be interesting to investigate in more depth the relationship between achievement and knowledge confidence, and to determine if a relationship exists between these two variables and time on task and perceived learning. From the results of this study it might be possible to make a case for the strength of these relationships; however, it should be quantified. Previous researchers have concluded that CL leads to increased time on task, to the best of the researcher's knowledge, no studies have investigated the effect of time on task on achievement in a CL environment.

Two groups were used for this study of CL – one cooperative and one IL group. Each group received the case and worked on the same case questions during the time between the pre- and post-tests. The IL group served as the control group. It may be useful to perform a study that contained a third group to act as another “control”. This group would write the pre- and post-tests at the same time as the cooperative and IL group; however, during the time between these tests, they would have no case exercise – in other words, they would do nothing. This type of control group might better reflect the individualistic learning environment of the traditional lecture format. Including a third group for this study was not feasible because the sample size was too small.

The large majority of students in the CL cohort perceived that the facilitator had a positive influence on their learning experience. It would be useful to quantify the importance of the facilitator's contribution to student learning in cooperative groups. A study comparing the achievement outcomes for students in cooperative groups with and without facilitators could be done. However, considering that these cooperative cases are resource intensive and it is often difficult to find enough facilitators for each case, it would also be useful to study the effect of “roaming facilitators” on student achievement. In other words, have one facilitator for every two

or three groups who would “roam” from group to group. If it is possible to reduce the number of facilitators without affecting student achievement, it would help to reduce the strain on instructor resources.

Finally, it was found that the medical students consistently rated themselves low for knowledge confidence compared to their actual level of achievement on the quiz, which was quite high. As previously discussed, this may have been because of the perceived low level of difficulty of the quiz questions. As a result, the students read into the question more than necessary and began to doubt their answer selection. However, it may be the result of some other factor, be it an idiosyncrasy of high achieving students, or because of the intensity of the undergraduate medical program. This finding does not coincide with some of the findings in the literature regarding confidence, where students often overrate their confidence; therefore, it warrants further investigation.

### **Concluding Comments**

CL is an instructional strategy designed to improve student achievement and affective outcomes by promoting student interaction, interdependence among group members, continuous development of social skills, group processing, and individual accountability within the group. The purpose of this study was to investigate the impact of this specific cooperative small group facilitated case studies on student achievement, knowledge confidence, as well as student perceptions of satisfaction, time on task, and the usefulness of the facilitator in helping students to learn.

The improvement in test score and knowledge confidence seen in the CL cohort shows the strength of this instructional strategy in helping the students to achieve higher and improve

their confidence in the knowledge of the material taught in the first year of medical undergraduate courses. The effect sizes measured for the cooperative cohort revealed a pre-to post-test improvement in mean score and confidence level that was much greater than that seen in the IL cohort. These effect sizes are consistent with effect size measurements of previous studies of CL and achievement (Slavin, 1995; Johnson, Johnson & Stanne, 2000). Statistical significance was not achieved; however, it is believed that with a larger sample size, statistical significance would have been reached. Calculation of the standard error of the means strengthened the argument in favour of the effectiveness of CL by showing that test scores and confidence levels for the pre- and post-test of the cooperative group were truly different values. With such a practically significant improvement in student achievement and knowledge confidence, the researcher feels strongly that these CL exercises are a valuable instructional resource and should continue to develop and expand within the undergraduate medical program in the College of Medicine.

Assessment of time on task should go beyond measuring only the *quantity* of time and include the *quality* of the time invested (Plant, Ericsson, Hill & Asberg, 2005). In the case of these CL exercises, the quality of the time spent appears to be quite high. The students interacted well with each other, they elaborated on their knowledge, and gave feedback to each other. The facilitator helped them to use their time as effectively and efficiently as possible to maintain high quality discussion. Any instructional strategy that produces these behaviours in students and encourages students to improve the quality of time they spend learning is invaluable for students and educators. The students in the IL cohort did not have the opportunity to partake in any of these very valuable elements, and this may have affected both the quantity and the

quality of the time spent on the case activity. This could explain why achievement gains in the IL cohort were smaller.

Although the role of the facilitator in these cooperative cases is intended to be minimal to allow for greater student control of both the process and the content discussion, it is still a very important role with specific functions. The facilitator must assume a supportive role in the group rather than the expert or leadership role. This is often a difficult transition to make for many teachers, especially in universities where lectures are the primary instructional method used. The facilitator must listen very carefully to the content of the discussion and decide when it is appropriate to intervene to guide the group back on track when they are discussing less important details, or to decide how and when to challenge students when their discussion is too superficial. A good facilitator will stimulate elaborated discussion yet still maintain the focus on the group and less on themselves. As a result, the students will learn more effectively, and they will feel challenged without feeling frustrated. This may lead to feelings of increased satisfaction with the learning experience.

While it is important to ensure that instructional strategies are effective in helping students to learn, it is also important to be attentive to student perceptions of the exercise being implemented. It seems intuitive to suggest that an educational strategy would only be made better if it helped students to learn *and* the students really enjoyed the experience. The achievement gains made through the use of these cooperative cases could be attributed, in part, simply because the students enjoy participating in them. They may be more highly motivated to learn because they are excited about working on a case in an informal, open learning environment where they can apply the material from lectures and see its relevance for future practice. As was seen in this experiment, these cooperative cases incorporated both elements,

because the students' achievement increased and they also reported high satisfaction with the learning experience.

The results of this experiment are in keeping with the results of the many studies of CL methods that have preceded it. The impact of this intervention on student achievement and confidence is much greater than when students work individually when effect sizes are compared. Although statistical significance was not reached, it is likely that it would have been reached with a larger sample size. Furthermore, it is clear from the results that the students enjoy the cooperative small group learning experience. If the students have higher achievement levels and they enjoy the experience and feel as though they are learning from it, then this should provide a strong case for continued use of these cases in the first year undergraduate curriculum. Because this method is based on the basic elements of CL developed by Johnson and Johnson (1999a), it could be adapted quite easily for use by disciplines outside of medical education. In light of these findings and the associated limitations, the researcher suggests that further research into the effectiveness of this CL method be completed to support these results, and that consideration be made for the expanded use of these cases in the first and subsequent years of the medical undergraduate curriculum.

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**APPENDIX A**

**APPLICATION FOR APPROVAL OF RESEARCH  
PROTOCOL**

## Application for Approval of Research Protocol

**1. Supervisor(s):** Dr. M. D'Eon, Educational Support and Development  
Dr. P. Renihan, Educational Administration

**1a. Student:** Greg Malin, Masters of Educational Administration

**1b. Dates of Study:** Start Date: February, 2007  
Completion date: March, 2007

### 2. Title of Study:

A Study of the Impact of Cooperative Small Group Facilitated Case-Based Discussions on Learning Outcomes

### 3. Abstract:

The College of Medicine introduced cooperative small group facilitated case-based discussions in 2003-04 as part of the first year medical curriculum. The purpose was to supplement a primarily lecture-style offering of basic science material with the intention of incorporating a more active, contextual, and cooperative learning environment to improve learning and long-term retention of basic science concepts. These sessions run in a similar manner to tutorials except they are cooperative and the facilitator's role is different. The students receive a case and pre-session reading topics. On the day of the case the students gather in small groups (7-8 students) to discuss the questions that are distributed at the discussion session. The facilitator is present to help guide the students. The extent to which this specific strategy does, in fact, influence learning outcomes is not known. Therefore, our research questions include; what is the impact of cooperative small group facilitated case-based discussions on learning outcomes when compared to independent learning styles? Also, what aspects of this activity are perceived to influence learning outcomes? Our hypothesis is that cooperative small group facilitated case-based discussions improve learning outcomes as compared to independent study methods.

### 4. Funding:

There is no funding for this research project.

### 6. Conflict of Interest:

Greg Malin is the coordinator of the small group facilitated cases as well as an instructor in the College of Medicine. He teaches the students who will be participants in this study.

### 7. Participants:

The participants for this study will be a convenience sample of year one medical and dental students. Because the cases are specific to medicine and the medical school curriculum it is necessary to determine their effectiveness within this specific student population. These small group case sessions are a required component of the ITDL 206.18 course, therefore students are expected to participate in the discussions, however consent will be obtained on a volunteer basis from the students to use any data collected for this study (*please refer to paragraph 8 on consent for more information on this*). The students will be randomized within the convenience sample

to ensure a heterogeneous distribution of students in the control and treatment groups as well as the small groups within the treatment group. A third party representative from the Educational Support and Development unit will be responsible for obtaining informed consent for the release of data from students in an attempt to minimize any potential coercion to participate. This individual has no formal contact with the students. This third party individual will be responsible for communicating with the students and this will be done as a presentation in a large group setting using the format for recruitment of participants provided by the ethics committee. This third party individual will also be responsible for distributing and explaining this study's disclosure document to students. All data will be collected by the third party member and numbers will be assigned to participants to ensure anonymity and confidentiality. The criteria for selection of participants are that they are first year medical and dental students. The participants that are part of the control group will be given the opportunity to receive the intervention after the study data is collected.

### **8. Consent:**

Consent will be obtained from the students regarding use of the data obtained in this study for research purposes. The students will be given a written disclosure of the study purpose (*please refer to Appendix A*) which will be accompanied by a verbal disclosure, both of which will be administered by a third party individual from the Educational Support and Development unit to avoid any conflict between the researcher and the students based on the relationship between the researcher and the students. The students will be assured that the release of their data for use in this study is voluntary, anonymous and confidential and a decision to not release their data will not affect or influence their standing within the course or the College of Medicine. In order to ensure anonymity and confidentiality a third party individual with no connection to the course or the study will communicate all disclosure information to the students and obtain consent from the students to participate. All data will be type-written and names will be removed and numbers assigned to each participant. In addition, the students will be assured that the researcher will have no knowledge of who gave consent or did not. The students will be assured that they may withdraw their data from the study at any time and this will, again, not affect or influence their standing in the course or College of Medicine. A written signed consent form will be distributed and collected by the third party individual (*please refer to Appendix B*).

### **9. Methods:**

This study will be a comparison of the impact of a specific cooperative small group learning method with an independent learning method on learning outcomes and will be performed in the following way. For two or three cases prior to the actual study, I will administer pre and post-tests which will be corrected and handed back to the students. This is not normally performed for these cases throughout the year. However, for the purposes of this study, it will be helpful to include this. This data will not be collected for research. There is no risk of harm to the students; in fact, it may be of benefit because it could serve as a form of formative evaluation. All students will attend lectures as outlined in the course syllabus and may receive course handouts as determined by the specific instructor. At a point following the lectures covering the material to be addressed in the related case, all students will receive the case and associated pre-session reading topics, but they will not receive any related questions until the day of the case session. The pre-reading topics guide the students in their preparation for the actual session.

All students will be assigned to groups of seven or eight. Immediately before the actual case session, all students will meet as a large class and will complete a pre-test of eight (8) multiple choice questions that address concepts related to the lecture and future case questions. This pre-test will be collected for the study. The students will then distribute themselves to their respective assigned groups. However, in order to blind the students who will be working on the case independently, half of the students will be told a contrived story that their facilitators did not show up (*This issue is discussed in section 12 – Risks, Benefits and Deception, below*). These students will be asked to remain in the large classroom, where they will be given the question sheets for the session and asked to answer the assigned questions individually, while the contrived problem with the facilitators is dealt with.

At this point we will have the two groups established for this study; the treatment group, who will answer the questions in small group discussions and the control group, who will answer the questions individually.

One week after the control and treatment groups have answered the session questions, they will meet as a large class to complete the post-test which will be the same eight questions from the pre-test. They will also be given a questionnaire with questions about their time on task prior to the session and during the session. Also, questions will address preferences related to individual versus cooperative learning methods and general satisfaction questions (*please see Appendix C*).

A third party representative will then reveal the nature of the study to the students and at this time the same third party representative will obtain informed consent to use the data from the pre and post-tests as well as the information gathered from the questionnaires. All students in the control group, regardless of their decision to participate in the study will be offered the opportunity to participate in a regularly structured cooperative small group session.

## **10. Storage of Data**

On completion of the study, all data (pre-test/post-test and questionnaires) will be securely stored by the researcher's supervisor, Dr. Marcel D'Eon in the Department of Educational Support and Development in the College of Medicine at the University of Saskatchewan for a period of five years, and then destroyed. Access to outside individuals will not be granted.

## **11. Dissemination of Results**

The data collected in this study will be used by the researcher in partial fulfillment of the requirements for the degree of Master of Education in Educational Administration. Results may also be published as an article in a scholarly journal or presented at a conference. In all cases, the identity of participants will be protected.

## **12. Risk, Benefits and Deception**

The issue of deception must be addressed for this particular study. The researcher felt that in order to preserve the integrity of the data of this study, a deception had to be created in order to blind the students as to the intention of the study. If the students were aware of the nature of the study, it may influence the quality of their participation in either of the groups, which could contaminate the results. If the students were made aware, perhaps a student in the control group, for example, may contaminate their answers because they prefer learning in a small group environment and vice versa. By blinding the students, a more natural and unbiased intention and effort is sought.

The researcher felt that the risk or harm to the students would be minimal because the students in the control group would be offered the opportunity to participate in the regularly structured cooperative small group sessions at a later date. Also, these small group sessions are currently only a supplement to the course curriculum with the intention of improving learning, although they may not perform this purpose. All information discussed in the cases was first presented as a lecture, so the students are not receiving new material during these sessions, nor are the specific cases or questions evaluated on subsequent examinations.

Since the researcher teaches these students, every effort will be made to remove the researcher from contact with the students as it applies to this research study. The third party individual will communicate with the students the disclosure of the study as well as when obtaining consent. All reasonable attempts will be made to ensure this individual has no connection with the students. This individual will collect all the pre and post-tests and questionnaires so the researcher has no contact with original documents. Confidentiality will be ensured in the consent to participate. Also, the students will be assured of the voluntariness of participation and that it will not compromise their standing in the course or College of Medicine.

### **13. Confidentiality**

Anonymity and confidentiality will be maintained through the use of a third party individual who will collect all materials (pre-test/post-test and questionnaires) and assign numbers to these materials so that the names of the participants is protected. Pre/post-tests and any written comments will be type-written to avoid any possibility of recognition of handwriting.

All results will be reported as aggregates of either the treatment group or the control not as individual scores or responses to the questions in the questionnaire, so confidentiality of individuals will be protected.

### **15. Debriefing and Feedback**

After the administration of the post-test, all students will be informed of the nature of the study by the third party individual with emphasis on explaining the reason for using deception in the control group (*please refer to Appendix B*). The students will then be asked to sign the consent form. The students will then be asked to complete the questionnaire. A request form for a written summary of the research data will be supplied.

### **16. Required Signatures**

Researcher: \_\_\_\_\_

Supervisor: \_\_\_\_\_

Supervisor: \_\_\_\_\_

Department Head: \_\_\_\_\_

**17. Contact Information**

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S7J 3N8  
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## Appendix A

### Disclosure Document to Study Participants

#### **A Study of the Impact of Cooperative Small Group Facilitated Case-Based Discussions on Learning Outcomes Compared to Independent Learning**

Hello First Year Medical Students,

I am currently working toward a Master's Degree in Educational Administration specializing in Medical Education. The purpose of my study is to investigate the use of cooperative small group facilitated case-based learning and its impact on learning outcomes as compared to independent learning.

I am studying the facilitated small group integrative cases in which you have been participating since the beginning of the academic year. This case session that you just completed was the **ONLY** one that was part of my research study, none of the cases prior to this were studied in any way and none of the subsequent cases will be investigated.

For this study, I needed to divide the class into two groups; one that completed the case in the regular intended manner, and the other group to complete it independently. The students in the independent learning group were told that their facilitators did not show up, however, it was my intention to have this group work independently for the purposes of this study. The reason for blinding everyone to this intervention was to obtain the most unbiased efforts and responses from everyone. I did not want answers to be compromised in any way, either consciously or unconsciously, which can happen if everyone is made aware of the intention of the study, or is allowed to self-select which learning method in which to participate.

The data I will use for this study will be the pre-test and post-test scores as well as the responses to the questionnaire. Your anonymity and confidentiality will be protected through the use of a third party individual who is not directly associated with this course or this research study. This individual will disclose and collect all information and consent forms. Also, the pre/post-tests will be type-written and your name will be removed and a number assigned so that I will not be able to associate your name with your data and I will have no knowledge of whether or not you gave consent to be a participant. Please be assured that participation in this study is completely voluntary and should you choose not to participate, it will not affect in any way your standing in this course or the Colleges of Medicine or Dentistry.

This project has been reviewed and approved by the University of Saskatchewan's Behavioural Research Ethics Board on January 31<sup>st</sup>, 2007.

Should you choose to participate in this study, please read and sign the attached consent form which will allow me to use your information for my research. If you have any questions or

concerns, please feel free to call me at 966-2739, or email me [grm831@mail.usask.ca](mailto:grm831@mail.usask.ca). You may also contact my supervisor, Dr. Marcel D'Eon at 966-2756 or [marcel.deon@usask.ca](mailto:marcel.deon@usask.ca). If you have any concerns about your rights as a participant, you can contact the Ethics Office at 966-2084. Out of town participants may contact the Ethics Office by calling collect.

Thank you for your consideration,

Greg Malin

## **Appendix B**

### **Consent Form for Release of Data**

#### **A Study of the Impact of Cooperative Small Group Facilitated Case-Based Discussions on Learning Outcomes**

Thank you for your consideration to participate in this study.

The purpose of this study is to determine the impact of the facilitated small group cases, which you have been involved in throughout the year, on learning outcomes compared to independent study methods. By investigating this learning method, it may help to further knowledge about the extent to which the different instructional strategies and the specific elements used within each strategy contribute to student learning of basic science concepts. It may also give us direction on how to improve the integrative case process.

Please be assured that participation in this study is completely voluntary and should you choose not to participate, it will not affect in any way your standing in this course or the Colleges of Medicine or Dentistry. Also, you may withdraw your consent at any time during the course of this study and it will not affect your standing in this course or in the Colleges of Medicine or Dentistry and all your data will be destroyed.

The data I will use for this study will be the pre-test and post-test scores as well as the responses to the questionnaire. Your anonymity and confidentiality will be protected through the use of a third party individual who is not directly associated with this course or this research study. This individual will disclose and collect all information and consent forms. Also, the pre/post-tests and questionnaire responses will be type-written and your name will be removed and a number assigned so that I will not be able to associate your name with your data and I will have no knowledge of whether or not you gave consent to release your data.

All data will be securely stored with Dr. Marcel D'Eon, Head of the Department of Educational Support and Development, University of Saskatchewan for a minimum of five years in accordance with University Council guidelines.

The results of this study will be used to complete a Master's Thesis and may be published as an article in a scholarly journal or presented at a conference. In all cases results will be reported as aggregates of either the treatment or the control groups, not as individual scores or responses in order to protect your confidentiality.

This project has been reviewed and approved by the University of Saskatchewan's Behavioural Research Ethics Board on January 31<sup>st</sup>, 2007.

If you have any questions or concerns, please feel free to call me at 966-2739, or email me grm831@mail.usask.ca. You may also contact my supervisor, Dr. Marcel D'Eon at 966-2756 or marcel.deon@usask.ca. If you have any concerns about your rights as a participant, you can contact the Ethics Office at 966-2084. Out of town participants may contact the Ethics Office by calling collect.

I, \_\_\_\_\_, have read and understand the description provided above.

I am aware of the nature of the study and understand that I am free to withdraw at anytime during the course of this study. A consent form has been given to me for my records.

---

(Signature of Participant)

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(Date)

---

(Signature of Researcher)

---

(Date)

## Appendix C

### Integrative Case Questionnaire – Small Group Form

Please answer these questions as accurately as possible. Be assured that your responses will be kept confidential and will be type-written to ensure that your anonymity is preserved. **All questions refer to your participation in the Diabetic Ketoacidosis Case on March 13<sup>th</sup>.**

**1. Please circle one response to each statement in relation to completing the case session in a small group.**

**A. Working through the case questions was a good use of my time.**

Strongly Disagree      Disagree      Neutral      Agree      Strongly Agree

**B. I felt that I learned a lot by working through the questions during the session.**

Strongly Disagree      Disagree      Neutral      Agree      Strongly Agree

**2. Please list any courses/programs you have completed prior to medical school that were related to the content presented in the case.**

**3. How much time did you spend preparing for this specific case from the time that you first read the case to the actual case session?**

No Preparation      <15 min      16-30 min      31-45 min      45-60 min      61-75 min      75-90 min

If more than 90 minutes, what was the total time you spent?

**4. How did you prepare for this case? Check any that apply.**

Learned from lectures related to the topic \_\_\_\_\_  
 Reviewed lecture notes \_\_\_\_\_  
 Consulted Textbooks \_\_\_\_\_  
 Used Internet resources \_\_\_\_\_  
 Talked to content experts \_\_\_\_\_  
 Discussion with peers \_\_\_\_\_  
 Used prior knowledge/experience \_\_\_\_\_  
 Other - indicate: \_\_\_\_\_

**5. Did you complete all the assigned questions during the session? (i.e. questions 1-8)**

*Yes*

*No*

**A. If you answered NO, how many of the assigned questions did you complete during the session?**

**6. How much time did you spend working through the assigned questions during the session?** (Please do not include the time required for assigning roles and completing the group processing and individual accountability response).

<15min

15-30min

30-45min

46-60min

>60min

If more than 60 minutes, what was the total time spent?

**7. Did you access the answers to the assigned questions made available online?**

*Yes*

*No*

**8. Did you research or try to answer the other questions that were not assigned as part of the case session? (i.e. questions 9-14).**

*Yes*

*No*

**9. How much time did you spend investigating any of the concepts and/or case questions (i.e questions 1-14) after the day of the case session?**

No time      <15min      16-30min      31-45min      46-60min      >60min

If more than 60 minutes, what was the total time spent?

**10. For this specific case, the facilitator helped me to learn the concepts addressed in the assigned questions during the session.**

Strongly Disagree      Disagree      Neutral      Agree      Strongly Agree

**Thank you for completing this Questionnaire!**

## Appendix D

### Integrative Case Questionnaire – Individual Form

Please answer these questions as accurately as possible. Be assured that your responses will be kept confidential and will be type-written to ensure that your anonymity is preserved. **All questions refer to your participation in the Diabetic Ketoacidosis Case on March 13<sup>th</sup>.**

**1. Please circle one response to each statement in relation to completing the case session on an individual basis.**

**A. Working through the case questions was a good use of my time.**

Strongly Disagree      Disagree      Neutral      Agree      Strongly Agree

**B. I felt that I learned a lot by working through the questions during the session.**

Strongly Disagree      Disagree      Neutral      Agree      Strongly Agree

**2. Please list any courses/programs you have completed prior to medical school that were related to the content presented in the case.**

**3. How much time did you spend preparing for this specific case from the time that you first read the case to the actual case session?**

No Preparation      <15 min      16-30 min      31-45 min      45-60 min      61-75 min      75-90 min

If more than 90 minutes, what was the total time you spent?

**4. How did you prepare for this case? Check any that apply.**

Learned from lectures related to the topic \_\_\_\_\_  
 Reviewed lecture notes \_\_\_\_\_  
 Consulted Textbooks \_\_\_\_\_  
 Used Internet resources \_\_\_\_\_  
 Talked to content experts \_\_\_\_\_  
 Discussion with peers \_\_\_\_\_  
 Used prior knowledge/experience \_\_\_\_\_  
 Other - indicate: \_\_\_\_\_

**5. Did you complete all the assigned questions during the session? (i.e. questions 1-8)**

*Yes*

*No*

**A. If you answered NO, how many questions did you complete during the session?**

**6. How much time did you spend working through the assigned questions during the session? (Please do not include the time required for completing the group processing and individual accountability response).**

<15min

15-30min

30-45min

46-60min

>60min

If more than 60 minutes, what was the total time spent?

**7. Did you access the answers to the assigned questions made available online?**

*Yes*

*No*

**8. Did you research or try to answer the other questions that were not assigned as part of the case session? (i.e. questions 9-14)**

*Yes*

*No*

**9. How much time did you spend investigating any of the concepts and/or case questions (i.e questions 1-14) after the day of the case session?**

No time      <15min      16-30min      31-45min      46-60min      >60min

If more than 60 minutes, what was the total time spent?

**Thank you for completing this Questionnaire!**

**APPENDIX B**  
**DIABETIC KETOACIDOSIS CASE**

## Integrative Case Studies

### *ENDOCRINE SYSTEM – DIABETIC KETOACIDOSIS*

#### **A Diabetic Financial Consultant**

A 30-year-old diabetic financial consultant had been well for the past 10 years. A few days before admission he caught the influenza virus and developed fever, abdominal pain, nausea, and vomiting. Because he was unable to eat, he had not taken his insulin. Over time, he began to show signs of decreased level of consciousness, and was brought to the hospital by his brother.

On admission the patient was semiconscious, he had a fruity odour on his breath, his breathing was deep and rapid, and he was moderately dehydrated. A neurological examination was performed. Urine tested strongly positive for glucose and for ketone bodies. Blood ketones were elevated. A bed-side chem strip (estimates blood glucose) was too high to give a meaningful reading. Stat blood work was called for.

An arterial blood sample was sent for tests (below). While awaiting the test results, the patient was given 12 U of insulin intravenously and a 1 L bolus of *normal* (isotonic) saline was given. The patient was hooked up to a cardiac monitor, and a run of ventricular tachycardia was noticed by the nursing staff. Therefore, an infusion of NaHCO<sub>3</sub> (50 mEq in 1 L of normal saline over 30-60 minutes) was started. An insulin infusion was started at 1 U/hr (50 Units of regular insulin in 500 mL normal saline), and after the normal saline bolus was completed, a normal saline infusion at 250 mL/hr was started.

Laboratory results came in about an hour:

Measurement	Patient	Normal Range
Blood glucose	30 mmol/L	3.3-5.8 mmol/L (fasting)
Urea	6.5 mmol/L	2.5-8.0 mmol/L
Creatinine	260 µmol/L	70-120 µmol/L (male)
Na <sup>+</sup>	138 mmol/L	135-145 mmol/L
K <sup>+</sup>	5.9 mmol/L	3.5-5.0 mmol/L
Cl <sup>-</sup>	94 mmol/L	98-106 mmol/L
Total serum CO <sub>2</sub>	3 mmol/L	21-30 mmol/L
Arterial p CO <sub>2</sub>	17 mm Hg	85-105 mm Hg
Blood pH	7.05	7.35-7.45

The insulin infusion at the rate of 1 U/hr in normal saline was continued. Another 50 mEq NaHCO<sub>3</sub> was infused over a period of 30-60 minutes. In total, the patient was given a 3.5 L of isotonic saline and 100 mEq of NaHCO<sub>3</sub> during the first 2 hours of treatment.

A blood sample was taken 1 hour after the initiation of treatment and the results were:  $K^+$ , 4.5 mEq/L; glucose, 25 mmol/L; total  $CO_2$ , 5.1 mmol/L; pH, 7.1; ketones, strongly positive. The patient's level of hydration appeared better and he had begun to excrete urine, but he was still semiconscious. In view of these results, insulin infusion was continued along with isotonic saline with the addition of 20 mEq  $K^+$  (as KCl)/L saline.

Two hours later, blood glucose was 15 mmol/L and total  $CO_2$  was 10 mmol/L. The patient was definitely improving; he was no longer hyperventilating, and was now conscious. The intravenous drip was changed to isotonic saline solution containing 5% glucose plus 20 mEq  $K^+$  /L infused at 150 ml/hr, and the insulin infusion continued at 1 U per hour. Two hours later, blood glucose fell to 12 mmol/L, and the serum  $K^+$  was 4.2 mmol/L. Total  $CO_2$  was 15mmol/L, and the pH was 7.35. Plasma ketones were only trace-positive. The insulin infusion was therefore continued as well as the 5% glucose in saline, with hourly check of blood glucose concentration and titration of the insulin infusion to keep blood glucose between 6-10 mmol/L.

The patient was much better next morning, and was able to eat breakfast. At that point, he was given 10 U insulin R and 12 U insulin N by subcutaneous injection. The intravenous drip was discontinued 30 minutes later.

**Identify key terms (and terms you are unfamiliar with) in the case and look up the meaning in a medical dictionary.**

### **Topics for Review**

Diabetes mellitus: type I and II

Diabetic Ketoacidosis

Anatomy and histology of the pancreas

Insulin and its actions

Types of insulin used in therapy

Neurological tests to assess brain stem function

Biochemical pathways for  $\beta$ -oxidation of fatty acids, gluconeogenesis, protein catabolism

Hormonal (activity) changes in a hypoinsulinemic (low insulin) state and their function(s)al significance.

Glucocounter regulation

**APPENDIX C**  
**DIABETIC KETOACIDOSIS CASE QUESTIONS**

**QUESTIONS:**

1. Why did severe hyperglycemia develop?
- 2a. How did ketoacidosis develop? Why was the patient's breathing pattern altered?
- b. What is the hormonal basis for the development of the ketoacidotic state in this individual?
3. Explain the logic of the treatment with respect to fluid and electrolyte administration.
4. How did the administered insulin help to correct the metabolic abnormality? Was enzyme induction involved in the therapeutic effect of insulin?
5. Considering that  $\text{Na}^+$  was lost in the urine, why is plasma  $\text{Na}^+$  concentration almost normal?
6. Could the hyperglycemia be controlled by lowering the carbohydrate intake?
7. What is the status of hepatic glycogen content in this patient?
8. Malonyl-CoA inhibits  $\beta$ -oxidation of fatty acids. Its concentration in the hepatocyte falls in insulin deficiency. What is the physiological significance of the former and the pathological significance of the latter statement?
9. What are some of the reasons for the dehydration in this patient? As a specific consequence of this dehydration, what hormone would you expect to be affected? What would its actions be?
10. A semiconscious patient will very likely not be aroused enough to cooperate with you as you perform a neurological exam. There are, however, parts of the exam you can perform to test the function/dysfunction of the brainstem. For each level of the brainstem (i.e. midbrain, pons, medulla):
  - a. name one reflex that tests cranial nerve function;
  - b. name the cranial nerve(s) being tested by each reflex;
  - c. provide a brief description of the circuitry involved in the reflex at the midbrain level.
11. Which part/parts of the pancreas secrete insulin. Describe its histological structure.
12. What is the anatomical location of the pancreas? Is the pancreas, retro, intraperitoneal or both?
13. Describe the lymphatic drainage of the pancreas.
14. What is the embryological origin of the pancreas?

**APPENDIX D**  
**FACILITATOR BRIEFING PACKAGE FOR DIABETIC**  
**KETOACIDOSIS CASE**

## Facilitator Briefing Package

### *Thanks for volunteering!*

In this package you will find an explanation of the role of the facilitator with student comments from an evaluation done last year. Also included is the process to follow. We will be ‘experimenting’ with various ways of conducting the small groups so the process may vary slightly from week to week.

### **Facilitator Role**

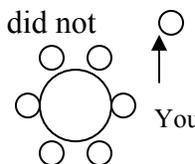
Facilitators help the students to learn by allowing them, in a safe environment, to work through the questions for the case. Facilitators are not tutorial group leaders and **do not** lecture or explain at length. Facilitators allow the students to help each other and to explain the material and to challenge each other. Facilitators keep the environment safe by catching the students before they wander too far off track and waste too much time with wrong or misleading ideas. Facilitators can answer questions, give explanations, and make suggestions all within these guidelines. It is important that the students themselves, as much as possible, struggle through the questions for the cases because this is how they will learn both the course content and how to function in teams.

### **Group Process**

The process will be the following.

You will be assigned to a room and students will sort themselves out into groups and one group will go to your room.

1. Introduce yourself (Name, Brief background info.). Many of the students did not get the name of the facilitators last term. They want to know who you are.



Sit close, but not in the circle of students. The arrangement needs to look like the students are working together without you. You may have to move chairs so students are clustered around a table or desk and facing each other. Some rooms are more challenging than others with fixed desks and tables. Be creative. However, **do not** arrange the students all facing you as in a small group tutorial.

2. Tell the students they can begin by first choosing people to fill the three roles of manager, checker, and timer. They will then start on their own. Allow the manager to call for the questions. **Please answer only questions 1- 8.** **Encourage the students to do the others on their own time and that they are no less important for emphasizing key concepts.** The facilitator does not lead the session. That is the students’ job and they will become good at it.

3. Listen carefully to the discussion question. If they are getting off track suggest they think about 'x' or 'y' more closely. Find ways of hinting. If asked, answer a question with just enough of an explanation that they can get going on their own.
4. When they finish a question let them know if they got it right or even read out parts of the model answer for them.
5. When they have completed all the assigned questions and are ready to move on or time runs out hand out the Group Process Forms. These are to be completed individually first and then briefly shared in turn with the others in the small group.
6. When the Group Processing is complete, announce the individual "mystery" question (**QTN #1**). **DO NOT** let them know that this is the "mystery" question until this time. They will then use the space provided to complete the answer to the best of their ability. They are not permitted to consult with others at this point; the response is to be done individually.
7. Please fill out the facilitator feedback form while the students are answering the mystery question and group processing information. This information is valuable for us to determine where we can make improvements to the content/questions or process.
8. Collect the forms with answers. Inform them that the answers to all questions will be posted later on WebCT.
9. You are all free to go!
10. If you have any questions, please feel free to contact me @ 966-2739 or grm831@mail.usask.ca.

Here are some comments that the students gave us about facilitators.

**Facilitator behaviors that promoted my learning were:**

- Clinical correlations. Good explanations when confused.
- Teaching us concepts.
- Guiding us as to whether on the right track.
- Going over answer.
- When we arrive at decision, they tell us if we are correct.
- Excellent assistance/explanations of concepts I did not understand.
- Most importantly, level of knowledge and experience regarding the specific cases. If they let us work out the questions ourselves but are there to direct us in the right direction and confirm that we have the correct answer (or read us the correct answer), it helps.
- Asked questions of us leading us to answers – strong guidance was needed and appreciated.
- Giving hints.

**Facilitator behaviors that did not promote my learning were:**

- Withholding answers when we were stuck. Just reading answers, not giving us a chance to work through it. Balance between these 2 is important!
- Too much instruction.
- Lack of knowledge of subject. Lack of clarity in explanation.
- Not answering questions directly.
- Going beyond what the question asked.
- Lecturing on material I already know.
- Letting us go down wrong path for too long.

**APPENDIX E**

**COOPERATIVE SMALL GROUP STUDENT ROLES**

## Integrative Cases for Basic Science

### Student Roles and Group Process

Students, working together and using each others knowledge and understanding, tackle each question in the case ensuring that each person in the group can articulate the explanation. After all questions have been answered by the group, the facilitator will assign one of the questions to be answered individually, in writing. The answer has to be handed in for review. The designated question will not be disclosed to the students until after the group discussion.

Facilitators have been briefed to keep students from wandering too far off track and to indicate when they are on the right track. They have taken an oath not to lead a tutorial and explain the answers to you! The work of answering the questions must be done by the students to benefit from this exercise.

#### **Student Roles:**

**Manager:** Reads the questions and initiates discussion; invites others to participate; monitors the discussion. Based on the available time (see Timer) may call an end to the discussion of a particular question.

**Time:** Watches the time available and the amount of work to complete to ensure that the tasks are finished on time.

**Checker:** Ensures that everyone in the group knows what has been decided by the group, as an acceptable explanation. (Simply asking if everyone understands is usually not enough to check for understanding. Eye contact is important; consider asking people to explain a question in their own words.)

**Encourager:** You know the drill. Tells people when they have helped the group. Makes sure that at the end people are recognized for their contribution.

**Contributors:** Everyone contributes by volunteering ideas and by refining others; by showing interest and by fulfilling designated role.

**APPENDIX F**

**PRE/POST-TEST QUESTIONS FOR STUDY**

**BIOCHEMISTRY DIABETIC KETOACIDOSIS BACKGROUND QUESTIONS**

**NOTE:** Please indicate after **EACH** question how confident you are that you have chosen the correct answer on a scale from 1-10

1 = **LEAST** confident

10 = **MOST** confident

1. All of the following mechanisms will occur as a result of deficient insulin **EXCEPT:**
- A) Decreased glucose uptake by skeletal muscle
  - B) Increased protein breakdown in muscle
  - C) Increased lipid breakdown in adipocytes
  - D) Decreased gluconeogenesis in liver

**Level of Confidence:**

2. An example of a ketone body is
- A) Acetyl-CoA
  - B) beta-hydroxybutyrate
  - C) glycerol
  - D) pyruvate

**Level of Confidence:**

3. Which of the following hepatic metabolic changes contribute specifically to the development of ketoacidosis?
- A) Increased beta-oxidation
  - B) Increased protein synthesis
  - C) Increased gluconeogenesis
  - D) Increased glycogenolysis

**Level of Confidence:**

4. Which of the following metabolic activities in muscle is most active in a diabetic patient with low insulin levels?
- A) Glycolysis
  - B) Gluconeogenesis
  - C) Proteolysis
  - D) Lipogenesis

**Level of Confidence:**

5. Elevated levels of glucagon in insulin deficiency are due to
- A) the stimulatory effect of corticosteroids produced in response to high glucose
  - B) the removal of insulin-induced inhibition of glucagon in the pancreas
  - C) increased levels of circulating ketone bodies
  - D) a direct stimulatory effect of high plasma glucose

**Level of Confidence:**

6. Administration of insulin in a hyperglycemic patient will result in a decrease all of the following **EXCEPT:**

- A) glucocorticoid release
- B) growth hormone secretion
- C) gluconeogenesis
- D) metabolism of ketone bodies

**Level of Confidence:**

7. How is it possible for the rate and depth of breathing to affect pH in body fluids?
- A) With increased air exchange, more O<sub>2</sub> is exchanged with body cells, binding H<sup>+</sup> ions.
  - B) During increased air exchange, more CO<sub>2</sub> is given off, returning H<sup>+</sup> ion concentrations to normal.
  - C) Increased long term respiration produces more hemoglobin thus increasing the buffering of the blood.
  - D) The rate and depth of breathing does not alter hydrogen ion concentration in body fluids.

**Level of Confidence:**

8. Glucagon stimulates all of the following metabolic pathways except:
- A) Hepatic fatty acid synthesis
  - B) Hepatic glycogenolysis
  - C) Adipose lipolysis
  - D) Hepatic gluconeogenesis

**Level of Confidence:**

9. In poorly controlled diabetes, the major source of carbon skeleton for gluconeogenesis is:
- A) lactate
  - B) leucine
  - C) ketone bodies
  - D) alanine

**Level of Confidence:**

10. Which endocrine or biochemical abnormality in diabetes is directly responsible for stimulating the production of ketone bodies?

- A) Insulin deficiency
- B) Elevated cortisol
- C) Hyperglucagonemia
- D) Hyperglycemia

**Level of Confidence:**

**APPENDIX G**

**INDIVIDUAL ACCOUNTABILITY AND GROUP  
PROCESSING SHEET**

**Integrative Case Studies  
Individual Response Sheet**

**Case:**  
**Name:**

**Date:**

**Group Process:**

Identify 2 or more member actions that contributed positively to the success of the group:

Identify 1 or more action(s) that might improve the group functioning:

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Individual Accountability: (response to the designated question)

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Assessment of individual accountability: Pass / Fail

*Comments:*