The effect of problem-based learning on students' critical thinking dispositions and approaches to learning: a study of the student nurse educators in Hong Kong

Agnes Fung Tiwari

University of Wollongong

1998

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THE EFFECT OF PROBLEM-BASED LEARNING ON STUDENTS' CRITICAL THINKING DISPOSITIONS AND APPROACHES TO LEARNING: A STUDY OF THE STUDENT NURSE EDUCATORS IN HONG KONG

A thesis submitted in fulfilment of the requirements for the reward of the degree of DOCTOR OF PHILOSOPHY

From

THE UNIVERSITY OF WOLLONGONG

By

AGNES FUNG YEE TIWARI, R.N., M.Sc.

Department of Nursing
1998
This thesis incorporates original research conducted by the author and includes no material accepted for any other academic award in any university. To the best of my knowledge, it does not include any material authorized by another person, except when duly referenced.
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Problem-based learning has been advocated by many educators as a promising educational strategy. Yet, despite the various studies, there is inconclusive evidence about the effectiveness of problem-based learning.

The purpose of this research study was twofold. Firstly, problem-based learning was implemented as an attempt to enhance student nurse educators’ dispositions to critical thinking and to promote a deep approach to learning. While the inclination to think critically and the adoption of a deep approach to learning are important to all professional nurses, this researcher has targeted the study on a group of student nurse educators. As role models to future generations of nurses, these nurse educators would influence the attitudes of their students in thinking and learning. Two outcome measures were used. The dispositions toward critical thinking were assessed using the California Critical Thinking Disposition Inventory (CCTDI) while the Study Process Questionnaire (SPQ) was used to measure the approaches to learning. The research involved a 14-week experimental period and a follow-up period six months later. A quasi-experimental ‘Untreated Control Group Design with Pretest and Posttest’ as described by Cook and Campbell (1979) was employed to determine the outcome measures. The original design was modified with the addition of a follow-up study. A total of 27 participants were involved, representing 100% of the total number of student nurse educators in Hong Kong in 1996-1997. The findings show that problem-based learning could be an effective intervention to promote the dispositions toward analyticity, systematicity, critical thinking self-confidence and cognitive maturity. Moreover, six months after the experiment, the experiment group was still showing positive inclination to these
dispositions. In terms of the dispositions toward truth-seeking, open-mindedness and
inquisitiveness, there was no significant difference between the experimental and control
groups at the end of, and six months after the experiment. Thus, there is no evidence to
suggest that problem-based learning has a significant effect on these three dispositions.
In the context of approaches to learning, there was no significant difference between the
experimental and control groups in the surface, deep and achieving approaches before, at
the end of, and six months after the experiment.

Secondly, the study investigated the factors that might have influenced the results of the
outcome measures. Qualitative interviews were conducted immediately after the
experiment and six months later. The qualitative data show that the disposition toward
truth-seeking could be affected by culture and the pursuit of truth may be sacrificed for
the sake of maintaining social harmony in the Chinese culture. Moreover, problem-based
learning offers students the opportunity to work with problem situations and improve
their problem-solving skills, which in turn could help them develop positive dispositions
toward analyticity, systematicity, critical thinking self-confidence and cognitive maturity.

In the light of these findings, it is important that continuing effort be made to monitor the
effects of problem-based learning in nursing education.
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The author would like to thank her supervisor, Associate Professor F. Yuen for the time, patience, and expert guidance so generously given.

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The author is indebted to the student nurse educators who participated in this study. Without their commitment and enthusiasm, it would be impossible to carry out the study.

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CHAPTER ONE

INTRODUCTION
CHAPTER ONE
INTRODUCTION

1. **Background**

Historically, the teaching of nurses has been teacher-centred and subject-focused. Nurse educators would be expected to introduce their students to particular knowledge, skills, and procedures which formed the basis of nursing practice. In the days when nurses were trained within an apprenticeship model where the health care arena provided a wealth of on-the-job experiences, it was an accepted norm that nurses learned by observation and practice, with trial and error and a small amount of theoretical education forming an adjunct to those experiences.

While this traditional model of training nurses might have served the needs of the health care system for many years, increasingly it has been criticized for not adequately preparing nurses to deal with today's complex health care situations (Chenoweth, 1995; McClosky & Grace, 1994; Street, 1991). There may be some truth in the criticism about the mismatch between traditional nursing education and contemporary nursing practice.

In the current health care climate, the ever increasing knowledge and advancing technologies dictate that nurses should have the skills and dispositions to keep up-to-date with nursing knowledge and development. In order to achieve this, nurses should be prepared to learn throughout their careers. Knowing what they do not
know is important for on-going learning. To this end, nurses should develop self-critical awareness of their own strengths and limitations. They have to develop an ability to acknowledge the existence of alternative interpretations of evidence while committing themselves to particular views. In addition, the knowledge acquired has to be applied. This necessitates the skill to integrate theory and practice so that generalizations can be made from a theoretical base to the reality of the practical world.

Unfortunately, the traditional model of nursing education has socialized students to receive rather than to search for knowledge. In this mode of teaching, the knowledge transmitted is seen as authoritative, to be passed on from teachers to students. The assumption is that knowledge and procedures have to be instilled in students, who in turn are passive recipients in the learning process (Ramsden, 1992).

When the traditional mode of teaching nurses is compared with the approach to learning required of contemporary nurses, it is evident that a gulf exists conceptually and practically. In essence, the traditional model fails to prepare nurses for the kind of learning required for the changing world.

Having to cope with an ever increasing knowledge and technology is not the only challenge confronting today's nurses. Changes in society's expectations have also made an impact on contemporary nursing. One of these is the increased awareness of health care consumers and their demands for information and involvement in decision-making. This global social phenomenon, which originated in North
America, through Europe, Australia, is now finding a foothold in Hong Kong. This social movement has re-shaped nursing practice. Nurses are now personally responsible for ensuring that informed consent takes place for all treatments offered to health care consumers. In addition, they are required to safeguard the interests of those in their care, while at the same time justifying public trust and confidence.

The traditional purpose of training nurses to 'fit in' the health care system is inappropriate in the face of such a social movement, which has uprooted the foundation of conventional practices of health care professionals. Instead, nursing education should aim to educate nurses. This means giving nurses the opportunity to gain a real understanding of their discipline, to become reflective and thinking practitioners, and to learn to develop creative strategies to deal with the complexities and ambiguities that can never be managed by textbooks and ritualistic procedures (Chenoweth, 1995; Champion, 1991). In other words, thinking skill rather than ritualistic practice is what is needed for contemporary nursing.

Apart from the two major assaults on nursing as described above, the profession is also facing a number of challenges that have seriously questioned the appropriateness of the traditional model of nursing education. The challenges include: (i) the call from within the profession that nursing needs to develop a stronger knowledge base from which to explore the complexities of nursing practice and to safeguard standards; (ii) legislation that allows for greater consumer rights while at the same time demanding more accountability from nurses; and (iii) the current economic climate that demands efficient as well as cost-effective practice. Nurses in Hong
Kong, like their peers in other parts of the world, are facing similar challenges.

In the face of all these challenges, the implication for nursing education is clear: it is no longer appropriate to train nurses. Instead, nursing education should educate nurses so that they would develop the kind of thinking and learning approach required for contemporary nursing.

2. **Critical Thinking**

While there might have been suggestions that learning to think is crucial for students’ professional and personal success, the exact nature of this thinking has only been made explicit during the past decade. With the support of official mandates and legislation in the United States of America, critical thinking has been recognized as the thinking skill integral to business and economic success and vital for professional practice (National Goals for Education, 1990). Such a recognition, however, is not confined to North America. Critical thinking as an educational goal has been promoted with varying degrees of intensity throughout the world, especially in tertiary education (Paul, 1993).

In nursing, critical thinking is identified as a key component in clinical judgment (Ford & Perfetto-McGrath, 1994; Kataoka-Yahiro, 1994; Benner, 1984). Critical thinking is thought to be most apparent when the nurse employs reflective judgment in response to a novel or ill-defined problem situation. When engaging in reflective judgment, the nurse thinks critically to identify the problem, select an appropriate
problem-solving behaviour from previously defined solution path (script) when possible, evaluate effectiveness of the chosen script and own performance of the script, and infer any need for creative intervention or new script (Facione, 1995). Critical thinking is thus vital to clinical judgment.

It is thought that nurses who are skillful in critical thinking would be able to make competent clinical judgments. The latter are the basis for the delivery of safe, comprehensive, individualized, effective and innovative care. Further, if the nurse is to function effectively in collaborative team decision-making, s/he must be capable of formulating sound clinical judgment in such matters that affect outcomes of health care and delivery of services (Chenoweth, 1995). Thus, in addition to enhancing nursing practice, critical thinking also plays an important part in promoting the standing of nurses in the health care team.

Despite the recognition given to critical thinking, the idea of teaching nurses to think critically has been questioned in some quarters. For instance, as Chenoweth (1995) comments, one of the objections expressed is whether critical thinking learned in the academic environment can easily be transferred to nursing practice. The argument is that in the academic environment, critical thinking is principally associated with literacy (such as the interpretation, analysis and criticism of written texts, theory and philosophical positions), which is radically different from the critical thinking required for the clinical environment (which emphasizes interpretation, analysis and evaluation of events, situations and human reactions). This concern may be justified in light of some of the narrow conceptions of critical thinking, for example, Ennis
(1962) defines critical thinking only in terms of deductive and inductive reasoning. However, one should not lose sight of the fact that some definitions of critical thinking are broad enough to encompass the diverse contexts in which personal decisions and professional judgments are made, for instance, critical thinking as conceptualized by the Delphi Report on Critical Thinking (American Philosophical Association, 1990). It is claimed that the generalizability of critical thinking depends on the definition given to it (Chenoweth, 1995). In other words, if critical thinking is defined broadly, its application to nursing practice will be enhanced. This is an important consideration for adopting a broad definition of critical thinking for this study.

Notwithstanding the efforts made by nurse researchers to build up a database of critical thinking in nursing, little is known about the actual impact of nursing education on students’ critical thinking. Partly, this may be attributed to the long standing methodological difficulties in critical thinking measurement. Since 1992, however, the position has markedly improved, with nurse scientists in the United States taking a lead in this direction. As valid and reliable instruments become available, and longitudinal and cross-sectional studies into nurses’ critical thinking get underway, it is now possible to investigate the effect nursing education has on the development of students’ critical thinking. For example, Facione & Facione (1997) have collected data from 50 nursing programmes in the United States from 1992 through 1997. The aggregation of these test data, the largest data set known to date, has helped to resolve some long standing questions in critical thinking. At the same time, it has given nurse educators a firmer and more scientific basis from which to
explore the complex web of circumstances surrounding critical thinking. Compared with their peers in the United States, nurse educators in Hong Kong are, however, lagging far behind in the research of critical thinking. For instance, there is no published evidence that the critical thinking of local nurses has been assessed in any systematic manner. It is the intention that this study will lay a foundation from which subsequent research on the local nurses’ critical thinking can be pursued.

Moreover, despite the advances made in critical thinking research in the United States, Facione and Facione (1997) note that only a few studies have reported how critical thinking might differ by cultural groups. Among those studies, one is a dissertation study of high school students in the Southwestern United States in which Latino students who had immigrated to the United States demonstrated significantly higher critical thinking dispositions than Caucasian students in their same school districts (Giancarlo, 1996). Others include studies of French-speaking Canadian mathematics and science students (Ferguson, 1995), and Latino business professionals (Mancinelli, 1996). There has been no study into the critical thinking of Hong Kong Chinese, despite the claim that the way that Chinese think is quite different from other cultural groups (Bond, 1991). This observation has further motivated this researcher to study the critical thinking of Chinese nurses in Hong Kong.

Some leading critical thinking theorists (Paul, 1993; Kennedy, Fisher & Ennis, 1991; Byrne & Johnston, 1987) believe that the disposition or habit of mind to think critically is crucial for critical thinking. Despite this recognition, the dispositional
aspect of critical thinking has been under-discussed and under-researched. To some extent, this may be due to the late development of a suitable instrument for assessing critical thinking dispositions (Spicer & Hanks, 1995). While there have been a number of instruments for assessing critical thinking skills, measurement of critical thinking dispositions was not possible until 1992 when the California Critical Thinking Disposition Inventory (CCTDI) was first introduced. The importance of measuring the dispositions of critical thinking has been brought to light by Facione and Facione (1997), the team that first used the CCTDI to measure nursing students' critical thinking dispositions in the United States. In their extensive study, it was revealed that one group of students (the RN to BSN part-time students) scored significantly lower on the CCTDI at the exit of the nursing programme, compared with their entry scores. In other words, as these students progressed through the programme, their enthusiasm for higher order thinking actually diminished. This was an unexpected finding as it would be reasonable to assume that exposure to new frameworks of knowledge and clinical judgment would excite rather than dampen their enthusiasm. One suggestion is that the difficulties of combining work and study might have caused them to become disillusioned about what the educational process has to offer. If this indeed is the case, one wonders if similar results would be found with other students who pursue their academic nursing programmes on a part-time basis. As the RN to BSN programmes in Hong Kong are all run on part-time mode, could the same be happening to these students? At this point in time, no research data are available that would allow an analysis of the critical thinking dispositions of nursing students in Hong Kong. Until that is known, there is no way of knowing the pattern of their critical thinking dispositions over time. An exploration of the local
part-time nursing students' critical thinking dispositions was therefore imperative.

3. **Approaches to Learning**

Ramsden (1992, 1979) postulates that when a student embarks on learning, the process itself signifies a relation between the student and the material being learned. It relates to how the student makes sense of the learning task, and decides how to go about learning it. Thus, it is about 'what' and 'how' they learn. This postulation has been operationalized as students' approaches to learning and there is a wealth of empirical evidence to demonstrate the relationship between this concept and the process and outcome of student learning (Biggs, 1992, 1987; Entwistle, 1992; Ramsden, 1992, Marton, Hounsell & Entwistle, 1984; Marton & Saljo, 1976). The relationship of nursing education and two of the approaches to learning: surface and deep, will now be explored.

Earlier it was stated that a different kind of approach to learning is required of nurses in the contemporary health care climate. It is argued that a deep approach is desirable. The basis for the argument is as follows. From the vast amount of information available, the nurse has to focus on what is signified, that is, the information applicable to solving the problem. To make sense of this information, s/he has to relate the new knowledge to previous experience. Given the complex nature of health care problems, s/he will have to integrate knowledge from different sources. Before this knowledge can be applied to a real situation, s/he has to distinguish evidence from argument, and to organize the different aspects into a
coherent whole. By tackling the task in the above manner, the nurse stands a better chance of arriving at the kind of understanding required for the complex health care reality. The elements of 'focusing on what is signified', 'relating to previous experience', 'integrating knowledge from different sources', 'distinguishing evidence from argument', 'structuring knowledge into a coherent whole', and 'application of theoretical ideas to reality' as described above, are encapsulated in the deep approach to learning as envisioned by Biggs (1992), Ramsden (1992), and Entwistle and Marton (1984). Thus, a deep approach is appropriate for learning in today's health care environment.

It is further argued that the traditional model of nursing education promotes a surface rather than a deep approach to learning. This is based on the observation that the traditional model emphasizes transmission of knowledge, with a focus on the signs of information (terms and definitions) rather than deeper meaning. Information is memorized, and facts and concepts are associated unreflectively. Different parts of the learning task are unrelated, and the student fails to distinguish principles from examples. Knowledge acquired in this manner is cut off from everyday reality, and the student treats the learning task as an external imposition. The elements of 'focusing on the signs', 'memorization of facts', 'inability to relate different parts of the learning task', 'unreflective association of facts and concepts', 'failure to distinguish principles from examples', and 'treating learning as an external imposition' as identified above reflect a surface approach to learning according to Biggs (1992), Ramsden (1992), and Entwistle and Marton (1984).
The discussion so far suggests that contemporary nurses would benefit from changing their approach to learning from surface to deep. However, as they are products of the traditional model of nursing education, one wonders whether they can discard their old habit of learning and take on a new approach? Leading theorists in approaches to learning (for example, Biggs, 1996; Ramsden, 1992; Entwistle, 1992; Marton, 1988) think that it is possible to do so. It is said that “approaches to learning are not something that a student has: they represent what a learning task or sets of tasks is for the learner” (Marton, 1988, p.75). Thus, in helping students to change their approaches to learning, the teacher is not trying to change the students, but to change their perceptions of the learning task. For example, if students see the task as learning unrelated facts, they would use a surface approach. On the other hand, if they perceive it as learning for understanding, they are more likely to use a deep approach. Ramsden (1992) further argues that every student is capable of using both surface and deep approaches, and the same student would use different approaches on different occasions, depending on how the learning tasks are perceived. To add weight to the assertion that approaches to learning are amenable to intervention, Biggs (1996), Entwistle (1992), and Ramsden (1992) all agree that good teaching should engage students in ways that would encourage them to deploy a deep approach to learning.

To follow on the argument that the traditional model of nursing education is not meeting the profession’s needs and that it is possible to improve students’ approaches to learning, it is logical to suggest that new models of educating nurses should be developed to improve students’ learning. The matter, however, is not that simple. It
has been suggested that often, teachers teach the way that they were taught (Ramsden, 1992). Hence, if teachers were taught to surface learning, that is the way they will teach their students to learn. Based on Ramsden’s suggestion, it would be reasonable to deduce that a change in teacher education is a precursor to any improvement to students’ approaches to learning. Teacher education should aim to change teachers’ understanding of teaching and introduce them to a deep approach of learning. In the case of nursing education, the preparation of nurse educators should be changed radically so that teachers of nurses can shake off the shackles of the traditional model and learn to approach their learning in a deep and meaningful manner. It is with such intention that problem-based learning is introduced to the student nurse educators in this study. It is hoped that they will return to their workplace and design educational models that would promote a deep approach to learning.

4. **Problem-based Learning and Approaches to Learning**

The traditional view that basic concepts and principles have first to be taught before students can apply them is cast aside with problem-based learning. Instead of the teacher giving them information, problem-based students get themselves involved in the learning task by analyzing the problem situation, exploring the possible solutions, understanding the concepts, and generally learn in a more satisfying and meaningful manner.

Theoretically and empirically, the close relationship between problem-based learning
and deep approach to learning is convincing. Theoretically speaking, problem-based learning makes use of the principles that encourage students to become engaged with the learning task. Deep learning is thus promoted as a result of the active role played by students in their learning. Empirical findings have also confirmed that problem-based students adopt a deep approach to learning (Mitchell, 1992; Biggs, 1991; Newble & Clarke, 1986). Thus, it would be reasonable to assume that problem-based learning would promote deep learning in students.

In Hong Kong, recognizing the educational benefits offered by problem-based learning, educators responsible for professional education and preparation have begun to incorporate this learning strategy in the curricula. For example, the Faculty of Medicine in the University of Hong Kong has introduced a problem-based curriculum for medical education in 1997. Some of the nursing programmes in tertiary education have also included problem-based learning as one of the teaching/learning strategies. While it is encouraging to witness genuine efforts made to improve student learning, the effect of problem-based learning on students’ approaches to learning must be properly evaluated. Through this study it is hoped that a better understanding of the influence of problem-based learning on student nurse educators’ approaches to learning within the local context can be gained.

5. **Problem-based Learning and Critical Thinking**

While it has been suggested that problem-based learning is one of the most effective ways of developing critical thinking in nursing students (Chenoweth, 1995), an
extensive search of the literature by this researcher has found no empirical evidence to support this claim. This is an interesting discovery considering that there have been many studies on the effect of problem-based learning on clinical reasoning skills, and the latter must presumably involve some critical thinking.

When the principle and process of problem-based learning are examined, it seems that this learning strategy is conducive to the development of students' critical thinking. Problem-based learning embodies the principle that the starting point of learning is a problem. The concepts and facts related to the problem would not be previously taught, as in lecture methods, for instance. Instead, the students have to reason their way through the learning process, thinking critically as they tackle each stage of the problem-solving. In this sense, critical thinking is encapsulated in the principle of problem-based learning. In addition, the process of problem-based learning reinforces the need for students to use their critical thinking skills. For instance, as students work with the scenario presented in problem-based learning, they learn that there are many views and possibilities associated with the problem. They are required to judge critically the validity and appropriateness of each of them, before deciding which one(s) would best solve the problem. Also, problem-based students learn to analyze information during group tutorials. Such activity involves students examining the information critically for what it claims to be and how it may relate to the problem situation. Thus, information is not accepted on face value. Meyers (1986) suggests that the exposure to contesting points of views and participation in critical discussion are two of the ways of promoting students to think critically. From the above description, it would seem that both are key components
of the problem-based learning.

Although the speculation about the link between problem-based learning and critical thinking appears plausible, it should be tested empirically. Research into the interplay of the two concepts will address the gap in the existing knowledge. This is one of the reasons for conducting this study.

6. **Operational Definitions used in this Study**

As problem-based learning, critical thinking, and approaches to learning, can be interpreted in a number of ways, there is a need to clarify their operational definitions as used in this study.

In terms of problem-based learning, the operational definition is adapted from the descriptions offered by Barrows and Tamblyn (1980) and others (Norman & Schmidt, 1992; Boud & Feletti, 1991). In this study, problem-based learning is defined as an educational strategy in which students acquire knowledge and skills from the process of learning to understand or resolve a problem that has been carefully constructed to facilitate active student participation and transfer of learning. Thus, working with a problem situation rather than formal input from a teacher stimulates student learning.

For the purpose of this study, the definition of critical thinking is operationally derived from the Delphi Report on Critical Thinking (American Philosophical
Critical thinking is operationalized as a process of purposeful judgment based on reasoned consideration to evidence in the context of making a decision about a problem, goal, or desired outcome. Further, this process of purposeful judgment is subjected to on-going self-appraisal.

As with regard to the approaches to learning, the operational definition in this study is based on the interpretation offered by Biggs (1992) and Entwistle and Ramsden (1983), which is the student's predisposition to adopt certain learning strategies when s/he is required to tackle a learning task.

In this study, the term ‘student nurse educators’ refers to those students undertaking the Postgraduate Diploma in Nursing Education (PgDNE). Admission to the programme is determined by the students’ eligibility for registration as teachers of nurses stipulated by the Nursing Board of Hong Kong. Upon completion of the programme, these student nurse educators are eligible to apply for admission to the Indicative Register as Registered Nurse Teachers.

7. **Purpose of the Study**

In the previous sections, it is suggested that the traditional model of teaching nurses is not conducive for the development of critical thinking and deep approach to learning. An injection of a new philosophy into the nursing curricula is needed. Such a philosophy should be orientated toward student-centred learning and critical inquiry. Problem-based learning, with its emphasis on clinical reasoning and independent
learning skills, has been advocated by its proponents as a promising educational strategy. While research evidence suggests that problem-based learning is effective in some areas, research findings in other areas are inconclusive. As discussed earlier, no studies have been conducted that would demonstrate the effect of problem-based learning on critical thinking. In addition, although problem-based learning has been shown to promote a deep approach to learning in general education, further study is required to investigate this link in the context of nursing education.

The questions that are raised include:

Is problem-based learning effective in enhancing students’ dispositions to critical thinking? Can problem-based learning promote the adoption of a deep approach to learning by students?

In essence, the research question for this study is:

‘Is there a difference between the traditionally taught student nurse educators and problem-based student nurse educators in terms of their dispositions to critical thinking and approaches to learning?’

8. **Significance of the Study**

The absence of empirical data related to local nurses’ dispositions to critical thinking and approaches to learning and the inconclusive findings in the evaluation of
problem-based learning indicate the need for this study.

First, while research on nurses’ critical thinking has been well underway in other countries such as the United States of America, study into the Hong Kong nurses’ critical thinking is virtually non-existent. This study could provide impetus for the nursing profession to pursue a systematic measurement of the critical thinking of the local nurses.

Secondly, although studies into the critical thinking dispositions of some cultural groups have been conducted in the United States, none of these involves Hong Kong Chinese. Given the speculation about the uniqueness of Chinese thinking, this is a significant gap in the understanding of critical thinking. This study seeks to contribute to the body of knowledge in relation to the critical thinking dispositions of Hong Kong Chinese.

Thirdly, while the importance of approaches to learning has been well researched, its significance in the local nursing education setting has received little attention. This study could provide an insight into how local nurses approach their study.

Fourthly, even though much research has been conducted in problem-based learning, very little is known about its effect on students’ critical thinking. In addition, even in the area of approaches to learning where problem-based learning has proved to be effective in general education, it is uncertain whether such effectiveness will be repeated when problem-based learning is applied to nursing education. This study
could enlighten nurse educators of the effects of educational intervention. Such an understanding could be the basis for designing programmes to promote students’ dispositions to critical thinking and approaches to learning.

Finally, the idea of a quasi-experiment is that the research takes place in the real world (in this study, it is the reality of nursing education), while at the same time controlling for influences that could obscure or compound the effects that are of particular interest. Despite the small sample size used in this study, the conditions required for a quasi-experimental design have been observed. As this is the first quasi-experiment ever conducted locally to evaluate the effectiveness of educational intervention in nursing, this study could provide a framework for nurse educators to monitor and evaluate the nursing curricula.
CHAPTER TWO

REVIEW OF RELATED LITERATURE
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REVIEW OF RELATED LITERATURE

This chapter reviews three main areas of literature that are relevant to this study. The first section examines aspects of critical thinking. The second section explores problem-based learning. Literature related to students’ approaches to learning comprises the final section.

1. Critical Thinking

Reviewing the literature, one notes that much has been written about critical thinking. For example, according to Paul (1985), nearly 2000 articles on or related to critical thinking were written between 1978 and 1985. While compiling an annotated bibliography on critical thinking, Cassel and Congleton (1993) noted a total of 930 items between 1980 and 1991. Definitions of critical thinking, skills and attributes of a critical thinker, and the teaching and assessment of critical thinking feature prominently in the vast amount of literature. However, despite the claims made by a broad range of courses said to be promoting this thinking skill, there is still no conclusive evidence that any particular teaching approach is more effective in fostering students’ critical thinking.

As Cassel & Congleton (1993) and Brookfield (1987) suggest, partly, the evaluation of the pedagogical efforts in promoting critical thinking has been hampered by the absence of a universally agreed definition of critical thinking. As a result of the lack
of definitional agreement, a wide range of views exists as to what critical thinking really is. For instance, critical thinking has been defined as logical reasoning (Hallet, 1984; Ruggiero, 1975), reflective judgment (Kitchener, 1986), assumption hunting (Scriven, 1976), the creation, use and testing of meaning (Hullish & Smith, 1961), depending on whose writing one happens to be reading at the time. Establishing a clear conception of critical thinking is therefore important. As there are diverse meanings given to critical thinking, the definitions will now be examined more fully.

1.1 Definitions of Critical Thinking

Critical thinking can be defined narrowly or broadly. The narrow definitions regard critical thinking as a self-contained type of thinking. Its emphasis is on the products rather than processes of thinking (Sander, 1992; Yinger, 1980). Broad definitions, on the other hand, consider critical thinking as an expanding and exploratory process and is synonymous with other general thinking processes. For example, Dewey (1933) equates critical thinking with reflective thinking.

1.1.1 Narrow Definitions of Critical Thinking

Most of the narrow definitions of critical thinking focus on problem-solving and inductive/deductive logic (Sander, 1992; Yinger, 1980). A more detailed discussion of these two narrow definitions of critical thinking will be given here.

Narrowly defined as synonymous with problem-solving, critical thinking is seen as
the assimilation and processing of information in response to a problem and the judgment and selection of the best solution. The work by Dressel and Mayhew (1954) is an early example of conceptualizing critical thinking in the context of problem-solving. Based on an extensive examination of literature and research in the field of thinking skills, Dressel and Mayhew proposed an inventory of problem-solving abilities that they considered as encompassing most aspects of critical thinking. The inventory includes the abilities to:

- define a problem,
- select pertinent information for the solution of a problem,
- recognize stated and unstated assumptions,
- formulate and select relevant and promising hypotheses, and,
- draw conclusions validly and to judge the validity of inferences.

Despite the lack of elaboration on these abilities, Dressel and Mayhew's work has significantly influenced the conceptualization of other critical thinking theorists. For example, Young (1980) states that critical thinking "can be characterized by the ways in which the contents and mechanisms of human cognition are involved in the solution of problems and the making of decisions and judgments" (p. ix). Thus, problem-solving is evident in Young's conceptualization of critical thinking. Two prominent critical thinking theorists, Watson and Glaser, specifically built upon the problem solving abilities identified by Dressel and Mayhew and defined critical thinking as:
"a composite of attitudes, knowledge, and skills which include: (1) attitudes of inquiry that involve an ability to recognize the existence of problems and an acceptance of the general need for evidence in support of what is asserted to be true; (2) knowledge of the nature of valid inferences, abstractions, and generalizations in which the weight or accuracy of different kinds of evidence are logically determined; and (3) skills in employing and applying the above attitudes and knowledge" (Watson & Glaser, 1980, p.1).

It is worth noting that Watson and Glaser's definition of critical thinking has been adopted by many researchers both within and outside the nursing profession in their work on critical thinking (For example, Shin, 1998; Vaughan-Wrobel, O'Sullivan & Smith, 1997; Rossignol, 1997; Behrens, 1996; Brooks and Shepherd, 1990; Bawens and Gerhard, 1987; Kemp, 1985; Ketefian, 1981; Matthews and Gaul, 1979). Sander (1992) notes that Watson and Glazier's definition of critical thinking is popular with nurses. Miller and Malcolm (1990) claim that as the definition by Watson and Glaser focuses on problem-solving, it is more relevant for nursing. Similar sentiment is also expressed by Hickman (1993).

Despite its popularity, conceptualizing critical thinking as problem-solving has been criticized. The main concern is whether problem-solving is synonymous with critical thinking. Beyer (1985) contends that critical thinking should not be equated with problem-solving, and questions the assumption that students learn to think critically through solving problems. The suggestion that critical thinking is not the same as problem-solving has the support of Tanner, a prominent nurse scientist known for her
work on clinical judgment. Tanner (1993) argues that critical thinking is not the same as problem-solving, and this is evidenced by the repeated failed attempts to identify any significant relationship between these two concepts. Kurfiss (1988) also makes a clear distinction between critical thinking and problem-solving. She states that while the goal of problem-solving is to find a correct answer, the emphasis of critical thinking is to construct a plausible representation of the situation or issue so that it can be presented in a convincing argument. In addition, whether all problem-solving activities require critical thinking has also been questioned. Furedy and Furedy (1985) suggest that problem-solving may or may not involve critical thinking. Citing an example of a standard chemistry problem, they claim that solving such a problem requires merely the application of accepted formulas, and not necessarily the use of critical thinking. Paul (1993) also argues that not all problem-solving processes promote critical thinking. He sees the cultivation of critical thinking as directly related to the manner in which the problem is solved. Thus, if the problem is solved procedurally, it would impede rather than promote critical thinking. A problem is said to be solved procedurally when one follows a series of rigid procedures rather than principles, and when one restricts one’s reasoning to only one frame of reference. According to Paul, the skill of critical thinking will only develop through problem-solving if one gets into the habit of reasoning dialectically. Dialectical reasoning involves moving back and forth between opposing points of view and contradictory lines of reasoning while using each to cross-examine the other critically. Finally, conceptualizing critical thinking only as problem-solving is criticized because it is too narrow and does not fully embrace the scope and complexity of critical thinking (Kinney, 1980).
Other than problem-solving, critical thinking is also narrowly defined in the context of logic (Yinger, 1980; Sander, 1992). To be more precise, logic in this sense refers to deduction and induction, the traditional notion of reasoning that has a long history dating back to Aristotle's theory of syllogisms. Beyer (1987) notes that in deductive reasoning, one moves from general principles to specifics. On the other hand, in inductive reasoning one infers broad meanings such as generalizations and principles from many specifics. According to Facione and Facione (1997), assuming that all the premises used in deriving a certain conclusion are true, deductive reasoning guarantees the truth of the conclusion while inductive reasoning gives strong warrant to the truth of the conclusion.

Conceptualizing critical thinking in terms of deductive and inductive reasoning is sometimes referred to as the classic way of defining critical thinking (Facione & Facione, 1997). This traditional conception of critical thinking originates from the discipline of philosophy and it emphasizes the judgmental dimensions of critical thinking, that is, what a statement means and whether it should be accepted or rejected (Smith, 1953). Robert Ennis, a leading critical thinking theorist, has elaborated on Smith's idea and refined the conceptualization of critical thinking over the past four decades. The twelve aspects of critical thinking as identified by Ennis (1962) is generally accepted as the earliest attempt to explore the concept of critical thinking in a thorough and comprehensive manner. Ennis envisaged that the twelve aspects of critical thinking would form the basis for research in the teaching and evaluation of critical thinking ability. The twelve aspects of critical thinking are:
1. Grasping the meaning of a statement.
2. Judging whether there is ambiguity in a line of reasoning.
3. Judging whether certain statements contradict each other.
4. Judging whether a conclusion follows necessarily.
5. Judging whether a statement is specific enough.
6. Judging whether a statement is actually the application of a certain principle.
7. Judging whether an observation is reliable.
8. Judging whether an inductive conclusion is warranted.
9. Judging whether the problem has been identified.
10. Judging whether something is an assumption.
11. Judging whether a definition is adequate.
12. Judging whether a statement made by an alleged authority is acceptable.

Scanning through the list, it is evident that both deductive and inductive reasoning are included in Ennis' twelve aspects of critical thinking. Also, Ennis depicts critical thinking as a general skill, which is content- and context-free.

Defining critical thinking as "the correct assessing of statements" (p.81) in 1962, Ennis has since broadened the definition to "reflective and reasonable thinking that is focused on deciding what to believe or do" (1987, p.10). Deduction and induction, as encompassed in inference (that is, whether the reason would support the conclusion) remain as the basic elements in Ennis' (1996, 1987) more recent
conception of critical thinking. Ennis' prolific work on critical thinking has influenced many critical thinking theorists to incorporate deduction and induction in their conception of critical thinking (for example, Beyer, 1987; Facione, 1984; D'Angelo, 1971). Whether or not critical thinking theorists make explicit references to Ennis' conception of critical thinking, the tradition of conceptualizing critical thinking in the deduction/induction dichotomy has remained strong (Facione & Facione, 1997). In particular, a reform movement, known as the Informal Logic and Critical Thinking (ILACT) movement has been gaining popularity. This movement, as reported by Fisher (1988), is one that has a strong emphasis on deduction and induction and aims to teach people to transfer their logical thinking ability to everyday real life situations. Judging by the earnest development of the ILACT movement in Europe and North America, the deduction/induction tradition of critical thinking is showing no sign of waning.

It should be noted that there are doubts about the association of logic with critical thinking. For example, McPeck (1981) asserts that there is no conceptual or pedagogical link between logic and critical thinking and concludes that "the real problem with uncritical students is not a deficiency in a general skill, such as logical ability, but rather a more general lack of education in the traditional sense" (p.22).

In McPeck's view, teaching someone how to conduct logical thinking does not necessarily lead to the development of critical thinking. To appreciate his argument, one has to recognize the position taken by McPeck in the teaching of critical thinking. He believes that critical thinking is subject-specific; and the correct
assessment of reasons, which is central to critical thinking, depends on the possession of specialized, field-dependent knowledge. Thus, to be able to think critically, one must have the specific knowledge in that particular field. In McPeck’s view, logic is general and subject-neutral, and is therefore irrelevant to critical thinking.

McPeck’s argument that critical thinking is a contextual skill has the support of Byrne and Johnstone (1987). These authors contend that critical thinking involves more than the possession of logical skills, and one must have the knowledge of the subject to be able to think critically.

In addition to the doubt expressed about the relationship between logic and critical thinking, a question has been raised about the appropriateness of using logic to develop critical thinking ability. Logic and critical thinking are thought to be grounded in different realities, that is, logic retreats from the everyday world and is intended only for the professionals. Critical thinking, on the other hand, is about the real world concerning ordinary people. Thus, to learn to think critically, a phenomenological approach rather than a logical one is a more suitable strategy (Langsdorf, 1988).

The preceding paragraphs have described the narrow definitions of critical thinking. Such definitions, with an emphasis on either problem solving or logic, are narrow in focus and concentrate on the product of thinking. They are clearly restrictive and ignore the other intellectual processes involved in critical thinking. The broad definitions of critical thinking will now be explored.
1.1.2 Broad Definitions of Critical Thinking

The broad definitions emphasize critical thinking as a process with an expanding and exploratory nature. Facione and Facione (1997), Paul (1993), Brookfield (1987), McPeck (1981) have all contributed to the broad definitions of critical thinking.

McPeck (1981) defines critical thinking broadly as “the propensity and skill to engage in an activity with reflective skepticism” (p.152) and suggests that “perhaps the most notable characteristic of critical thought is that it involves a certain skepticism, argument or suspension of assent towards a given statement, established norm or mode of doing things” (p.6). McPeck claims that this conception of critical thinking is broad enough to incorporate problem-solving as well as other intellectual processes involved in critical thinking. Reflective skepticism, as advocated by McPeck, is the judicious use of skepticism and is essential for critical thinking. As explained earlier, McPeck argues that critical thinking is not a content-free general skill but consists of both knowledge and critical components. He believes that the critical component is dependent on the knowledge component. In response to those who advocate that critical thinking is a general skill, McPeck criticizes them for not recognizing the importance knowledge and information have for critical thinking. Whether critical thinking is a general skill transferable across the disciplines or a subject-specific and knowledge-dependent ability has been the subject of a long and fierce debate for the past three decades. There is no sign of an agreement in this matter.
Highlighting the characteristic of critical thinking as “reflecting on the assumptions underlying others and our ideas and actions, and contemplating alternative ways of thinking and living” (p.x), Brookfield (1987) sees critical thinking as much more than just logical analysis. Indeed he subscribes to a broad conception of critical thinking, describing it as a process and locating it in the broader context of everyday lives.

Brookfield suggests that critical thinking is a process because critical thinkers should be skeptical to claims to universal truth or total certainty, and must continually question assumptions. Similarly, realizing that the assumptions that give rise to ideas and actions may be inappropriate, critical thinkers should continually explore new ways of thinking about aspects of their lives. Thus, by its nature, argues Brookfield, critical thinking can never be finished. “[It is] a process, not an outcome” (Brookfield, 1987, p.6).

In terms of context, Brookfield (1987) has placed critical thinking in the reality of adult life. He sees the ability to think critically as crucial to “understanding our personal relationships, envisioning alternative and more productive ways of organizing the workplace, and becoming politically literate” (p.14). It is clear from this that Brookfield has taken critical thinking out of the narrow confines of the classroom where it is taught, usually as logical analytical skills. In his view, critical thinking plays an important role in the workplace, interpersonal relationships and citizenship responsibilities. The breadth of Brookfield’s vision of critical thinking is evident in the way he explains personal troubles in the context of the wider social changes. He asserts that through the processes of active inquiry, reflective analysis
and informed action, critical thinkers come to realize the personal, institutional and
environmental forces that have brought them to their current situations. It is through
this realization that they begin to take action to change aspects of these situations. In
short, they learn to break free from those forces that prevent them from seeing new
directions and gaining control of their lives, their society and their world.

Brookfield (1987) argues persuasively that recognizing assumptions that underpin
thinking and action is one of the central components of critical thinking. This
includes recognizing one's own as well as others' assumptions. Further, in order to
appreciate how the other person makes sense of his/her world, it is necessary to enter
into that person's mental framework and try to understand the world from that
person's viewpoint. Brookfield is not alone in emphasizing the importance of
recognizing opposing points of view when reasoning. Dialectical thinking, that is,
the ability and readiness to think accurately and fairly within contradictory
frames of reference is also a central feature in Paul's (1993) conception of critical
thinking.

Paul (1993), who defines critical thinking as "disciplined, self-directed thinking
which exemplifies the perfections of thinking appropriate to particular mode or
domain of thinking" (p.137), is noted for categorizing it into two forms: weak sense
and strong sense critical thinking.

According to Paul (1993), weak sense critical thinkers, though skillful in using their
intellectual abilities in thinking and formulating arguments, have not achieved
command over their mind and behaviour. They think critically only with monological issues (problems that can be solved by reasoning exclusively within one point of view). When they are dealing with multilogical issues (problems that require analysis from more than one, and often conflicting points of view), they still approach the problem from a single rather than multiple frames of reference. Paul suggests that weak sense critical thinkers lack the ability and disposition to critique their own thought, and fail to reconstruct arguments for viewpoints opposed to their own. Consequently, their thinking is egocentric and ethnocentric, and they use their critical thinking skill selectively and self-deceptively to foster their vested interest. Their critical thinking ability only serves to increase intellectual arrogance and closed-mindedness. In Paul’s view, weak sense critical thinking is “disciplined to serve the interests of a particular individual or group, to the exclusion of other relevant persons or groups” (Paul, 1990, p.33).

Paul (1993) suggests that although much of the human problems are of a multilogical nature, we tend to reduce them to a monological level, partly because of the schooling we receive, which over-emphasizes thinking within one point of view. In order to solve human problems that are usually messy, controversial, and value-laden, Paul suggests that strong sense critical thinking is needed. Strong sense critical thinking does not just rely on technical competence to solve problems, it is a way of life in which one develops a critical and reflective attitude toward ideas and behaviours, and considers the problem in the context of the wider social and political world. Thus, strong sense critical thinkers approach problems in a holistic manner, using deep philosophical questioning and honest criticism. Recognizing the natural
tendency to defend and buttress their own ideas and assumptions, strong sense critical thinkers routinely subject outlook and interpretation of others as well as those of their own to serious examination. As a result, they develop an ability and habit to question their own frame of reference, and enter sympathetically and imaginatively into viewpoints opposed to their own. They reason dialectically to determine when their own point of view is weakest and an opposing viewpoint is strongest. They are not blinded by their own points of view and recognize the need to put their views to the strongest test. Strong sense critical thinkers are prepared and able to reason within multiple perspectives, put themselves in the place of others in order to genuinely understand them, and conduct their thinking across disciplines and domains. In this way, they have achieved command over their own thinking, which embodies intellectual empathy and open-mindedness. In Paul’s (1990) words, strong sense critical thinking “is disciplined to take into account the interests of diverse persons or groups” (p.33).

The strong sense critical thinking as advocated by Paul is not new. It is rooted in the Socratic ideal that entails a disposition to question assumptions, an ability to evaluate and analyze in a rational manner, and a passion for disinterested inquiry (Furedy and Furedy, 1985). Paul claims that the idea of strong sense critical thinking has been underscored by a number of critical thinking theorists before him and cites the writings of leading scholars such as Ennis (1992), Lipman (1991), Siegel (1980), Scriven (1976), Peters (1973), Scheffler (1973), and Passmore (1967) as examples.

Recognizing that divergent views in the conceptualization of critical thinking have
hindered curricular and research efforts, an interactive panel of experts was convened in 1988 under the auspices of the American Philosophical Association to work toward a clearer conceptualization of critical thinking. This panel consists of forty-six theoreticians from several academic fields. Using the Delphi method, the panel came up with a cross-disciplinary conceptualization of critical thinking, and the Delphi Report on Critical Thinking was published in 1990 (American Philosophical Association, 1990). This expert consensus conceptualization of critical thinking describes it as "the process of purposeful, self-regulatory judgment; an interactive, reflective, reasoning process" (Facione, Facione & Sanchez, 1994, p. 345). This purposeful, self-regulatory judgment requires analysis, interpretation, inference, evaluation, explanation and meta-cognition (Facione & Facione, 1997). An ideal critical thinker, thus conceived in the Delphi Report, is someone who is:-

"... habitually inquisitive, well-informed, trustful of reason, open-minded, flexible, fairminded in evaluation, honest in facing personal biases, prudent in making judgments, willing to reconsider, clear about issues, orderly in complex matters, diligent in seeking relevant information, reasonable in the selection of criteria, focused in inquiry, and persistent in seeking results which are as precise as the subject and the circumstances of inquiry permit" (American Philosophical Association, 1990, p.3).

It is evident from the above description that the Delphi conceptualization of critical thinking is focused on judgment and not on other kinds of good thinking, for example, creative intervention (Facione, 1995). Seen as a process of purposeful
judgment, the emphasis of critical thinking, according to the Delphi definition, is on decision-making in the context of an identified problem, goal, purpose and desired outcome. By giving reasoned consideration to evidence, contexts, conceptualizations, methods, and criteria, the Delphi definition of critical thinking is suitable for the diverse contexts that accompany professional practices such as nursing. The self-regulatory nature of the critical thinking process is also emphasized by the Delphi definition. The self-appraisal of one’s thinking process is considered to be simultaneous and meta-cognitive, that is, one thinks about and evaluates one’s thinking while engaging in the process of purposeful judgment (Facione, 1995).

Conceptualizing critical thinking as a non-linear recursive process, the Delphi Report’s definition goes beyond the narrow linear models and can be applied across disciplines and fields of practice and into civic and personal lives (Facione, Facione & Sanchez, 1994). The Delphi’s definition of critical thinking has been used as the basis for measuring critical thinking. One of the instruments, the California Critical Thinking Disposition Inventory (CCTDI) was used in this study.

Compared with the narrow definitions of critical thinking that takes argumentation and reasoning out of context, the broad definitions locate critical thinking in the real world. In this respect, the broader definitions appear to be more realistic than the narrower versions. Also, by emphasizing the importance of monitoring one’s own thinking, the broader definitions encompass more than just discrete components of critical thinking skills, which the narrower definitions tend to focus on. This emphasis on metacognition, that is, the need to monitor the process and product of
thinking and where necessary, correct one’s reasoning, is much needed for a concept as complex as critical thinking.

Despite the positive aspects, the broad conceptualization of critical thinking has its critics. Yinger (1980) is concerned that the definitions can be so broad that they offer little psychological or pedagogical guidance. Similarly, Govier (1988) argues that a course based on strong sense critical thinking as described by Paul, “will, in effect, include everything from metaphysics to psychoanalysis, to political theory, to ethics, to history, and heaven knows what else” (p.37). She also questions whether it is really possible that a teacher does not impose his/her own beliefs in the classroom, a condition required for dialectical thinking. Further, to be able to recognize the assumptions underlying one’s own thinking and action is no easy task, as Brookfield (1987) freely admits. Assumptions are so internalized that they have become second nature to one’s belief system. Therefore, hard intellectual effort is required in order to suspend one’s own conventional beliefs and take a critical look at the taken for granted ideas. Also, having to admit that the assumptions on which one’s own personal existence rests might be faulty can be profoundly threatening. Finally, the processes of schooling and experience encourage convergent thinking regardless of the complexity of the problem (Egan, 1986). However, one has to think divergently in order to imagine alternatives. Thus, divergent thinking as expected of a critical thinker in the broad sense, is an unfamiliar mode of thinking to most people. It should be recognized that intellectual efforts, self-discipline and emotional strength are required to think divergently.
Judging from the diverse definitions given to critical thinking, one may get the impression that it is a mystified concept. Indeed, Halonen (1995) suggests that scholars of critical thinking contribute to this state of mystification by either failing to delineate the scope of their individual approaches to critical thinking or neglecting to review their conceptual foundations before offering new insights on critical thinking. Taking heed of this criticism, the conception of critical thinking that directs this study will now be discussed.

1.2 Conception of Critical Thinking adopted for this Study

Critical thinking as conceptualized in the Delphi Report on Critical Thinking (American Philosophical Association, 1990) has been adopted for this study. The Delphi Report defines critical thinking as "purposeful self-regulatory judgment manifests itself in giving reasoned consideration to the evidence, context, standards, methods, and conceptual structures within which a decision is made about what to believe or what to do" (Facione & Facione, 1997, p.1). The adoption of the Delphi definition is justified for a number of reasons.

First and foremost, the Delphi definition is broad enough to encompass the key characteristics considered to be the essential features of critical thinking, namely, inductive/deductive reasoning, problem-solving, reflective skepticism, and dialectical thinking. In terms of inductive/deductive reasoning, Facione and Facione (1997) have reported strong statistical correlation between the scales of critical thinking skills as identified in the Delphi Report (analysis, evaluation and inference) and
inductive/deductive reasoning in a meta-study involving 50 programs of nursing education throughout the United States. The finding adds weight to the suggestion that inductive/deductive reasoning is encompassed in the Delphi definition of critical thinking. With reference to problem-solving, the Delphi Report considers that critical thinking is utilized *"whenever a person or group of people set about to think thoughtfully through a question with a view toward problem-framing or problem-solving"* (Facione & Facione, 1997, p.86). It is evident from this statement that problem-solving is included in the Delphi definition of critical thinking. It is also suggested that reflective skepticism and dialectical thinking are embraced by the Delphi definition of critical thinking, as metacognition. Metacognition requires one to monitor and if necessary, correct one's own thinking. Also, thoughtful consideration should be given to evidence, methods, theories, contexts, and criteria while keeping an open mind to alternative analysis, interpretation, evaluation, inference, and explanation throughout the thinking process (Facione & Facione, 1997). This process necessitates the execution of reflective skepticism and dialectical thinking.

Inductive/deductive reasoning, problem-solving, reflective skepticism, and dialectical thinking are considered to be relevant for the student nurse educators in this study. The reality where they practice as professional practitioners is complex and challenging. Working in such an environment, they have to have the ability to manage situations that are often messy and unexpected, and for which no perfect solutions may exist. In these situations, these practitioners have to weigh up the pros and cons and make difficult decisions. As they are responsible for the safety and
welfare of clients in their charge, the decision-making has implications for client care. For these practitioners, the habit and ability to think logically, to temporarily suspend judgment, and to reason from different perspectives is essential as it would enable them to comprehend the situation more thoroughly and to think in a fairminded manner. Further as fallible human beings operating under such difficult circumstances, it is important that they regularly monitor their own reasoning. Hence the commitment to self-regulatory thinking is essential.

Another reason for adopting the Delphi definition for this study is that the conceptualization of critical thinking is derived from rigorous scientific methods and has interdisciplinary consensus. In addition, there are on-going efforts to subject the Delphi definition to empirical testing (Facione & Facione, 1997). So far, the results have added weight to the original conceptualization.

A third reason for adopting the Delphi definition is that unlike many other definitions of critical thinking, it can be tested directly using the instruments developed from the Delphi Report. For example, the dispositions of critical thinking can be assessed using the California Critical Thinking Disposition Inventory (CCTDI).

By focusing on the Delphi definition of critical thinking, this researcher realizes that she may be criticized for limiting the scope of this study or even taking the risk of introducing bias. It may be argued that the limitation is justifiable on the ground that the purpose of this study is to evaluate the impact of problem-based learning on students' critical thinking and not to assess their thinking according to the different
definitions of critical thinking, the latter would require a separate paper. The risk of introducing bias, on the other hand, warrants further consideration. It has been suggested that the development and manifestation of critical thinking is influenced by culture. For example, Halonen (1995) suggests that in some culture, students are not predisposed to challenging authority in the classroom or applying a critical approach to published findings or learning experience. Thus, to decry the quality of critical thinking in these students would be to ignore the cultural variable in critical thinking development and manifestation. Norris (1995) also comments that judging the critical thinking of a certain culture against a standard established by some other culture would not only be pointless but risk introducing bias in critical thinking measurement.

Cultural bias is said to be present if the critical thinking so measured “...undervalued a culture...on account of alleged deficiencies in the thinking of persons of that culture” (Norris, 1995, p.201). Such view is shared by Bond (1991), who has conducted extensive research into the psychology of Chinese people and written abundantly on the subject. Indeed, Bond comments that there are distinctive features in the way Chinese think and claims that these cultural characteristics are the products of the social training and educational requirements to which the Chinese have been subjected. In order to understand the cultural influence in the Chinese thinking, this issue will now be explored.
1.3 How Chinese Think

Bond (1991) notes that there is only meagre evidence to illustrate how Chinese people think. From the little that is available, it seems that the way Chinese think is quite different from other cultural groups. In terms of Chinese people's critical thinking ability, the database is even more scarce.

Notwithstanding the lack of comprehensive empirical evidence, concern has been expressed about the stifling effect of Chinese education on the development of a critical mind. For example, Chan (1996) criticizes the education system in Hong Kong for its emphasis on the product rather than the process of learning. He is critical of the examination-oriented education system that encourages memorization and regurgitation of factual knowledge in examinations at the expense of problem-solving and critical thinking abilities. In another study, Gow, Balla, Kember, and Hau (1996) are doubtful about the effectiveness of the passive form of learning adopted by Chinese students. In the views of these authors, combining memorization and understanding in their learning approach (which Chinese students seem to favour) may not be conducive to the development of novel problem-solving and critical thinking abilities.

As not much has been documented about the critical thinking ability of Chinese people, this researcher has to refer to writings on Chinese cognitive ability and make a calculated guess about how well the Chinese would perform in critical thinking.
If critical thinking is conceptualized as inductive/deductive reasoning, then the Chinese probably would do well as evidenced by the superior performance of Chinese students in mathematics tests documented in international studies (Stevenson & Lee, 1996). In order to do well in these tests, the students would have to use reasoning to deduce and solve mathematical problems instead of relying on rote learning.

When critical thinking is conceptualized as the ability to solve problems, then the Chinese may or may not perform well as there are conflicting views about the problem-solving ability of Chinese people. Both Biggs (1991) and Chan (1990) consider Chinese students as proficient problem-solvers. However, Bond (1991) suggests that the Chinese tend to be inhibited when facing new situations for which they have no prescribed mode of solution. He attributes this to the Chinese education system, which emphasizes memorization at the expense of hypothesis testing and experimentation. Consequently, Chinese students are not encouraged to develop an active, searching mode of behaviour, which is required for novel problem-solving.

Creativity should also be considered as it is an integral part of problem-solving. Results of creativity tests suggest that the Chinese are less creative than their Western counterparts (Chan, 1996; Bond, 1991). This is because unlike the Western culture Chinese culture does not nurture creativity. Bond (1991) thinks a number of factors may account for this. First, time and encouragement are needed for creative exploration. This is where Chinese culture comes into conflict with the notion of creativity as restrictiveness is the norm in Chinese childrearing practices and the
Chinese child is actively discouraged from exploring and manipulating the environment. Secondly, the emphasis of Chinese education is on memorization. This is probably due to the need to learn the Chinese language in the form of pictorial characters. As a result, not enough time is spent on the nurturing of creative ability. Thirdly, nurturing creativity implies valuing individual expression and freeing from prescribed modes of thinking, both of which are contrary to the Chinese value of social harmony and raise the fear of luan, or chaos. Hence, creativity is not encouraged in the Chinese culture. As creativity is regarded as essential for novel problem-solving, Chinese people, not known for their creativity, may have difficulty dealing with problem situations for which they have had no experience (Bond, 1991).

If critical thinking is conceptualized in terms of challenging assumptions and questioning prescribed views, then the Chinese may well have difficulty, due to a number of reasons. In the first place, Chinese have been socialized to respect their elders and act within the dictate of hierarchy. This stems from the Confucian teaching of *Wu Lun*, the five cardinal relations, in which juniors and seniors have their ranking (Bond, 1991). As a result, the Chinese are reluctant to speak out of turn or question their senior’s views. Similarly, debating with one's senior is considered to be a sign of utmost disobedience in the Chinese culture (Wu, 1996). Chinese students would never question their teachers or challenge their judgments. Indeed, they would “go beyond such given barriers with trepidation” (Bond, 1991, p.31). Thus, challenging assumptions or questioning others’ views would be a difficult task for the Chinese. Secondly, the training of affective control is an important aspect of traditional Chinese childrearing. Apart from its emphasis on composed, reverential
behaviour, the Confucian family rule also stipulates the need for bugou yanxiao, that is, never to reveal one's thoughts and feelings (Dardess, 1991). Therefore, it will not be a natural tendency for Chinese people to make public their thinking, and this inhibition includes challenging or questioning others. Thirdly, even if a Chinese person is prepared to challenge or question, s/he may not have the ability to argue persuasively. During their schooling, the Chinese devote much of their time in the memorization of facts, and argumentation is a much neglected area in their education (Bond, 1991). Finally, harmony is the foundation of Chinese culture. Preserving peaceful relations is highly prized and maintained through effective communication (Gao, Ting-Toomey, & Gudykunst, 1996). The notion of lian, or face is an important consideration in Chinese communication. Hu (1944, p.45) defines lian as something that “represents the confidence of society in the integrity of ego's moral character, the loss of which makes it impossible for him to function properly within the community”. The Chinese regard limao or politeness as a means of showing concern for the other's face while impoliteness threatens it (Gabrenya and Hwang, 1996). In the Chinese culture, questioning or challenging another person's viewpoint is construed as impolite and 'not giving a person face'. Therefore, Chinese people are very reluctant to engage in such activity.

Conjectures about Chinese people's critical thinking has highlighted how culture may influence critical thinking development and manifestation. In light of this, this researcher has paid special attention to the issue of culture when analyzing the findings in this study.
In addition to culture, the fostering of critical thinking can also be influenced by the efforts made to teach it, as explained in the following paragraphs.

1.4 Teaching Critical Thinking

The teaching of critical thinking is not a new idea. Its roots can be traced back to the teaching practice of Socrates some 2400 years ago (Paul, 1993). Since then, critical thinking has been promoted by a number of prominent writers such as John Stuart Mill (1947), John Henry Newman (1912), and William Graham Sumner (1906). More recently, critical thinking as a goal of education has been advocated by leading critical thinking theorists such as Ennis (1996), Paul (1993), Brookfield (1987), Sternberg (1987), and Meyers (1986). The seminal works of Dewey (1933) and Glaser (1941) are just two examples of experiments into the teaching of critical thinking. In some parts of the world, the need to teach students to think critically has been given official endorsement, for example, in the United States of America, critical thinking has been incorporated into the Department of Education's "National Educational Goals for the Year 2000" (National Educational Goals Resources Group, 1991). Also, the National League for Nursing, through its program accreditation process, has stipulated that nursing programmes have to teach students to think and to show evidence of students critical thinking skills (National League for Nursing, 1990). Here in Hong Kong, although the attention given to the teaching of critical thinking does not match that of the United States, the need to foster students' thinking skills has been identified as one of the main educational targets by the University of Hong Kong, generally recognized as the leading university locally and
in the region. Recognizing the importance of critical thinking in the education of health care professionals, the Department of Nursing Studies in the same University has taken the lead to promote the fostering of critical thinking in students and in highlighting it as a key educational goal in the baccalaureate nursing programme (Department of Nursing Studies, 1996).

Citing philosophical justifications ranging from Kantian, through Utilitarian, to Aristotelian, Blair (1988) asserts that there are good reasons for including the fostering of critical thinking as an educational aim. While supporting the need to teach students to think critically, Kinney (1980) laments that a paradox exists in the reality of teaching critical thinking. He claims that although universities declare support for such teaching, the environment of higher education actually discourages students to think critically because of the teacher-dominated, passive learning climate. Consequently, students react indifferently to the call for critical thinking although they may be quite capable of thinking analytically in their daily activities. Paul (1993) also contends that education is generally failing to teach students to think. Quite apart from the debate as to how well critical thinking is being fostered in higher education, there is the fundamental question of whether critical thinking can be taught at all.

1.4.1 Can Critical Thinking be Taught?

For those who reckon that critical thinking cannot be taught, Young (1980) suggests that they may have a misconception that no attempts to foster critical thinking can
compensate for the negative effects of in-born ability and earlier schooling. They may also believe that thinking is simply the result of mastery of content and cannot be improved through learning how to think.

On the contrary, there are those who believe that critical thinking can be taught. The Informal Logic and Critical Thinking Movement is such an example. With an objective to improve reasoning and critical thinking skills through direct teaching, the Movement is committed to the vision that critical thinking is teachable (Fisher, 1991). Recent research and instructional development also suggest that it is possible to teach students to think critically through purposeful curricular designs and specific teaching-learning strategies (Ennis, 1996; Paul, Binker, Jensen & Kreklau, 1990; Halpern, 1989; Brookfields, 1987; Meyers, 1986; Arons, 1985).

There are reports of major gain in critical thinking abilities for those undertaking such programmes as the ADAPT program at the University of Nebraska, and Project SOAR at Xavier University of Louisiana (Meyers, 1986). On the other hand, there are doubts about the effectiveness of education in fostering students' critical thinking (McMillan, 1987; Norris, 1985). In nursing, studies into the impact of nursing education on students' critical thinking abilities offer conflicting findings. In a number of studies, no evidence was found that critical thinking developed naturally as an outcome of baccalaureate education (Facione, 1991; Bawwens and Gerhard, 1987; Sullivan, 1987). In other studies, however, a significant increase in critical thinking scores between the entry and completion points of the programme was reported (Gross, Takazawa, & Rose, 1987; Berger, 1984). Significantly higher
critical thinking ability was also found among baccalaureate and master's prepared nurses compared with diploma students (Pardue, 1987). More recently, in a longitudinal study conducted by Maynard (1996), although no significant change in critical thinking scores was found as the nursing students progressed through the programme, there was a significant increase when they became practicing nurses.

Notwithstanding the studies cited above, research evidence of the impact of nursing education on the development of critical thinking is sparse, as noted by Sander (1992), and Miller and Malcolm (1990). Even in the studies where an apparent increase in critical thinking was reported, no details were given as to what might have contributed to the improvement. Assuming that critical thinking can be taught, there still remains the question: if so, how?

1.4.2 How to Teach Critical Thinking?

Ennis (1992) identifies four approaches to teaching critical thinking: general, infusion, immersion, and mixed. The general approach attempts to teach critical thinking separately from the content of subject matter. In this mode, critical thinking may be taught in separate courses, separate instructional units, or as a separate thread in an existing subject matter. For example, an informal logic course may be used as the means to teach critical thinking abilities and dispositions. Kruse and Presseisen (1987), Sternberg and Kastoor (1986), Nickerson, Perkins and Smith (1985), and Sternberg (1984) have all described examples of the general approach to teach critical thinking.
Unlike the general approach, infusion of critical thinking instruction is rooted in subject matter. Students are encouraged to think critically about the subject while developing a deep and thoughtful understanding of the subject matter. The general principles of critical thinking are made explicit to students during the instruction. Proponents of the infusion approach include Resnick (1987), Swartz (1987), and Glaser (1984).

In the immersion approach of teaching critical thinking, although students are also exposed to similar thought-provoking instruction as in the infusion method while getting deeply immersed in the subject, general critical thinking principles are not made explicit during the learning process. McPeck (1990) is a keen supporter of the immersion approach. It may be argued that to some extent problem-based learning encompasses this approach. Although they are not instructed as to how to approach their learning critically, problem-based students are involved in critical reasoning as they work with problem situations.

Finally, there is the mixed approach, which combines the general approach with either the infusion or immersion approach. In this approach, there is a separate thread of teaching the general principles of critical thinking while students are also involved in subject-specific critical thinking instruction. Perkins and Salomon (1989), Nickerson (1988), Sternberg (1988), and Ennis (1985) are proponents of the mixed approach.

Subject matter knowledge is a necessary condition for thinking critically in the
infusion and immersion approaches but not required at all in the general approach. The involvement (or not) of the subject matter is also the basis whereby Fisher (1991) distinguishes the two different methods in teaching critical thinking. One is to teach critical thinking using direct methods, that is, methods designed specifically for the purpose of developing students’ critical thinking. In this method, learning to think critically is independent of any subject matter. The other way is to teach critical thinking indirectly, that is, to develop students’ critical thinking in the process of learning a subject. The indirect method takes the view that all reasoning is subject-specific (McPeck, 1990), and the only way to learn to reason well is to master the subject matter. Thus, the content of the subject determines the appropriateness of the reasoning.

As discussed earlier, McPeck (1981) refutes that critical thinking is an universal skill and argues vehemently against teaching critical thinking in isolation from specific subjects. While some scholars have also observed that being an expert thinker in one field is no guarantee that s/he will demonstrate the same degree of critical thinking in another field (Carter, 1993; Fisher, 1991; Meyers, 1986), others have reacted quite strongly to McPeck’s claim (Quinn, 1994; Ennis, 1992; Fisher, 1991; Siegel, 1990; Blair, 1988; Govier, 1988; Furedy and Furedy, 1985). The common belief shared by these writers is that discipline-specific orientation to critical thinking, as advocated by McPeck, is theoretically implausible: an *ad hominem* fallacy is a fallacy in any field and there are general principles of reasoning that would apply to many disciplines. Ennis (1992) further argues that subject knowledge could even be counter-productive to critical thinking because an expert is so well-informed about
the subject that s/he may stop considering alternatives. Despite the interest expressed in the teaching of critical thinking, there is no evidence that any particular method is more effective than the other and further research is required to determine the merits of each approach in fostering critical thinking (Kennedy, Fisher & Ennis, 1991).

While scholars may debate about the best way of teaching critical thinking, they generally agree that a learning environment conducive for the development of critical thinking is vital (McPeck, 1992; Kennedy, Fisher, and Ennis, 1991).

1.4.3 Learning Environment Conducive for the Development of Critical Thinking

For a learning environment that is conducive for the development of students' critical thinking, the following elements have to be present: stimulating students' interest, creating meaningful discussion, exposure to thoughts and views of others, and fostering a trusting and supportive atmosphere (Meyers, 1986). An elaboration of each of these elements is as follows.

Interest is the sine qua non for attention and without such motivation, even the best planned lecture is in vain (Meyers, 1986; Whitehead, 1929). Although human beings are born with an innate curiosity, Meyers argues that this natural inclination to learn must be nurtured as previous socialization and schooling would have encouraged a state of intellectual passivity or disengagement in the students. He also suggests that teachers may stimulate students' interest by creating a learning environment with an element of mystery, for instance, commence each course with a problem or
something that is not fully understood. Paul (1985), Scriven (1985), Eisner (1983), Thomas (1982), and Lipman (1976) also support using problems to promote learning in the classroom. Citing Piaget's concept of disequilibrium (1976), Meyers offers a rationale for this problem-oriented approach in learning. In his view, if a problem for which no certain answer exists is presented to the students, this arouses a sense of curiosity and uneasiness in them. Once the students' interest is captured, they can then be guided to learn to think critically and to develop confidence in their own ability to analyze and solve problems. Using problem as a starting point of learning is the central tenet of problem-based learning, a learning strategy used in this study. The theory and practice of problem-based learning will be discussed later in this chapter.

Once students' interest is aroused, this has to be sustained for learning to take place. Meyers (1986) suggests that this can be achieved through meaningful discussion. By creating opportunities for meaningful discussion through debates and questioning, not only would students' interest be engaged, they also learn to build mental structures necessary for critical thinking. A study by Smith (1977) demonstrated that student participation, teacher encouragement, and peer interaction correlated positively with improved critical thinking scores. Discussion as a preferred method of teaching critical thinking has the support of prominent critical thinking theorists including Paul and Heaslip (1995), Paul (1992), Kennedy, Fisher and Ennis (1991), Brookfield (1987), Perkins (1987), Sternberg (1987) and Ennis (1985). However, it is worth noting that students and teachers are generally unprepared for their role in this learning strategy (Meyers, 1986). The traditional teacher-centred approach
discourages rather than promotes meaningful discussion. Amongst the teaching/learning methods that purport to promote meaningful discussion, problem-based learning is noted for its emphasis on group tutorial during which students play a key role in presenting and debating their hypotheses of the problem situation.

In the process of learning to think critically, it is important that students are exposed to the thoughts and views of others (Paul & Heaslip, 1995; Paul, 1992; Kennedy, Fisher & Ennis, 1991; Meyers, 1986). Lawson and Renner (as cited in Meyers, 1986) emphasize the need for the learner to experience the viewpoints and thoughts of others in order to be shaken from his/her egocentric views. Although the comment is meant for teaching children, Meyers believes the same could apply to college students who are learning to think critically. Paul reinforces this view by recommending that exposure to contesting points of views is a necessary step to develop strong sense critical thinking. Exposure to contesting viewpoints can be achieved by posing challenges to students' thinking and encouraging them to explore opposing points of view on the subject under discussion (Paul & Heaslip, 1995).

However, learning to question one's own assumptions and beliefs in which one has a personal and egocentric investment can be a very difficult and traumatic experience (Paul, 1992). Therefore, students should be helped to reason from multiple perspectives through carefully designed learning strategy. When the learning process is centred on a problem, as in problem-based learning, students are encouraged to share their analyses of the problem situation during group discussion and to consider their as well as alternative analyses critically. Not only would this promote a broader picture of the situation, opportunities are created for students to develop the habit and
skill to think within multiple points of view.

Finally, an atmosphere of trust and support is essential if students are to let go of their own biases and try out new ways of thinking, a point noted by Meyers (1986). Support can be provided in a number of ways including validating students' contributions to class discussion, showing patience as students learn to think critically, and giving timely encouragement to students. When students feel that their views and experiences are respected by the teacher, they are more likely to be open and have trust in this form of learning. In order to foster an open and trusting atmosphere, the learning strategy adopted should reflect the belief that students are capable of independent thinking and active learning. With an emphasis on the uniqueness of personal construction of knowledge, problem-based learning acknowledges students as key players in their own learning and capable of thinking for themselves. In this sense, there is potential to foster an open and trusting atmosphere in problem-based learning.

While it is important to create a learning environment conducive for the development of students' critical thinking, it is equally important to identify the attributes of a critical thinker. In other words, the habit and ability that a critical thinker is supposed to have and which can be nurtured. In the following, the attributes of a critical thinker will be discussed.
1.4.4 Attributes of a Critical Thinker

There is general consensus that the attributes of a critical thinker consist of the skills and dispositions to think critically (Facione & Facione, 1997; Ennis, 1996; Paul, 1993; Fisher, 1991; Byrne & Johnstone, 1987; Meyers, 1986; Furedy & Furedy, 1985; D’Angelo, 1971).

As for the nature of critical thinking skills, different opinions prevail. For example, Brookfield (1987) cites four abilities that he considers to be essential for critical thinking while D’Angelo (1971) proposes a total of fifty critical thinking skills! Among the many critical thinking skills identified, Sander (1992) notes that four are frequently cited by the various writers. They are the ability to recognize stated and unstated assumptions, draw valid conclusions, judge validity of inferences, and solve problems. Assumption is what one takes for granted without the need to provide evidence as justification (Dressel & Mayhew, 1954). “The presence and nature of assumptions within an argument determines whether or not the conclusions reached are acceptable” (Sander, 1992, p.24), therefore the ability to recognize stated and unstated assumptions is vital to a critical thinker. Sander in her study defines valid conclusions as those that really do follow from the evidence. As valid conclusions are a product of correct reasoning, the ability to draw valid conclusions reflects the quality of one’s thinking. Further, in order to judge the validity of inferences, one has to have the ability “to discern when conclusions reached are based on common beliefs or personal preconceptions rather than on the collection of evidence” (Sander, 1992, p.25). A critical thinker must be able to judge whether the reason offered in
support of a conclusion is acceptable and sufficient to establish the conclusion. Finally, to be able to solve problem, a critical thinker should have the ability to "identify, clarify, and evaluate perplexities" (Sander, 1992, p.26). This includes the ability to collect relevant data, make judgment, develop alternatives, and evaluate outcome in relation to the problem identified.

From the Delphi Report on Critical Thinking (American Philosophical Association, 1990) as discussed earlier, core critical thinking skills have been derived. These are the skills of analysis, inference, and evaluation (Facione & Facione, 1997). The authors describe analysis as the ability to "comprehend and express the meaning or significance of a variety of materials, situations, expressions, etc. and to identify the intended and actual inferential relationships among statements, questions, concepts, beliefs, or judgments" (Facione & Facione, 1997, p.9). Inference is described as the ability "to identify and secure the elements needed to draw reasonable conclusions, to form conjectures and hypotheses, to consider relevant information, and to educe the most reasonable consequences which follow, either most probably or necessarily, from those elements" (p.9). The critical thinking skill of evaluation is depicted as the ability "to assess the credibility of statements and the logical strength of inferential relationships and to be able to justify one's reasoning by reference to relevant evidence, concepts, methods, contexts, or standards" (p.9).

By offering descriptors of critical thinking skills in the form of analysis, inference, and evaluation, the Delphi Report may give the impression that critical thinking is a linear process. In fact, this is not the intention. The Report portrays critical thinking
as a non-linear, recursive process expressed as “a cognitive process in which one interprets one's inferences, evaluates one's interpretations, explains one's evaluations, ... any combination, in a simultaneous or recursive manner that scientists have yet to easily chronicle or document” (Facione, 1995, p. 3).

Underlying the abilities to think critically are certain dispositions, which are the combinations of attitudes and inclinations. Like the critical thinking skills, an array of dispositions has been suggested. The frequently cited dispositions include questioning mind, intellectual curiosity, objectivity, open-mindedness, and systematicity (Sander, 1992). Despite the recognition given to the dispositional aspect of critical thinking, there is a lack of empirical evidence in this important area. Hopefully, the situation may soon improve with the construction of the California Critical Thinking Disposition Inventory (CCTDI), which is designed specifically for the measurement of critical thinking dispositions (Facione, Facione & Sanchez, 1994). Derived from the Delphi Report on Critical Thinking (American Philosophical Association, 1990), the seven dispositions in the CCTDI considered as essential for critical thinking are truth-seeking, open-mindedness, analyticity, systematicity, critical thinking self-confidence, inquisitiveness, and cognitive maturity (Facione & Facione, 1997). Truth-seeking refers to intellectual honesty and the desire for the best knowledge. Open-mindedness is the tolerance for new ideas and divergent views. Analyticity is being alert to the need to use reason and evidence to solve problems. Systematicity is the inclination to be organized, focused, and persevering. Critical thinking self-confidence is the trust one has in one's own reasoning. Inquisitiveness is the intellectual curiosity that one has for learning.
Cognitive maturity is the judiciousness that enables one to see the complexity in problems.

The importance of critical thinking dispositions has been highlighted by a number of critical thinking theorists. For example, Byrne and Johnstone (1987) maintain that although one may possess critical thinking skills, it would require propensities to exercise them. Kennedy, Fisher and Ennis (1991) contend that the possession of critical thinking skills would not lead to rational reflective thinking unless they are used in conjunction with the appropriate dispositions. Paul (1993) expresses his concern that without the necessary dispositions, critical thinking skills alone would only lead to close-mindedness. The meta-study conducted by Facione and Facione (1997) has made a start to explore critical thinking dispositions in a systematic manner. It is hoped that this study may follow this lead.

The preceding paragraphs have examined the teaching of critical thinking, an area that has received extensive attention of the academic community. On the other hand, the measurement of critical thinking has generally been neglected (Ennis, 1993; Kennedy, Fisher, & Ennis, 1991).

1.5 Measuring Critical Thinking

Perhaps due to the lack of attention paid to the evaluation of critical thinking, there is a dearth of critical thinking tests, whether they are commercial standardized tests or privately designed ones. There are problems too with the ones that are available.
Most of the existing tests are not comprehensive enough, often failing to assess important aspects of critical thinking such as open-mindedness. Also, the tests tend to be general content-based, and few can be used to assess critical thinking ability in a specific subject (Ennis, 1993).

Because of the complex nature of critical thinking, devising tools to measure this construct is no easy matter. Young (1980) observes that the measurement of critical thinking presents challenges to both teachers and students. Furedy and Furedy (1985) contend that unless the differences in the conceptualization of critical thinking are resolved, the different interpretations would lead to conflicting analyses. They further caution that even if an agreement can be reached, measuring critical thinking is still problematic as the phenomenon is complex and does not lend itself readily to quantifiable measurements. Rane-Szostak and Robertson (1996), Hickman (1993), and Kintgen-Andrews (1991) reiterate the difficulty of measuring critical thinking. There is also a need for the development of more, better, and varied instruments for assessing critical thinking (Ennis, 1992; Ennis & Norris, 1990; Norris & Ennis, 1989; Arter & Salmon, 1987). Before considering what should be done, it would be useful to take stock of what critical thinking tests are available.

1.5.1 Published Critical Thinking Tests

These are mainly pencil-and-paper, machine-scorable multiple-choice tests. The advantages are obvious. They are more economical compared with, say, essay tests, and can be administered to large groups of students fairly easily. Scoring is
comparatively quick and easy. An understanding of critical thinking is not required for those who administer or score the tests. There are disadvantages too. Dispositions of critical thinking such as the inclination to be open-minded cannot be assessed easily using multiple-choice questions. Also, when the participant realizes that s/he is being tested for critical thinking, Hawthorn effect may cause the person to display certain behaviour just for the occasion. Furthermore, these tests typically assess the outcome of judgment but not the reasoning behind it. Thus, the test taker may not have given a 'correct' response according to the keyed answer but the reason behind the choice may be equally sound (Kennedy, Fisher & Ennis, 1991).

Examples of commercial instruments measuring critical thinking include the Watson-Glaser Critical Thinking Appraisal (WGCTA), the Cornell Critical Thinking Test (CCTT), the California Critical Thinking Skill Test (CCTST), the California Critical Thinking Disposition Inventory (CCTDI), the New Jersey Test of Reasoning Skills, and the Ross Test of Higher Cognitive Processes.

Among the critical thinking tests, the WGCTA (Watson and Glaser, 1980) has been the most widely known and used (Facione & Facione, 1997; McPeck, 1981). It is a multiple-choice tool with text-based questions and is used to measure the skills aspect of critical thinking. The typical question format in the WGCTA asks test takers to judge whether a purported conclusion must be true, is probably true, is probably not true, or must be false, given a set of premise statements. The popularity of the WGCTA is empirical. For example, McMillan (1987) reviewed 27 studies that investigated the impact of education on college students’ critical thinking, in which
16 used the WGCTA as the measuring tool. Also, in a review of the research on
critical thinking conducted in nursing education between 1977 and 1990, Hickman
(1993) found that the WGCTA was the instrument used in 17 out of the 20 studies
reviewed. As the WGCTA is based on Watson and Glazier's definition of critical
thinking, and the latter is popular with nurse researchers as explained earlier, the
frequent appearance of the WGCTA in nursing research is understandable. However,
McMillan (1987) questions the appropriateness of using the WGCTA to measure the
impact of education on critical thinking:

"The Watson-Glaser CTA was developed to provide a sample of the ability to
think critically about statements encountered in daily work, magazines, and
newspapers. Consequently, it is not surprising that it would be difficult to
show how a specific curriculum, course, or teaching strategy affects such
general critical abilities in a different context than what was studied in class"
(p.10).

McMillan's (1987) comment may have given a clue as to why mixed findings have
been reported in studies that use the WGCTA. Based on the reviews of the WGCTA
conducted by Mitchell (1985), McPeck (1981), and Abo El-Nasser (1978), McMillan
concludes that it may not be an appropriate tool to measure a complex construct such
as critical thinking.

McPeck (1981) criticizes the WGCTA for limited construct validity and for
confusing proposition with inference. Referring to the numerous muddles and
ambiguities in the test, McPeck suggests that the WGCTA actually discourages respondents from using critical thinking when taking the test. Also, in view of the high correlation between the WGCTA and IQ, McPeck argues that the WGCTA measures not so much critical thinking as IQ.

Modjeski and Michael (1983) conducted an evaluation of the WGCTA and the CCTT. They invited a panel of 12 psychologists to assess the validity and reliability of the WGCTA and CCTT, using the Standards for Educational & Psychological Tests (America Psychological Association, 1974). The panel members were unanimous that there was a need to improve on the validity and reliability of both of the tests.

Facione and Facione (1997) who have conducted an extensive study on the correlation between the WGCTA and CCTST, conclude that although the WGCTA was an adequate tool for its time, it has not evolved into a rich and robust conceptualization which is necessary for measuring something as complex as critical thinking.

The CCTST (Facione, 1992) and the CCTDI (Facione & Facione, 1992) are the two critical thinking tests derived from the Delphi Report on Critical Thinking (American Philosophical Association, 1990). The CCTST measures the cognitive skills dimension of critical thinking while the CCTDI assesses the habits of mind dimension. As both instruments are conceptually grounded in the Delphi Report on Critical Thinking, they are based on a more scientific and robust framework. Like
the WGCTA, the CCTST and CCTDI are pencil and paper, machine-scorable tests, which can be administered to large groups of test takers fairly easily. Compared with the WGCTA, item formats in the CCTST and CCTDI are more sophisticated, as a result of the refinements available at the time they were developed (Facione & Facione, 1997). Hopefully, the muddles and ambiguities said of the WGCTA could be avoided in the CCTST and CCTDI. A significant contribution of the CCTST and CCTDI to the measurement of critical thinking is that with these two instruments, it is now possible to measure both the cognitive skills and affective dispositions of critical thinking.

The CCTST and CCTDI have also been used for the purposes of outcome assessment and programme evaluation (Facione & Facione, 1997). By administering the two tests at various levels of the programme (e.g. at entry and exit), it is possible to compare the change of students' critical thinking over time, and to evaluate the effectiveness of the programme based on the aggregate data.

Despite the advances in measuring critical thinking made possible by the CCTST and CCTDI, two factors are worthy of note when using the instruments. As the tests are based on the Delphi conceptualization of critical thinking, an understanding of the theoretical basis is necessary in order to make an accurate interpretation of the results. Rane-Szostak & Robertson (1996) suggest that a specific critical thinking course may be required for those using the CCTST and CCTDI. Further, as both instruments are conceptualized and developed for those in the North American culture, this raises the issue as to whether they are suitable for those from a different
culture. The issue of culture sensitivity will be elaborated in Chapter three.

In addition to the commercial standardized tests, educators and researchers have also used alternative assessment techniques to measure critical thinking.

1.5.2 Alternatives to Commercial Instruments

A number of these instruments have been documented in the literature. For example, Ennis (1993) suggests the use of essays to assess critical thinking. Compared with multiple-choice tests, essay tests are more comprehensive and assess more aspects of critical thinking. They also allow test takers to justify why they make certain judgment. Hence, those who can think critically but who may have assumptions different from those of the test constructors are less likely to be penalized as in the multiple-choice tests. While essay tests may be useful, they do have their limitations. They are more expensive and time-consuming to administer and score. Special ‘training’ is required for those marking the essay tests. As subjectivity is inevitable in marking essays, so if several markers are involved, inter-rater reliability could be a problem unless special steps are taken to guard against this (Ennis, 1993; Kennedy, Fisher & Ennis, 1991).

Tests based on Bloom’s Taxonomy (Bloom et al., 1956) of analysis, synthesis, and evaluation have been constructed to measure critical thinking. McDowell and Chickering’s (1967) Experience of College Questionnaire is such an example. However, there are problems in using Bloom’s Taxonomy to measure critical
thinking. The Taxonomy is really intended as a means to guide the selection of items for testing students' learning, and not for the purpose of evaluating their responses (Biggs & Collis, 1982). Further, Bloom's Taxonomy is vague, which makes the operationalization of the Taxonomy impossible (Ennis, 1993). To prove his point, Ennis identifies at least five different ways of interpreting the concept of analysis as described in the Bloom's Taxonomy, and there is nothing in common between them.

Interview is a useful way of supplementing other methods of measuring critical thinking although it has not been widely used for this purpose (Kennedy, Fisher & Ennis, 1991). Even though the interview method is costly and special training of interviewers is required, it is an invaluable method to elicit detailed explanation from the test taker, especially in terms of their rationale for making certain judgments. Such an explanation helps the researcher to understand what and how the test taker thinks, which is important for the analysis of that person's thinking (Sormunen & Chalupa, 1994; Norris & Ennis, 1989; Norris & King, 1984).

Blair (1988) declares that no critical thinking test has satisfied everyone. There is a need, therefore, to select the most appropriate approach to suit the purpose of the study. Ennis (1993) claims that despite the inadequacy of the current state of critical thinking measurement, it is possible to obtain an accurate assessment with careful consideration. Such consideration will now be discussed.
When making a decision as to how to measure critical thinking, it is important to remember that critical thinking is not just a collection of simple skills, and various authors have attested to the complex nature of this construct (Facione & Facione, 1997; Rane-Szostak & Robertson, 1996; Spicer & Hanks, 1995; Hickman, 1993; Kintgen-Andrews, 1991; McMillan, 1987; Furedy & Furedy, 1985). Given the complexity, it is unlikely that a single tool can cover all the dimensions of critical thinking, therefore, a combination of measurements should be used (Spicer & Hanks, 1995; Ennis & Norris, 1990). This has the advantage that the strength of each measuring method is reflected in the overall assessment while the deficiency of one method is compensated by the other. One example of combined measurements is the use of multiple-choice test to collect objective, quantifiable data and interview to elicit rich, qualitative information. The combination of quantitative and qualitative data has its advantage. As each type of data reveals a different perspective of critical thinking, the advantage of assessing critical thinking through qualitative and quantitative measurements is that it allows the assessor to view the construct from different perspectives. For something as complex as critical thinking, the more dimensions that can be revealed, the better the understanding. To assist this researcher to gain a better understanding of the critical thinking dispositions of the student nurse educators, a combination of objective tests and interviews was used in this study.

While the measurement of critical thinking skills has received some attention in the
past, the dispositional aspect of critical thinking has long been neglected. This is partly due to the lack of an appropriate measuring tool until the development of the CCTDI (Spicer & Hanks, 1996). With the availability of the CCTDI, the measurement of the affective elements of critical thinking should now receive the attention that it deserves. Measuring critical thinking dispositions is important because the possession of critical thinking skills is no guarantee that the person would use such skills, unless there is a consistent internal motivation to do so (Facione & Facione, 1997). Such motivation is manifested as critical thinking dispositions. With the earlier studies concentrating only on the skills aspect of critical thinking, an equally important aspect of critical thinking has been overlooked. It is intended that this study will address a hitherto neglected area of critical thinking research through its focus on critical thinking dispositions.

Ennis, known for his pioneering work in critical thinking, has offered a number of suggestions for the selection of critical thinking measuring tools (Ennis, 1993). First, is the critical thinking tool based on a defensible conception of critical thinking? Given the doubts that have been expressed about the WGCTA, this point is particularly pertinent. Secondly, is the critical thinking test comprehensive in its coverage of the concept? This should remind researcher not to rely solely on one single test method. Thirdly, is the test constructed at a level that is appropriate for those taking the test? If it is at a level too advanced for the test takers, the results would not truly reflect their performance in critical thinking. The above suggestions were taken seriously when deciding which measurement tool would be used in this study. Eventually, it was decided that the CCTDI, which was derived from a clear
and robust conceptualization of critical thinking, would be used for this study instead of the WGCTA even though the latter had been used extensively in nursing research. Also, to supplement the data obtained through the CCTDI, interviews would be conducted to elicit further information from the participants of this study.

In addition to the above suggestions, Ennis (1993) has also cautioned researchers of critical thinking to be vigilant in the following:

- When a claim is made that the critical thinking test results are the effect of critical thinking instruction, it should be remembered that there might be other explanations for the results.

- Without the use of a control group, the pretest-to-posttest results should be viewed with caution as factors other than the one(s) identified could have influenced the results.

- The use of the same measuring tool for the pretest and posttest could threaten the internal validity of the test as the test takers could become test-wise and exhibit change not related to the intervention.

- Most critical thinking tests are not comprehensive enough and miss important aspects of critical thinking.

- As a result of scarce resources experienced in most of the research studies
on critical thinking, compromises often have to be made which may affect the selection of appropriate test instruments.

The above acted as a reminder to this researcher when considering the methodology of this study. The choice of a quasi-experimental design and the use of more than one test method reflected the effort made by this researcher to avoid some of the pitfalls in critical thinking measurement. Further discussion of the study design is included in Chapter three.

In summary, the review of the literature in critical thinking has shown that there is still much to be learned about this important concept. This study attempts to address some of the issues raised, particularly the relationship between problem-based learning and critical thinking. A review of the literature in problem-based learning will be discussed in the following section.

2. Problem-based Learning (PBL)

2.1 An Overview

Problem-based learning is defined by Barrows & Tamblyn (1980), the well-known PBL theorists, as "the learning that results from the process of working toward the understanding or resolution of a problem" (p.18). It should be pointed out that there is no definitive model of problem-based learning and several variations have been developed (Chen, Cowdroy, Kingsland & Ostwald, 1995). Notwithstanding the
ongoing argument about which variations are legitimate applications of the problem-based learning principles, there is a general recognition that problem-based learning has expanded from its initial narrow focus within the health field to other professional disciplines. Feletti (1993) suggests that the adoption of problem-based learning by the wider professional disciplines has resulted in several variations of this model. In his view, the ‘original’ problem-based description is narrow and restricted to the use of small-group tutorials in which students work through a given case or problem. Feletti uses the term ‘second-generation’ models to describe the different variations which have the same educational aims as the ‘original’ model but are organized and delivered in different ways. They are therefore modified applications of the original problem-based approach.

Irrespective of the different models, problem-based learning is seen by its supporters as a means of immersing students in the educational process rather than treating them as passive recipients of knowledge (Little & Ryan, 1988; McMillian & Dwyer 1988).

The focus of problem based learning is on a series of carefully constructed problems (Chen, Cowdroy, Kingsland & Ostwald, 1995; Little & Ryan, 1988; Lewis & Tamblyn, 1987; Newman, 1986). Based on the scenarios presented, students learn to identify the concepts associated with the problem. As described by Little and Ryan, in problem-based learning the role of the faculty member is to facilitate and guide student learning, while students are required to assume responsibility for their own learning. The students’ responsibility includes setting specific objectives, choosing and locating appropriate resources, and reflecting on their own learning. Hence,
problem-based learning requires a change in the traditional roles of lecturer and student, with lecturers acting as facilitators of learning and students as active participants in the learning process (Boud & Feletti, 1991; Hardy, 1990; Townsend, 1990). However, moving away from their familiar, well-practiced behaviour of learning into an approach that they are less confident of, and with which they are less sure of achieving valued outcomes, can and often does provoke students' discomfort.

As Albanese and Mitchell (1993) point out, problem-based learning, at its most fundamental level, is an instructional method characterized by the use of patient problems as a context for students to learn problem-solving skills and acquire knowledge about basic and clinical sciences. A broader definition, promoted internationally as the McMaster Philosophy, is that problem-based learning is an approach to structure a curriculum, in which students are typically confronted with health care problems as stimuli for learning. A multi-stage process is used in small group tutorials to develop students' clinical reasoning skills, promote the learning of basic science in a clinically useful way, develop independent learning skills, and motivate learning (Barrows, 1986).

Reviewing the literature, one notices that problem-based learning has become a recognized curricular innovation in medical schools worldwide (DesMarchais et al., 1992; Hill, 1992; Thomas, 1992; Yang & Zhang, 1991; DeVolder & DeGrave, 1989). In the case of nursing education, Margetson (1994), Little & Ryan (1988), McMillian & Dwyer (1988) have written about the application of problem-based learning in the education of nurses. In essence, problem-based learning was initially explored as a
result of the observation that students were unable to transfer learning from the classroom to clinical settings. As Walton and Matthew (1989) point out, students often enter clinical setting appear to be devoid of knowledge which they could be presumed to have possessed earlier on. Problem-based learning is seen by some as a means to assist students to transfer their prior learning to clinical situations. According to the advocates of problem-based learning, acquisition of knowledge and skills in a problem-based curriculum is achieved through working with problems that are similar to those that the students will experience in their professional practice. Further, they suggest that as learning is set in the context of real-life situations, when faced with similar problems in their professional practice, these students are more likely to recall and apply previously acquired information to problem-solving (Barrows & Tamblyn, 1980).

The objectives of a problem-based learning curriculum as described by Barrows in 1986 are still valid today. Four broad objectives are thought to be attainable through the problem-based learning approach: (1) structuring of knowledge for use in clinical contexts, (2) development of clinical reasoning process, (3) development of effective self-directed learning skills, and (4) increased motivation for learning (Barrows, 1986).

Problem-based learning has proven valuable not only in enhancing problem-solving ability and self-directed learning skill as suggested by Barrows (1986), but also in promoting team collaboration, participation in interdisciplinary discussion, and learning to listen (Chen, Cowdroy, Kingsland & Ostwald, 1995). Chen and
associates explain that problem-based learning stimulates an open and collaborative atmosphere in which problems are presented and discussed. In this learning environment, cooperation overshadows competition. Students learn not only to value their own ways of knowing, but to obtain and accept information from other sources, to question each other critically, and to obtain feedback on their own performance.

Although much of the literature on the relevance of problem-based learning for professional education is found in medical journals, it is important to note the work of Diekelmann (1990) in the context of nursing education. In her discussion of the nursing curriculum, Diekelman calls for a total reform and a critical review of the current practice of teaching in nursing. The philosophy as espoused by Diekelmann emphasizes the need for dialogues among nurses so as to promote listening skill, seek understanding and be open to all possibilities. She further argues that nurses should seek guidance and confirmation from one and other, collaborate and cooperate as team members, and be empowered as critical thinkers. Although Diekelmann does not specify the learning strategy involved in such a curriculum revolution, it can be argued that the objectives and processes of problem-based learning are incorporated in her framework. This is argued on the ground that reflective practice and critical thinking as emphasized by Diekelmann are embraced by the philosophy of problem-based learning (Stockhausen & Creedy, 1995), so too are the skills to listen and collaborate as team members (Shannon & Brine, 1995).

Specifically in nursing, Creedy, Horsfall and Hand (1992) describe the problem-based learning movement in Australian nursing education. These authors note that
variations of problem-based learning are being adopted in about 20% of the Australian nursing programmes. These authors assert that problem-based learning is a response to the ever increasing body of knowledge that has to be incorporated into the over-loaded nursing curriculum. They suggest that problem-based learning is the most promising educational strategy through which students learn to apply concepts of nursing and other sciences to their professional practice.

Whether or not one agrees with the claims of those who support problem-based learning, it would be hard to deny that it is radically different from the traditional, didactic teaching method. The historical background of problem-based learning will now be explored.

2.2 Historical Background

Problem-based learning as an approach to learning is not an entirely new phenomenon. Its foundations can be traced back to the work of Dewey (1933) and Piaget (1952). Historically, problem-based learning curriculum originated from medical education (Pallie & Carr, 1987; Tamblyn, 1980). The traditional medical curriculum is often subject-based in which basic sciences predominate initially, followed by clinical studies. Delivery of this type of curriculum is for the most part through the traditional lecture format. Questions were raised about the effectiveness of the traditional approach in medical education as early as the 1960s. For example, Miller (1962) found that regardless of their seniority and examination achievement,
none of the medical students in his study could pass the first year examination which they had previously passed. West (1966) contended that medical students were often over-taught, and suggested that the less the teacher taught, the more the students would learn. It is West's contention that while most teachers recognize the need to develop students' critical thinking and self-learning capacity, they are just too busy teaching instead of nurturing such capacity.

Criticisms of the medical education continued into the 1970s. A summary of the shortcomings highlighted is as follows:

- The little information that can be remembered may not be recalled when it is needed in the context of clinical care (Gonnella, 1970).
- Subject-based learning does not encourage self-directed learning (Bligh, 1972).
- A significant decline in student attention occurs after about fifteen to twenty minutes of the lecture (Bligh, 1972).
- Relatively little information that students memorize for tests can be recalled later (Levine & Forman, 1973).
- A significant amount of information given in a lecture is neither perceived nor absorbed (Ramsden, 1979).

Indeed Barrows (1986) captures the paradox of traditional medical education in a succinct way. In his view, medical schools aspire to produce problem-solving, independent, critical thinking practitioners, yet they prepare future medical practitioners by making students memorize large amount of information in irrelevant
context using low order cognitive skills. The students are, for the most part, spoon-fed, passive learners dependent on the teacher to provide them with the information, and seldom learn to acquire effective or efficient self-directed learning skills.

Such perceived weakness of conventional medical education has led to the exploration of alternative methods. For example, in pioneering a new medical school programme in 1969, the McMaster University introduced the problem-based approach based on the belief that lecture was not the most satisfactory means of providing a contemporary learning environment. As an alternative, an educational programme was developed in which students were presented with a problem or situation as a starting point for the identification of learning needs (McMaster University, 1996).

In its original form, problem-based learning defines both the approach and the method of learning. Problem-based learning reshaped medical education at the McMaster University by focusing learning on solving clinical patient problems (Bussigel, Barzansky & Grenholm, 1988). Although the take-up of problem-based learning was initially slow, the number of medical schools adopting a problem-based curriculum has increased. Initially, fewer than a dozen medical schools incorporated problem-based learning in their curricula (Kantrowitz et al., 1987). At the last count, over sixty schools worldwide have changed over to the problem-based curriculum (McMaster University, 1996). The trend of expansion is still continuing. Outside medical education, problem-based learning has been adopted as a means of professional education by a wide range of professions, including nursing (Boud &
In nursing, problem-based learning was introduced to the nursing curriculum at McMaster University over twenty years ago (McMaster University, 1996). Since then, variations of the problem-based curricula have been adopted for nursing education throughout the world, for example, in Australia (Alavi & Margetson, 1997), the United Kingdom (Murray, 1997), South Africa (Mzalisi, 1997), Thailand (Luecha, Senadisai & Apanantikul, 1997), and Hong Kong (Lai, Tiwari & Tse, 1997). Locally in Hong Kong, the use of problem-based learning in nursing education is a relatively recent development and has been confined to nursing programmes at the tertiary level. In 1997, the Problem-based Learning Project was set up with financial support from the University Grants Committee. This has provided funding for a number of problem-based learning initiatives in nursing education. Hopefully, this would provide the impetus for developing problem-based nursing curricula in Hong Kong.

The effort to implement problem-based learning is particularly notable in Australia where a network known as the Australian Problem Based Learning Network (PROBLARC) was founded in 1991. Through its bi-annual conferences, PROBLARC has provided opportunities for the sharing of experiences and challenges of implementing problem-based learning. Also, in Australia, the term ‘situation-based learning’ is used by some instead of ‘problem-based learning’. It is claimed that problem-based learning has negative connotations as it implies there is a problem which needs to be solved (Russell, Creedy & Davis, 1995). Curriculum
materials should, according to Tegel and Dockett (1995), include not only problems to be solved but also situations that need to be explained or managed. Reflecting this philosophy, the term ‘situation-based learning’ is advocated. It is thought that situation-based learning “provides a more positive connotation of applying learning to a specific situation which is explored in its own context and environment” (Russell, Creedy & Davis, 1995, p.61). An analysis of the identified situation, rather than a solution, is the final outcome of learning. This is considered to be more appropriate for academic learning as in the exploration of these situations, students are involved in identifying their own personal abilities for life-long learning while developing their critical thinking and reflection skills.

Whether it is the original problem-based model or one of the variations, certain theoretical perspectives are thought to underpin this learning strategy. This will be elaborated as follows.

2.3 Theoretical Perspectives underpinning Problem-based Learning

A constructivist approach to learning has been advocated as a key theoretical perspective underpinning problem-based learning (Russell, Creedy & Davis, 1995; Stockhausen & Creedy, 1995; Creedy, Horsfall & Hand, 1992). Constructivism emphasizes constant change and novelty. As such, events are in a state of flux, and the conditions of one event alter the context of a future event. One of the central tenets of constructivism is that individuals try to give meaning to the perplexing variety of events and ideas in their learning experiences. In the views of Blais (1988)
and von Glaserfeld (1989), constructivism views knowledge as something that the student must construct for and by himself/herself. In this way, individuals construct their own unique view of the world in order to understand, predict and control their environment. In this mode of learning, students engage thoughtfully with information while they make connection between the new information and their prior knowledge. The role of the teacher is to provide experiences that will assist students to make useful construction of knowledge (Cobb, 1994; Driver, Hilary & Leach, 1994). This view of learning is radically different from that of the traditional teacher-centred method.

Traditionally, teaching has been thought of as the transmission of knowledge. The role of the teacher is to tell, to be in control of the pace and content of the lessons, and to be the transmitter of truth and knowledge. In this mode of pedagogy, the role that many students assume is that of passive recipients of knowledge, being non-reflective and dependent upon the teacher. Rote learning is the norm. The aim is to pass examinations. Seldom, if ever, do students attempt to use their knowledge to solve problems in the learning situation.

On the contrary, the constructivist view of the learner is that individuals are not shaped by circumstances beyond their control and they are capable of undertaking enquiry and exploration (Kelly, 1970). In doing so, they adapt or create for themselves representative models of reality which guide their actions. Similarly, as suggested by Russell, Creedy & Davis (1995), constructivism does not see knowledge as something that reflects exactly the external reality, but consists of a number of
workable hypotheses. These hypotheses are constantly being put to the test as they interact with other people's constructions of the same situation. In constructivism, the individual's personal world view is given recognition. Further, as knowledge is viewed as tentative and socially constructed, it cannot be taught but is learned or constructed by the individual. Given the unfolding nature of experiential learning as envisioned in constructivism, learning strategy should allow for changing circumstances.

In problem-based learning, students actively engage with problem situations and build on their own understanding of the scenarios under the guidance of the facilitator. Working with problems helps to create the meaningful context in which new knowledge is acquired, and a personal construction of the problem and the content to be learned is allowed for in problem-based learning (Russell, Creedy & Davis, 1995). From the above description, it is evident that a student-centred approach is central to the concept of problem-based learning, with recognition given to the personal construction of knowledge. In this sense, problem-based learning is in keeping with the constructivist philosophy of learning.

Other than constructivism, alternative theories have also been suggested as the theoretical underpinning of problem-based learning. For instance, Coles (1990) and Barrows (1986) advocate the Information-Processing Theory. These authors hold the view that student learning is affected by past experience. Therefore, the instruction method must activate the student's prior knowledge, and problem-based learning provides the mechanism whereby this can be achieved. Such a view is echoed by
Ramsden (1991) who believes that if the problem presented in the classroom is realistic, the knowledge acquired will transfer more easily when students have to deal with similar problems later.

The Contextual Learning Theory has also been suggested as relevant for problem-based learning (Kingsley, 1996; Coles, 1990). According to this theory, problem-based learning has three phases, namely, providing the context, receiving the information, and relating the materials. Early in problem-based learning, the students encounter the problem, which provides the context. This situation prepares the students cognitively to receive massive amount of information. With the cognitive structure established, information about the context becomes meaningful and can be processed by the students. The attempt to solve the problem serves to relate new information to prior knowledge and helps to reinforce learning and facilitate recall.

The relevance of the Motivational Theory for problem-based learning has been highlighted by Good and Brophy (1991). These authors believe that the effort people expend on an activity depends on their estimation of the chance of success and how much they value the rewards that successful performance brings. In problem-based learning, students are encouraged to explore the various alternatives and to treat mistakes and failures as learning opportunities. They are thus motivated to persevere. Also, as students participate in problem-solving and self-directed activities, they are engaging in group work, which has a motivational effect on learning. Wiggins (1989) suggests that if during the process of problem-based learning, practitioners or outside experts are also used as resources, the motivation to learn dramatically
increases. Cornick (1995) comments that if real life problems are used for problem-based learning, this would further enhance motivation and increase the perceived value of the learning task.

Irrespective of the theoretical underpinnings, problem-based learning with its own unique conception of knowledge and method of delivery is often seen as profoundly different from the traditional concept of teaching and learning. The latter concentrates on the transmission of knowledge while problem-based learning seeks to stimulate students to hypothesize, make judgment, and use knowledge to solve problems. As pointed out by Barrows (1986), in problem-based learning, learning results from the process of working towards the understanding or the solution of a problem. Analyzing the true educational nature of using problems as a way of learning, Margetson (1993) suggests that problem-based learning stimulates a questioning attitude and a search for understanding.

Problem-based learning involves a shift in pedagogical emphasis, from discipline-based to problem-based, from disease-centered to patient-centered, and from competitive learning to cooperative learning. It requires teaching staff to radically change their conception of learning and to regard students more as colleagues, with whom they cooperate in an educational enterprise (Margetson, 1993). As Barrows (1986) points out, problem-based learning calls for an unconventional approach to learning. In this mode of learning, the recall of fact is not as important as the understanding of ideas and principles while the mastery of self-directed learning is paramount. Also, students learn to recognize what they need to know, and to use
learning resources effectively.

As Neame (1991), Biggs (1989), Gibbs (1989), Jackson (1989) and Knowles (1982) all point out, problem-based learning, if followed as intended, encompass all the elements for optimal learning. Research by Ramsden (1991, 1979) has indicated that students adopt 'deep' self-motivated learning strategies or 'surface' rote-learning modes in response to the purpose of the learning task, and that problem-based learning seems to foster the preferred 'deep' approach. If the aim of higher education is to encourage students to think for themselves and learn to learn, then problem-based learning seems appropriate because of its focus on self-directed learning, peer teaching, and critical reflection. As problem-based learning is radically different from the traditional method, its process will now be examined.

2.4 The Process of Problem-based Learning

Problem-based learning is designed with highly practical, real world problems in mind. As summed up by McDermont and Anderson (1991), Schmidt (1984) and Cooper (1983), the essence of problem-based learning is that students are confronted with professional tasks before they have studied the knowledge needed to deal with them. The philosophy of problem-based learning is described by theorists and educationalists at the McMaster University as one that "stems from the premise that acquisition of new knowledge requires activation of prior knowledge, and that knowledge is remembered best in the context in which it is learned" (McMaster University, 1996, p.3).
While working on the problems in problem-based learning, the students are encouraged to use a systematic working procedure to analyze the problem (Schmidt, 1983). To begin with, they discuss the case or problem as a group, clarify the terms and concepts not readily understood by making use of the knowledge of group members. The group then proceeds to generate hypotheses in relation to the problem. The learning issues are defined, which serve as a guide to study the literature or search for other information. Finally, learning resources are considered, and the teacher and students decide on where they can find the relevant information. At the next session, students report their findings to the group. Attempts are made to integrate the new information and relate it to previous knowledge. If the learning process raises new questions or leaves some issues unanswered, these will be listed and the cycle is repeated until a satisfactory clarification of the problem situation can be made.

The process as described above can be summarized by the six stages of problem-based learning suggested by Barrows and Tamblyn (1980):

(1) The problem is encountered first in the learning sequence, before any preparation or study has occurred.

(2) The problem situation is presented to the student in the same way it would present itself in reality.

(3) Students work with the problem in a manner which permits their ability to reason and apply knowledge to be challenged and evaluated, appropriate to the current level of learning.
(4) Needed areas of learning are identified as the problem is explored and used as a guide to individualized study.

(5) The skills and knowledge acquired by this study are applied back to the problem, to evaluate the effectiveness of learning and to reinforce learning.

(6) The learning that has occurred in working with the problem and in self-directed study is summarized and integrated into the student's existing knowledge and skills.

A number of educational advantages are said to be associated with problem-based learning, including the enhancement of clinical reasoning and promotion of self-directed learning skill. The effectiveness of this learning strategy will now be examined.

2.5 Effectiveness of Problem-based Learning

Several studies have explored the effectiveness of problem-based learning in enhancing knowledge retention. For example, Schmidt et al. (1989) asked subjects to discuss a problem and elaborate on the possible explanations. These subjects were subsequently asked to study a text relevant to the problem. When they were asked to recall what they had studied, their recall was much better than the control group who was not exposed to the discussion of the problem beforehand. In another study, Tans, Schmidt and Shade-Hoogeveen (1986) compared the performance of physiotherapy students randomly assigned to either a problem-based or lecture-based course in muscle physiology. Problem-based students recalled up to five times more concepts than the lecture group. The findings of these studies are consistent with the claim
that problem-based learning helps students to retain knowledge much longer than the conventional method (Rand & Baglioni, 1997; Creedy & Hand, 1995; Eisenstaedt, Barry & Glanz, 1990).

Problem-based learning is thought to enhance the integration of basic science knowledge into the solution of clinical problems (Barrows, 1985). Patel, Groen and Norman (1991) asked students from conventional and problem-based curricula to solve a clinical problem by integrating relevant science knowledge into their explanation of the problem. Students from the problem-based curriculum were able to integrate basic science and clinical knowledge. Such ability was not observed in those from the conventional curriculum. In another study conducted by Boshuizen, Schmidt and Wassamer (1990), the performance of pre-clinical students from two medical schools was compared, one with problem-based curriculum and the other with conventional curriculum. The students were asked to explain how a specific metabolic deficiency and a specific disease could be related. Those from the problem-based curriculum took an analytical approach by exploring the biochemical aspects, and linked them to the clinical aspects of the problem. Students from the conventional curriculum, on the other hand, searched their memories in order to find a direct answer to the question. The above findings support the suggestion that problem-based students are better able to integrate basic science into the solution of clinical problems.

Studies have shown that students in a problem-based curriculum acquire more self-directed learning skills than those in a conventional programme, and this difference is
sustained beyond the duration of the course. For example, Blumberg, Michael and Zeitz (1990) found that problem-based students reported greater frequencies of use of text books, journals, and informal discussions with faculty or peers but significantly less use of lecture notes and course syllabi. Using an audit of the library circulation data, the same researchers found that problem-based students borrowed more reading materials from the library than the conventional students. These findings support the claim that problem-based students are better able to learn on their own (Norman & Schmidt, 1992; Barrows, 1986; Barrows & Tamblyn 1980).

With regard to the affective outcomes, problem-based learning is thought to enhance students' intrinsic interest in the subject matter (Hessami, 1995; Barrows, 1986). Barrows and Tamblyn (1980) suggest that the student-centered approach, as advocated by problem-based learning, increases motivation. This is because students are given the chance to generate learning issues and have ownership of their own learning. In the studies conducted by DeVolder et al. (1986) and Schmidt (1983), problem-based students displayed more interest in studying literature relevant to the problems, and were more willing to attend lectures than non problem-based students. Smith (1995) also found that problem-based students were positive about the learning context and felt that problem-based learning had assisted them to learn.

It is noted that outcomes favor problem-based learning in several ways. Townsend (1990), and Lernau (1989) noted that students in their studies rated problem-based learning strongly for interest, relevance, high morale, and enthusiasm. Moore, Block and Mitchell (1990) found that PBL students were more likely to describe their pre-
clinical years in medical school as engaging, difficult but useful, while those in the conventional programme described theirs as irrelevant, passive and boring. There was also a clear trend towards higher ratings for problem-based graduates by their clinical supervisors as noted in the studies by Moore, Block & Mitchell (1990) and Santos-Gomez et al. (1990). Other researchers have found that problem-based learning promoted the desired deep learning approach in students (Johnston & James, 1995; McLeod & Whittemore, 1989; Chessel, 1986; Coles, 1985).

There is evidence that problem-based learning enhances students' command of the subject matters as they progress through the course. This compares favourably with lecture-based learning which fosters limited growth in the students (Murray-Harvey, 1993; Imbos, Drunkker & Van Mameron, 1984). Reporting on their study, Martenson, Erikson and Ingelman (1985) noted that problem-based students attained significantly higher scores in knowledge tests, and the retention of knowledge was sustained even after graduation.

The knowledge domain, however, is where concerns about problem-based learning are frequently expressed although research findings are not conclusive. For example, in a recent evaluation of all medical programmes in Holland, Majoor (1992) concludes that there is no significant difference between students on conventional and problem-based courses in the knowledge domain. On the other hand, in a meta-analysis conducted by Albanese and Mitchell (1993), there is evidence that problem-based students perform less well than conventional students in basic science tests. Having made this revelation, however, the authors then warn that the validity of the
findings may be low because problem-based students would have no experience of the traditional test methods which are the format used in the basic science tests reported. Margetson (1994) finds that although the acquisition of knowledge seems to be similar for both conventional and problem-based learners, a lack of confidence is reported by the latter. This is consistent with the general concern that problem-based students may not have a sufficient body of knowledge of sciences and pathology because they have not been taught in a teacher-directed way. Margetson suggests that this concern may have stemmed from the narrow conception of expertise which over-emphasizes the need for content. He argues that problem-based learning, rather than suffering from knowledge deficit, can in fact help students to use their knowledge more effectively because conceptualization instead of memorization is emphasized. In his view, effective use of knowledge by problem-based students is evidenced by their ability to make sound judgment, prioritize the most important problems, and know how to go about solving them.

Conflicting views have also been expressed about the role played by problem-based learning in enhancing students' problem-solving ability. While some have cast doubt on the enhancing effect of problem-based learning on students' problem-solving ability (Margetson, 1994; Norman & Schmidt, 1992; Norman, 1988), others have shown that such ability could be improved through problem-based learning. For example, in the study by Lai, Tiwari & Tse (1997), students who initially had a weaker ability in problem analysis and who adopted a more primitive problem-solving approach before their exposure to problem-based learning shifted to a more advanced approach to problem-solving after problem-based learning. In another
study, students who were involved in computer supported collaborative problem based learning (CSC-PBL) reported enhanced problem-solving ability attributed to the problem-based learning environment (Oliver & Naidu, 1997). Hmelo, Gotterer and Bransford (1997) compared the problem-solving ability of problem-based and non problem-based students. The researchers found significant differences in the reasoning strategies and coherence of explanations between the groups. Problem-based students were more likely to use hypothesis-driven reasoning in solving problems - a strategy that should lead to more flexible problem-solving and one that is used by experts when confronted with a complex or atypical problem. Greater coherence was also detected in the problem-based students' explanations in reasoning, thus suggesting that these students were more able to filter relevant from irrelevant information.

Clarke (1985) and Norman (1988) have reported that some students show anxiety in the initial stage of problem-based learning. The ambiguities of having to define their own learning needs, and the open, self-reliant nature of learning associated with problem-based learning are thought to contribute to this anxiety state. This effect, however, appears to fade in later years, with mature students finding the process easier. Moore, Block and Mitchell (1990) also reported higher stress level among problem-based students in their pre-clinical experiences at Harvard compared with their peers in the conventional curriculum. It should be noted that the stress reported by some problem-based students is not universal for all problem-based students. For instance, Moore-West and O'Donnell's (1985) study has shown that problem-based students are substantially less stressed than the conventional students.
As Schmidt (1984) and Engel, Clarke and Feletti (1982) comment, tutors who have experienced the problem-based learning approach usually become enthusiastic, and they value the opportunities to interact with students in the group tutorials. Schmidt (1984) reports that problem-based courses generate excitement among the staff who describe the process of problem-based learning as 'electric'. Walton and Matthew (1989) find that mutual planning between subject specialists in problem-based courses is generally highly valued, although some staff may become discontented because they feel they have lost their expert status. Having examined a number of studies into faculty members’ satisfaction, Albanese and Mitchell (1993) conclude that faculty members find problem-based learning a satisfactory way to teach, and there is no evidence that they dislike this learning strategy.

Problem-focused programmes are not necessarily more expensive to run despite the high demand on learning and human resources. From the findings of the various studies into the cost of running problem-based learning, Albanese and Mitchell (1993) conclude that the cost of these programmes is no greater than the subject-centered courses for student numbers of forty, and perhaps up to one hundred. For larger cohorts, however, the number of tutors required can drive up the cost.

Some may perceive that problem-based learning could cause reduced efficiency of time utilization. For example, Shahabudin (1987) suggests that more time is needed to cover the content in problem-based learning than the lecture method. However, other have shown that while problem-based learning may cover less content per unit time, students do retain a greater proportion of what they learn compared with
To summarize, despite the various studies into the effectiveness of problem-based learning, there is no conclusive evidence that problem-based learning is superior to the conventional method of instruction. Indeed, following a meta-analysis review of international literature from 1972 to 1992, Albanese and Mitchell (1993) recommend that caution be exercised in making comprehensive, curriculum-wide conversions to problem-based learning until more is known about this method. On the other hand, in a review of problem-based learning literature in the medical field, Norman and Schmidt (1992) suggest that there is ample evidence to show that students are well-motivated in a problem-based learning curriculum, with the development of effective self-directed learning skills.

In light of the inconclusive evidence about problem-based learning, any claims about the benefits of this method should not be accepted uncritically. This was certainly the stance taken by this researcher even as the initial ideas of this study were being formulated.

2.6 Implications for this Study

Writings on problem-based learning have made claims about its enhancing effect on students’ thinking ability. For example, Barrows and Tamblyn (1980) suggest that students’ clinical reasoning skills would improve through working with problems in problem-based learning. Although these authors have not explicitly referred to such
clinical reasoning skills as thinking ability, it would be hard to argue that the skill components involved in clinical reasoning (application, analysis, evaluation and synthesis) do not require higher-order thinking. More explicitly, Ryan and Quinn (1995) argue that not only can problem-based learning assist students to develop thinking skills, it also has the potential to help them develop a conscious awareness of their thinking processes and become metacognitive participants in the learning experience.

As identified by Ryan and Quinn (1995), the thinking skills involved in problem-based learning include the ability to:-

- analyze and synthesize data,
- develop hypotheses,
- apply deductive reasoning to a problem situation,
- draw conclusions after analysis, synthesis and evaluation of new information,
- synthesize strategies/solutions, and,
- monitor and evaluate own thinking process.

All of the above require the individual to think, not only to do so in a highly organized way, but to think in a critical manner. Thus, it can be argued that the ability to think critically is inherent in problem-based learning. Yet, a review of the literature has failed to pinpoint the effect of problem-based learning on students’ critical thinking, even though the impact of problem-based learning on students’ thought processes has been examined in the meta-analysis conducted by Albanese
and Mitchell (1993). Some references, however, have been made to the relationship between problem-based learning and critical thinking. For instance, in a study of the effectiveness of problem-based learning for the subject ‘Primary Health Care’ (Gold, 1995), the question as to whether problem-based learning made the students critical thinkers was posed by the researcher, but no answer was offered. In another study, Tegel and Dockett (1995) explain the close relationship between critical thinking and situation-based learning. Using a step-by-step approach detailing the process of situation-based learning, Tegel and Dockett show how critical thinking is linked with the different stages of the learning process. Although situation-based learning, rather than problem-based learning, is the focus of the discussion, a breakdown of the learning process shows that there appears to be much similarity between problem-based learning and situation-based learning, as both involve:

- data collection,
- identification of issues,
- formulation of hypotheses,
- areas of learning/research identified,
- test hypotheses,
- draw conclusions,
- formulate goals and strategies to manage situations, and,
- reflection on group processes and individual learning.

Despite such similarity, Tegel and Dockett’s (1995) paper makes no reference to problem-based learning. Therefore, while there may be a theoretical basis to believe that critical thinking is inherent in situation-based learning, any suggestion that there
is a positive correlation between critical thinking and problem-based learning is conjectural. Also, Tegel and Dockett use Bloom’s Taxonomy to define critical thinking. While the Taxonomy may be useful in operationalizing the concept, it does not take into account the dialectical nature of reasoning, which is an important aspect of critical thinking. Thus, even though Tegel and Dockett’s study may have provided a useful insight into the relationship between critical thinking and the learning process, more information is needed to evaluate the effectiveness of problem-based learning in promoting students’ critical thinking.

As problem-based learning requires students to hypothesize, analyze, apply, evaluate and synthesize, such undertakings should encourage them to use higher-order cognitive skills to deepen their learning rather than to reproduce information. There is now a considerable body of research to suggest that task requirements affect the process of learning students undertake. Indeed, Biggs (1993, 1987) and Marton, Hounsell and Entwistle (1984) comment that more work is required to examine the inter-relationship between the nature of teaching context, students' predisposition to learn in a particular way, their strategies for learning, and the nature of the learning outcome. Hence, in addition to critical thinking, this study will also investigate the effect of problem-based learning on students’ approaches to learning. The last of the major themes to be addressed in this literature review, approaches to learning, will be discussed in the next section.
3. **Approaches to Learning**

Teachers in higher education expect their students to develop intellectual abilities that go beyond the possession of technical skills and subject knowledge. Such abilities involve combining and relating relevant information so that the knowledge acquired can be used effectively. In this respect, students are expected to analyze what is unfamiliar to them, to critique proposed solutions to problems, to recognize the persuasiveness of concepts, and to apply ideas learned in the classroom to the world outside. In essence, students are expected to show an understanding of what they have learned and education is seen as a means of nurturing that understanding.

While educators have the intention to teach for understanding, their interpretation of understanding may differ from that of their students. Also, students may possess a large quantity of information and yet fail to reach a level of understanding. As understanding appears to be central to both teaching and learning, its meaning will be explored here.

### 3.1 What it is to Understand

A fundamental question confronting educators is what is meant by understanding. For some, understanding implies having the ability to construct a hierarchy of responses as espoused by Bloom et al. (1956), namely, knowledge, comprehension, application, analysis, synthesis, and evaluation. For others, understanding is having an insight into how the parts inter-relate to make a coherent whole, and generalizing...
this to a higher level of abstraction (Biggs, 1996). In this sense, understanding is more than the possession of a complex web of declarative knowledge, it involves the ability to apply the knowledge to practice. Understanding, according to Biggs, is empowering as it enables one to act more purposefully and effectively in important situations, particularly novel and challenging ones.

Biggs (1996), Perkins and Blythe (1993) note that although most teachers may claim that they teach for understanding, students do not always show the kind of understanding that the teachers intend. These authors believe that different levels of understanding can be elicited from students. However, only some of the higher levels really meet the teachers' expectation, which is the ability to restructure knowledge so as to apply it in novel situations. This has implication for those whose intention is to assist students to learn.

A question thus arises, what may account for the different interpretations of understanding? Biggs and Watkins (1993) believe that the variations may have stemmed from the different conceptions of learning and teaching.

Biggs and Watkins (1993) suggest that if learning is conceptualized quantitatively, it is a matter of how much is learned. The curriculum is seen as a collection of essential facts and skills, which is to be taught, assimilated, and tested on cue. In the same vein, teaching is considered as the transmission of knowledge. A good teacher is one who knows his/her subjects well and is able to communicate that knowledge fluently.
Quantitatively speaking, understanding is an increase in the units of knowledge, and is about memorizing. This involves the acquisition and application of facts and procedures (Beaty, Dall’Alba & Marton, 1994). Knowledge is seen as something ready made, out there, to be picked up and stored (Biggs & Watkins, 1993). If learning is inadequate, it is the student’s fault, attributing to a lack of ability, preparation, or motivation. Thus, understanding in quantitative sense is coming to know what already exists (Duffy, 1992; Brown, Collins & Duguid, 1989) and can be assessed quantitatively (as correct/incorrect) using the measurement model of assessment (Biggs, 1998; Taylor, 1994). However, despite its claim, Nuthall & Alton-Lee (1995) believe that quantitative scoring gives a simplistic and misleading picture of what has been learned and understood. Biggs (1996) also argues that in treating student learning as discrete units of declarative knowledge, assessment of understanding becomes a matter of finding out how many of these units have been attained, rather than taking into account how these units may integrate into a coherent whole.

To some, the quantitative view of learning violates the nature of knowledge and distorts the quality of teaching and learning. For example, Biggs (1996) asserts that the nature of knowledge is violated because instead of conceiving learning as a multidimensional process, the quantitative view treats it as a unidimensional process that can be charted in quantitatively defined incremental units. As for the quality of teaching and learning, Biggs and Tang (1998) suggest that learning is decontextualized in the quantitative model. This distorts the quality of learning which should be context-bound. Similarly, teaching is distorted because the focus is
on trivial performances (such as recalling facts correctly and getting simple tasks correct) rather than teaching complex ideas and checking the acceptability of students’ interpretations and applications.

An alternative way of conceptualizing learning and teaching is to take a qualitative view. It is obvious that there is a paradigm shift when learning and teaching are viewed qualitatively rather than quantitatively. Learning, in the qualitative view, is a constructive process. It is cumulative, changing its structure as it evolves. It usually starts quantitatively, but becomes more structured as understanding develops. The qualitative view of learning accepts that what is learned is determined internally by the learner and may not be what the teacher intends to be learned (Biggs, 1996; Biggs & Watkins, 1993). The belief that students actively construct knowledge for themselves, rather than absorb it from outside (like a sponge absorbs water) has implications for teaching. In adopting a constructivist approach, the teacher must allow students to develop self-direction, and not to force ‘correct’ constructions on them. In Shuell’s words, “... what the student does is actually more important in determining what is learned than what the teacher does" (1986, p.429).

At this point, it should be pointed out that the qualitative view of learning mirrors the constructivist approach to learning as discussed earlier under ‘Problem-based Learning’. This is because constructivism is also the theory underpinning the qualitative view of learning, hence the similarity.

Understanding, in the qualitative sense, is evidenced by the students actively
constructing their knowledge and using this to interpret the world. Understanding of a topic evolves cumulatively over time. It has horizontal interconnections with other topics and subjects as well as vertical interconnections with previous and subsequent learning in the same topic. It increasingly broadens and deepens, offering powerful perspectives to its owner to view and control reality, and is a valuable asset to have in this complex world. This kind of understanding is preferred to the quantitative way of understanding as argued by Biggs (1996).

In this qualitative tradition, assessment of students' understanding is therefore not whether they possess right or wrong answers, but whether the levels of understanding are reasonable at the stage of learning in question. Reflecting this, the teacher's task is not to teach correct understandings directly, but to help students construct understandings that are progressively more mature and congruent with accepted thinking. Thus, understanding is assessed by describing how well the student's performance matches the learning objectives. 'How well' is defined in terms of depth of understanding, seeing relations in novel experiences, successfully applying knowledge to professional problems of increasing complexity, and generalizing to new domains (Biggs, 1998; Biggs & Watkins, 1993).

It is evident from the above discussion that different interpretations of understanding exist as a result of the different conceptualizations of learning and teaching, which in turn affects the process and outcome of student learning. It should be pointed out, however, that students are not passive recipients in the learning process. Instead, they interpret the learning task according to their preconceptions, motivations, and
expectations, and then derive their own approaches to learning. Students’ approaches to learning will now be discussed.

3.2 Students’ Approaches to Learning

There are two interpretations of approaches to learning. One refers to how the learning task is processed. This is associated with the study by Marton and Saljo (1976) when the terms ‘surface’ and ‘deep’ approaches to learning were first identified. In Marton and Saljo’s study, the learning task for the students was to read academic articles. Some of them tried to understand the intended meaning of the articles (deep approach), while others focused on recalling key terms and memorizing details as accurately as possible in anticipation of subsequent questioning (surface approach). Another interpretation of approaches to learning refers to predispositions to adopt particular processes or strategies when confronted with a learning task. This interpretation is advocated by Biggs (1987) and Entwistle and Ramsden (1983), who, in addition to the deep and surface approaches, also identify a third factor known as the achieving approach.

Marton and Saljo (1976), Entwistle and Ramsden (1983), and Biggs (1992, 1987) have all made major contributions to the theory and development of approaches to learning. Each of these three schools of thought will be briefly examined below.

Marton and Saljo’s work on approaches to learning is classified as the phenomenographic school, that is, they adopt a qualitative research approach and
their measurement of approaches to learning is by means of in-depth interview. In their view, there is no instrument as such for measuring approaches to learning. In their studies into students' approaches to learning, two types of learning outcomes are revealed: conclusion-oriented and description-oriented (Marton & Saljo, 1976). In the conclusion-oriented outcome, main arguments are summarized and supporting evidences are sought. This outcome results when the student's intent is to understand the learning task, and when a deep-level approach is employed. This deep-level approach involves an evaluation of the relationship between the argument and the evidence, and attempts are made to relate the learning task to the student's past experience. The description-oriented outcome, on the other hand, is the listing of the main points covered in the learning task. This outcome is the result of an intent to memorize and the adoption of a surface-level approach. A surface-level approach focuses attention on specific facts and pieces of disconnected information which are then rote-learned.

As early contributors to approaches of learning, Marton and Saljo's work have had a profound effect on the thinking of those who subsequently study learning approaches in students. The problem of phenomenography as a means of measurement is that it is time-consuming, and expertise in the subject is required for those involved in data collection and analysis.

Unlike the phenomenographic school, Entwistle and Ramsden (1983) and Biggs (1992) advocate the use of inventories in measuring approaches of learning. However, despite this departure, the designs of their inventories are still heavily
influenced by phenomenography (Biggs & Watkins, 1993).

Entwistle and Ramsden (1983) develop the Approaches to Studying Inventory as a means of analyzing students' orientation to the learning situation. Three orientations are identified: meaning (search for personal understanding), reproducing (memorization), and achieving (doing whatever is necessary to earn high grades). According to the authors, each of these orientations involves a different source of motivation. The student seeking meaning is intrinsically motivated and is somewhat autonomous and independent of course syllabi. The student with a reproducing orientation is extrinsically motivated by fear of failure, dependent on course syllabi, and prone to memorize information verbatim. The achieving student is extrinsically motivated by hope for success and is said to be stable, self-confident, and ruthless. According to Entwistle and Ramsden, each of the orientations predisposes the student to adopt a certain approach to studying. Thus, the student seeking meaning tends to adopt a deep-level approach. The one with a reproducing orientation is inclined to adopt a surface-level approach, while the one with an achieving orientation is more likely to use any approach that earns high grades. An individual with an achieving orientation is very sensitive to the contingencies present in the situation. If the teacher wants understanding, the achieving student will use a deep-level approach, but if the teacher rewards reproduction, s/he will use a surface-level approach.

At the time when Entwistle and Ramsden (1983) were developing their Approaches to Studying Inventory, similar development was being carried out by Biggs (1979) in Australia. Like Entwistle and Ramsden, Biggs' research aimed to develop an
inventory to assess learning approaches. His original inventory, the Study Behavior Questionnaire (Biggs, 1970), was subsequently revised and relabelled as the Study Process Questionnaire (SPQ) (Biggs, 1979). Factor analysis of the SPQ identifies three factors that closely parallel those reported by Entwistle and Ramsden.

The three factors reported by Biggs (1979) contain both cognitive and motivational components. The first factor, utilizing, includes a fact-rote cognitive strategy and an extrinsic, fear-of-failure motivational component. The utilizing individual is a surface-level processor. The second factor, internalizing, contains a meaning-assimilation cognitive component and an intrinsic source of motivation. An internalizing individual is a deep-level processor. The last factor, achieving, has study skill and organization as cognitive components and the need for achievement as a source of motivation. This individual is an achieving-level processor.

The use of inventory to assess students' approaches to learning is an attractive idea as it is fairly easy to administer and interpret the results. While Entwistle and Ramsden's Approaches to Studying Inventory has an universal application, Biggs has produced a Hong Kong version of the Study Process Questionnaire (SPQ) (Biggs, 1992). This version of the SPQ takes into account the large variety of course programmes conducted at various levels in the different academic departments in Hong Kong. By grouping the programmes into clusters, individual norms for specific programmes are then worked out. A meaningful interpretation of the test results is possible by comparing the scores with the norms. The SPQ: Hong Kong version is thus sensitive to the nature of the local academic environment. This
instrument has been extensively tested in Hong Kong and shown to be compatible with the local culture and educational system.

Before we examine the surface, deep, and achieving approaches in more detail, it is necessary to note the concerns that have been expressed about the notion of approaches to learning.

One of the concerns is about the considerable confusion among teachers and researchers in terms of what comprises approaches to learning (Pask, 1986; Kolb, 1981). In particular, as Claxton and Murrell (1987) point out, cognitive approach is often mistakenly equate with approach to learning. While the former refers to the internal mediatory processes by which one interprets new experiences and sensory stimuli, the latter is one's predisposition to adopt a certain strategy when faced with a learning task. In the case of this study, as the approaches to learning is clearly defined and operationalized, confusion of terms should not be a problem.

Another concern is about the stability of a particular approach to learning. Some researchers such as Weimer (1990) and Kolb (1983) argue that students' learning approaches tend to change over time. They question whether the belief of a consistent approach to learning has much empirical validity. As far as this study is concerned, it is not about proving whether students' approaches to learning are static or not. Thus, the argument of stability or change over time should not affect this study.
A third concern is that in concentrating on approaches to learning, one may overlook the other factors which also determine how a student is going to learn, for example, the nature of learning task, the student's readiness to learn, and the dominant values and traditions of the culture of which the student is a member. Some have even suggested that instead of affirming the habitual, comfortable ways that students go about their learning, the teacher should examine the key factors influencing student learning and may even introduce them to alternative mode of learning if warranted (Brookfield, 1990). As the aim of this study is to assess if students alter their approaches as a result of certain educational intervention, and not about finding teaching methods to suit students' learning approaches, this concern is not significant here.

Having considered the concerns, the surface, deep, and achieving approaches to learning will now be discussed.

3.2.1 Surface Approach to Learning

With reference to the surface approach to learning, Biggs (1992), Marton and Saljo (1976), and Entwistle and Ramsden (1983) offer the view that the motive for learning is extrinsic. The learning task is carried out because of either positively (such as gaining a paper qualification) or negatively (life will be unpleasant if one does not accomplish the task) reinforcing consequences. Learning is like steering a middle course between working too hard and failing. A typical surface strategy is to rote learn. Surface motivated students focus on what appear to be the most important
topics or elements, and try to reproduce them accurately. As a result of this approach, they do not see the interconnections between elements, or the meanings and implications of what is learned. In essence, these students fail to integrate different aspects of the learning task into a coherent whole. This is not to deny that reproduction has its use in learning. In some instances, accurate reproduction is important, such as the accurate reproduction of formulae whether or not they are understood. However, this form of reproduction is not a surface approach, according to Biggs (1992). Students who adopt a surface approach do so to 'get by' with minimum effort, with the aim of getting the task out of the way. Such a strategy avoids in-depth involvement with the learning task, but one that would meet the minimal requirements. The surface approach reflects a quantitative conception of learning as discussed earlier. The belief is that the reproduction of detail is always appropriate and how well students learn is reflected by how much they reproduce. While students may know that their reproduction of detail is missing the point, they would still do so because they know teachers will give them credit for doing just that. It is thus clear that the choice of a specific approach to learning is a deliberate decision on the part of the student.

A typical surface-biased student (that is, one who shows a surface predominant or a surface exclusive profile as defined by the Study Process Questionnaire) tends to have a poor academic self-concept, and perform poorly except where rote learning is appropriate. In terms of understanding, although this student may be able to reproduce facts and figures, s/he lacks the ability to comprehend complex materials and synthesize abstract ideas.
3.2.2 Deep Approach to Learning

Contrary to the surface approach, Biggs (1992), Marton and Saljo (1976), and Entwistle and Ramsden (1983) view the motive for learning as intrinsic in the deep approach to learning. Motivated by curiosity or felt need, the learning task is seen as relevant or important, and the strategy adopted is to search for understanding. There is a personal commitment to learn. Such a commitment involves a higher cognitive activity than rote learning, which is the hallmark of the surface approach. Adopting a deep approach to learning, students search for analogies, relate to previous knowledge, focus on the underlying meaning rather than on the literal aspects, theorize about what is learned, and derive extensions and exceptions to the norm. They read widely, discuss with teachers and fellow students, and think deeply about what they learn. Such behaviours are marked by in-depth involvement on the part of the students, and there is a sense of ownership in the learning process. Unlike the surface approach that only involves a minimum of effort, the deep approach is total involvement: the students are immersed in the task of learning, and see it as interesting and personally involving. Students who use the deep approach possess a great deal of relevant content knowledge, which can be generalized to higher or abstract level of conceptualization. Learning, in the deep approach, is the construction of meaning. In this sense, the deep approach reflects the qualitative conception of learning, which emphasizes the importance of students' constructing their own knowledge and interpreting the world. It should be noted that in this context, although students are in control of the learning process, teachers play an important role by creating the opportunities where deep learning can take place.
A deep-biased student (that is, one who is labelled as deep predominant or deep exclusive by the Study Process Questionnaire) generally does well academically. They define their own learning goals and pursue them their own way. They follow their own academic interests; and with some guidance in organizing their strategy, they can pursue them at a high level. In terms of understanding, not only can these students integrate aspects of the learning task, they are also able to apply what they learn to novel situations.

3.2.3 Achieving Approach to Learning

According to Biggs (1992), Entwistle and Ramsden (1983), the motive for learning in the achieving approach is the satisfaction derived from tackling the learning task well, for example, obtaining high grades or winning prizes. Unlike the deep approach that focuses on the process of learning, the achieving approach, like the surface approach, is on the product. Biggs, Entwistle and Ramsden suggest that in the achieving approach, the strategy is to maximize the chances of getting high marks. This may or may not involve engagement in the learning task as the nature of the engagement depends on what earns the most marks. If the teacher rewards accurate recall of detail, then this is what the achieving student will give, with minimal engagement. The achieving strategy is about cost-effective use of time and effort. A typical achieving student is self-disciplined, neat and systematic, plans ahead, keeps clear notes, and allocates time to tasks in proportion to their importance. While surface and deep approaches are mutually exclusive, an achieving approach may be linked to either deep or surface approach, depending on the nature of the
learning task. Hence, an achieving student may be motivated to systematically rote learn selected detail to gain high marks, this is known as a surface-achiever. On the other hand, another achieving student may be motivated to search for meaning in order to gain high marks. This is a deep-achiever.

An achieving-biased student (that is, one who displays an achieving profile as defined by the Study Process Questionnaire) is typically ambitious, deliberate, and careful in planning. Unlike the surface student, s/he has a high academic self-concept, and performs well in examinations. As explained earlier, an achieving student may adopt a deep approach. In this case, not only would this student achieve high marks, understanding is evidenced by his/her grasping the deeper meanings of the learning materials. A deep-achiever usually presents few problems. On the other hand, a surface-achiever is one who wants to do well academically, but takes on a surface approach to do so, usually unsuccessfully. This student can be helped to improve through guidance in study skills.

3. 3 Chinese Students’ Approaches to Learning

As the setting of this study is in Hong Kong where the population is predominately Chinese, it is therefore appropriate to explore the Chinese students’ approaches to learning in this literature review.

Despite the apparent academic achievement of Chinese students at home and abroad, there is still a strong belief that they are more prone to rote learn than their Western
peers (Biggs, 1990, 1989). The stereotype of the Chinese rote learner seems to strike accord with the Australian academics interviewed in Samuelowicz’s (1987) study, in which Chinese students were seen to rely heavily on memorization than understanding, and prefer rote learning to application of principles.

While a first impression of the classroom environment in Hong Kong may suggest the preference for a surface approach and the suppression of a deep approach, local studies carried out in the last decade have confirmed only some of the popular views about the Chinese students’ approaches to learning, and indeed have revealed some rather unexpected findings (Lai, Tiwari & Tse, 1997; Tang, 1993; Watkins, Regmi & Astilla, 1991; Kember & Gow, 1991; Biggs, 1989). As expected, the Hong Kong Chinese students are noted to be high on the achieving approach. This probably reflects a long-held view among the Chinese that education is an important means of gaining upward social mobility. On the other hand, the expectations that Chinese students would be high on surface approach have not been confirmed. In fact, the opposite picture has emerged from the afore-mentioned studies: Chinese students in Hong Kong are found to be lower on the surface approach and higher on the deep and achieving approaches compared with their Australian counterparts. Despite the large class size, expository teaching methods, examination-orientation, and authoritarian class climate, Hong Kong students have shown to rely less on rote learning, and are more likely to study for understanding. A number of explanations have been suggested for the unexpected findings. These include the improper translation of the inventory used, inequivalent sampling, erroneous results caused by socially desirable responses, and different interpretations of surface and deep approaches. None of the
suggestions, however, explains the picture fully on close examination.

Another interesting finding of the above studies is that the students have their own preferred approach irrespective of how they actually approach their learning. The students in the studies express that they would like to approach their learning more deeply and meaningfully. To this end, they would prefer a learning atmosphere where teachers and students collaborate to generate a greater variety of interesting and challenging activities. What they say has provided a clue to the relationship between the teaching context and students’ approaches to learning. There is a suggestion that students first interpret the teaching context before deciding what approach they would adopt for their learning (Biggs, 1992). As it is known that surface approach generally leads to undesirable learning outcomes while deep approach to desirable ones, the implication for teaching is clear. Good teaching should minimize those factors that encourage a surface approach and maximize those that promote a deep approach (Biggs, 1996, 1992; Biggs & Watkins, 1993; Entwistle, 1992). How this may be done will now be discussed.

3.4 Matching Teaching with Learning

To discourage students from adopting a surface approach, teachers should first find out why the students select such an approach. Generally, students are more likely to adopt a surface approach when the learning task is too much for the time available or when assessment practices emphasize recall of detail. Stress, as in the form of time pressure and interpersonal friction between teacher and student, also encourages
surface learning. Teaching practices that cause students to be cynical or contemptuous, such as setting trivial tasks or not giving feedback to students, would also promote a surface approach to learning. Having identified the causative factor(s), the next step is to minimize teaching activities that encourage surface learning. This is, however, easier said than done. Students read their messages from what teachers actually do in their teaching and assessing, not from what they say. It is important, therefore, for teachers to realize what messages they are conveying to their students. Studies over the years have shown that a gulf exists between the rhetoric declared by teachers (the need to learn meaningfully) and the assessment tasks that they set (the focus on recall of facts and theories) as described by Biggs and Watkins (1993), Tobin and Fraser (1988), Entwistle and Marton (1984), Ramsden (1979), and Snyder (1971). Thus, as long as academic work is seen as earning points for a grade or preparing for examinations which require recall of factual information, students will adopt a surface approach to learning regardless of what teachers may say.

Biggs and Watkins (1993) suggest that it is possible to create conditions conducive for a deep approach to learning. These include ways of making learning pleasurable, having a correct mix of familiar and unfamiliar items in the learning task, encouraging students to own what they learn, and providing positive reinforcement. In essence, it is about promoting a learning environment that makes students feel that they are competent learners and have control over their own learning. Although such conditions may be difficult to create when dealing with large classes in an examination-oriented environment, it is possible to do so as indicated by several of
the studies conducted locally (Tang, 1993; Lai, 1993; Tang, 1991).

The use of group work, as in the form of cooperative learning (Lai, 1993) or collaborative learning (Tang, 1991), makes it possible for students to determine the nature and pace of their own learning. Further, if teachers are open to trying different ways of involving their students in the teaching context, students are more likely to see learning as interesting and meaningful and adopt a deep approach to the task (Tang, 1993). These local studies complement findings of earlier studies carried out in other parts of the world. Tobin and Fraser (1988) find that Australian students respond favourably to exemplary teaching, which includes using a repertoire of teaching strategies, recognizing students' misconceptions, and taking steps to correct them. As a result, they approach their learning meaningfully with significant improvement in the understanding of the subject. Similarly, in a British study, Ramsden (1988) describes how teachers use the phenomenographic approach to identify and correct students' misconceptions and to select teaching strategies appropriate for students' learning needs. Like the Tobin and Fraser's study, deep approach is induced with desirable learning outcome in Ramsden's students.

Encouraging an achieving approach to learning is possible by teaching learning and study skills directly to students across subject areas. This should help them to organize and manage their time better, and make note more efficiently. It should be pointed out that teaching study skills is a beguiling concept as it promises to improve learning independently of any other changes. The evidence, however, is equivocal. Positive results have been found under certain conditions, particularly with highly
motivated students in contexts that emphasize metacognitive skills of self-management (Biggs, 1988). In other studies, however, when study skills are taught with the aim of improving the students’ lack of such skills but without the emphasis on metacognitive skills, the students actually increase their use of surface strategies, the opposite of the intended result (Ramsden, Beswick & Bowden, 1986). Hence, study skills training can be a double-edged sword. As suggested by Biggs (1987), if the training is simply imported from without, if the students' conception of learning is quantitative, and if their motivation is extrinsic, the effort may be wasted. It is worth noting that an achieving approach to learning is more likely to be promoted when the students are achievement motivated, intrinsically interested in their subject area, and keen to search for meaning.

The discussion so far has shown that certain teaching/learning strategies lead to high level processes (a deep approach to learning), which in turn yield highly desirable learning outcomes (in the form of meaningful understanding). Amongst the teaching/learning strategies, problem-based learning has been suggested as one that would promote a deep approach to learning (Biggs, 1998; Watkins & Biggs, 1996; Ramsden, 1992). For instance, Biggs (1998) suggests that unlike students on the conventional curriculum who study to pass examination at the expense of deeper understanding, problem-based students concentrate on real, professional problems, which they have to work through, understand, and find the best solutions. During the course of handling these problems, problem-based students are deeply involved with the learning task. Instead of memorization of facts, they have to construct their own understanding of the learning materials, reflect on the deeper meaning of this newly
acquired information, and formulate strategies for the problem situations. Hence, problem-based learning offers the sort of learning environment that encourages students to develop a high deep and low surface profile. Indeed, this is precisely what has been observed by Mitchell (1992), Biggs (1991), Moore, Block and Mitchell (1990), Newble & Clarke (1986), and Coles (1985).

Biggs (1991) finds that compared with problem-based students, traditionally taught medical students display much higher surface-related scores and lower deep- and deep-achieving-related scores in the Study Process Questionnaire. This supports the findings of Mitchell (1992), Moore, Block and Mitchell (1990), and Newble and Clarke (1986) that problem-based students are more likely to study for meaning and less likely for reproduction.

Further, studies conducted by Newble and Clarke (1986) and Coles (1985) have shown that the deep approach to learning of the problem-based students becomes more consolidated as they progress through their programme. This is opposite to what is often observed of the conventional students who are more inclined to surface learn as they advance to senior years (Neufeld, Woodward & MacLeod, 1989).

As reviewed in the above literature, problem-based learning seems promising as a means to encourage students to adopt a deep approach to learning. It should be pointed out, however, that student learning is a complex process, the idea that the alteration of a single factor (for example, teaching context) will make a significant impact is too simplistic and fails to take into account the many variables that affect
student learning. For this reason, when implementing problem-based learning, teachers should not assume that students would automatically approach their learning deeply and meaningfully. The outcome of student learning should be carefully monitored and an evaluation of the learning strategy conducted in the light of empirical findings.

4. Summary

The review of literature has identified a number of studies related to critical thinking, problem-based learning, and approaches to learning. The studies serve to illustrate that critical thinking is an important concept that is appropriate for the education of nurses. This is significant for the premise of this research, which proposes to enhance the critical thinking of student nurse educators undergoing a postgraduate programme of teacher preparation. In addition, the literature review supports the purpose of this research, which is to examine the impact of problem-based learning on students’ critical thinking and approaches to learning. As the findings of the research studies in all of the above areas are often conflicting, and not always specific enough for the Hong Kong context, this study seeks to add to the body of knowledge that explores the relationship of these concepts.
CHAPTER THREE

THE CONTEXT AND RESEARCH DESIGN
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1. Nursing Education in Hong Kong

Historically, an apprenticeship system has been the model of training student nurses in Hong Kong. The training is hospital-based and operated by a school of nursing, which is attached to hospital. Although student nurses are recruited by a particular school of nursing, on completion of their programme they are free to apply for any nursing posts in Hong Kong. The school principal is the head of the nursing school, and is responsible for the strategic planning and operational management of his/her school, within the confines of the Hospital Authority policies and directives. The Hospital Authority is a statutory body responsible for setting policies, allocating resources, and monitoring services in over forty public hospitals in Hong Kong. The recruitment of student nurses is strictly controlled by the Hospital Authority policy on human resource planning.

The academic entry requirement for the hospital-based programme is a minimum of two passes in the Hong Kong School Certificate Examination, a public examination sat by Hong Kong students after eleven years of schooling. The exit qualification for these student nurses is a professional qualification that allows them to practice as registered nurses. Although these nurses graduate with a hospital diploma, such diploma is not recognized by the local universities. In order to upgrade their academic qualification to baccalaureate degree level, the hospital diploma graduates
have to undertake a conversion programme lasting up to four years part-time.

Following the overseas trend of upgrading nursing programmes to degree level, the tertiary education sector has started to offer part-time and full-time Bachelor of Science in Nursing since 1989 and 1990 respectively. Currently three universities in Hong Kong offer such programmes. In addition, there are a number of overseas universities providing distance education for local nurses. These distance-learning conversion degree programmes vary considerably in terms of duration, mode of study, and assessment requirements.

In addition to the baccalaureate nursing degree, both local and overseas universities also offer programmes leading to Masters and Doctoral degrees. In the last decade, education for nurses at tertiary level has changed dramatically. For example, ten years ago, the only way that a local nurse could obtain a degree was to go overseas for further education, usually in one of the universities in Australia, the United Kingdom or the United States of America. Nowadays, the trend has been reversed. Hong Kong nurses tend to explore local opportunities for further education before looking to overseas, as revealed by a study into local nurses’ intention for further education (Bartlett et al., 1995).

To summarize, at the time of writing this thesis, there are two modes of preparing student nurses for registration in Hong Kong. One is a 3-year hospital-based diploma programme in which student nurses are paid for their service contributions to the workforce. The other is a 4-year full-time university nursing degree programme with
students paying for their own tuition fees. For those already qualified as registered
nurses with a hospital diploma, an array of further education opportunities is
available.

As the education of nurses shifts from the hospital-based nursing school to tertiary
education sector, a noticeable impact on nursing education is that emphasis is now
given to quality in education. This is perhaps not surprising as universities are
increasingly having to account for the quality of their programmes. For example,
since 1995, all the local universities have been involved in 'Teaching Learning
Quality Process Reviews' organized by the University Grants Committee. The focus
on quality has started to make its impact on nursing education in a number of ways.
These include the introduction of innovative teaching/learning strategies, programme
evaluation, and the upgrading of minimum nurse educator qualification to degree
level.

2. **The Context of the Study**

The university where this study took place was established in 1972, as a polytechnic.
It acquired university status in 1994. Funded by the University Grants Committee, it
was the largest local tertiary institution at the time of this study, with 11,000 full-time
and 9,000 part-time students.

Reflecting its tradition as a polytechnic, the programmes offered by this university are
of an applied nature, at degree and diploma levels. This philosophy is particularly
evident among the part-time programmes, which are mainly designed to meet the educational and training needs of those already in employment. This is clearly the case with the nursing programmes. In addition to the full-time Bachelor of Science in Nursing (BSN) and the part-time Conversion BSN programmes, the Nursing Studies Section of the university also offers part-time diploma programmes in nursing management and nursing education for nurse managers and nurse educators. The Diploma in Nursing Education is of some relevance here as it is the predecessor of the Postgraduate Diploma in Nursing Education, the programme that was involved in this study.

It is worth noting that the university in this study has been the only tertiary institution in Hong Kong to offer a programme to prepare suitably qualified nurses as teachers of nurses since 1984. Until 1995, the preparatory programme was offered as a 2-year full-time diploma programme, and the possession of a nursing degree was not an entry requirement. Since 1996, this has been replaced by an 18-month part-time postgraduate diploma, which only admits graduates with a nursing or nursing-related degree.

The introduction of the Postgraduate Diploma in Nursing Education (PgDNE) is a reflection of the rapid changes in nursing education in Hong Kong. In response to the call from the profession and the Hospital Authority for a more up-to-date programme, the PgDNE was developed to replace the then Diploma in Nursing Education (DNE). The PgDNE was designed to meet the increasing expectation that nurse educators should have a strong grounding in the theory and practice of nursing education. They
should also be open to change and able to teach in classroom and clinical settings. In this respect, the PgDNE differs radically from the old DNE programme, the latter only prepared nurse educators for classroom teaching in the school of nursing.

The first cohort of the PgDNE commenced their study in September 1996. Of the twenty-seven student nurse educators, ten were unqualified nurse educators sponsored by the nursing schools. Another ten were clinical educators sponsored by the hospitals. Seven self-funded experienced clinical nurses made up the rest of the cohort. Although the main responsibility of these clinical nurses was to provide client care, they were also involved in the education of clients and their families, student nurses and junior colleagues. In essence, the student nurse educators in the PgDNE differ from those of the old DNE in that they are involved in teaching nurses and client education in diverse settings.

3. Methodological Issues

This section explores the essence of the experimental design as a way of verifying the effects of educational intervention. The idea of experimentation is not new. Indeed, as Neuman (1991) points out, the wave of enthusiasm for experimentation dominated the field of psychology during the Thorndike era, perhaps reaching a peak in the 1920s. However, such enthusiasm gave way to apathy and rejection, and to the adoption of new approaches in psychology unamenable to experimental verification. Good and Skeates (1994) also report on the scepticism about the direct contributions of controlled experimentation and suggest that researchers who are contemplating
using experimentation should take note of the false hopes, to avoid a recurrence of such disillusion. In particular, they indicate that some of the claims made about the rate and degree of progress as a result of experiments have been overstated, and are accompanied by an unjustified depreciation of non-experimental wisdom. In addition, some of the educational experiments have turned out to be tedious or not replicable, leading to further disillusion about the claims of experimentation.

Hence, when adopting an experimental approach, the researcher should be aware of the basic premise of this research design. The essence of the experimental design is the notion that two or more groups are equal on relevant characteristics before the treatment is applied to one of the groups. Also, in order to judge whether the treatment has had an effect, the groups are usually compared before and after the treatment. In the ideal situation, outcomes attributed to the treatment occur if there is an effect, but not otherwise.

It is often suggested that the experimental design is the most powerful research method for explanatory science, that is, it demonstrates the cause and effect relationships through experimentation. Roberts and Taylor (1998) suggest that as the most advanced type of quantitative research, experimental designs are most likely to show the strength of an association between variables, and to demonstrate whether changes in one variable cause effects in the other.

Limitations do occur, however, when experimental design is applied to nursing research. For instance, the most common experimental design involves the
manipulation of one variable and the examination of the consequences in a second variable. As allocation to either treatment or control group is random, the effect observed in the treatment group is presumed to be caused by manipulation. The problem with a discipline such as nursing is that it is not in such an advanced state that all variables have been identified. Also, there are variables significant to the outcomes of health and nursing that cannot be manipulated (Roberts & Taylor, 1998) A vital question is thus raised, if the researcher is unsure whether all the relevant variables have been manipulated, how certain can one be about the effect of the treatment?

Further, a problem associated with experimental design is that in a highly complex system of variables, there may be many interactions among the variables. For example, the relationship between two variables may vary according to the situation in which this interaction is being observed. Thus, in a system that involves many variables such as nursing education, examining the impact of one variable on the other with the other variables held constant may be an insufficient demonstration of the ‘true’ relationship between the variables.

Despite the above criticism, and while an evaluation of the effect of problem-based learning on the student nurse educators may not be suitable for a true experimental design, this researcher, however, believes that the natural educational setting in which this research is conducted would warrant the use of a quasi-experimental design.
4. **Design of the Experiment**

4.1 **Quasi-experimentation**

The research design chosen for this study is the quasi-experiment as described in Cook and Campbell's (1979) seminal work on quasi-experimentation. Similar to experiments, quasi-experiments involve treatments, outcome measures, and experimental units. However, unlike experiments, quasi-experiments do not use random assignment to create the comparisons, which allow for treatment-induced change to be inferred. In the absence of random assignment, the groups are considered as nonequivalent, that is, they differ from each other in ways other than the presence of a treatment. When interpreting results from quasi-experiments, the researchers are thus challenged to separate the effects of a treatment from those due to the initial noncomparability between the groups.

Compared with quasi-experiments, experiments are more powerful in inferring causation. The advantages of experiments, however, have to be weighed against the disadvantages. While experiments can exert control on the relevant variables in the laboratory setting, the exercise of such control is highly unlikely in the complex real world. In addition, findings from the laboratory cannot be assumed to hold in the field. This is particularly relevant for nursing and educational research, as it would not be practical or desirable to conduct such studies in the laboratory. On the other hand, inferring causation from nonexperimental designs has generally failed to satisfy researchers. Against this background, quasi-experiment, as an experimental approach
to causal research in field settings, conveys more conviction in inferring causation (Cook & Campbell, 1979).

An important consideration when conducting quasi-experiments is to minimize the loss in the quality of causal inference in field research. Amongst other things, this requires the researcher to collect data from noncomparable groups using certain design frameworks. A number of nonequivalent control group designs for the purpose of quasi-experimentation have been offered by Cook and Campbell (1979). The design used in this study is adapted from their 'Untreated Control Group Design with Pretest and Posttest', with one modification.

The original 'Untreated Control Group Design with Pretest and Posttest' as described by Cook and Campbell is shown in Figure 3.1.

![Figure 3.1: Untreated Control Group Design with Pretest and Posttest](Cook & Campbell, 1979)

\[
\begin{array}{cccc}
E & O_1 & X & O_2 \\
C & O_1 & O_2 \\
\end{array}
\]

In this design, as depicted in Cook and Campbell's notational system, 'O' stands for an observation, the subscripts 1 and 2 denote the sequential order of recording observations. 'X' stands for a treatment. The dashed line between the groups
indicates that they were not randomly formed. Such design involves the inclusion of a control group (C). As suggested by Neale & Liebert, (1986), the use of a control group provides a baseline against which the effects of the experimental treatment may be evaluated. Thus, with a control group, the researcher would have reasonable confidence that differences between the groups after treatment are, in fact, due to the treatment. Such optimism, however, should be guarded. The researcher should be aware that in implementing a nonequivalent control group design, there is no certainty that the groups were equal before the treatment. To overcome such design deficit, Roberts and Taylor (1998) suggest the use of a pretest to establish if the groups were initially equivalent on the dependent variable. Hence, a pretest has been built into the design of this study, which is depicted as ‘O₁’ in Figure 3.1.

In this research, the original design by Cook and Campbell (1979) was modified with the addition of a post-experimental follow-up study, which was carried out six months after the intervention. The purpose of the follow-up study was to assess if the effect of problem-based learning was retained after the intervening period. The modified design used in this study is shown in Figure 3.2.

Figure 3.2: Modified Untreated Control Group Design with Pretest and Posttest

<table>
<thead>
<tr>
<th>Group</th>
<th>Pretest</th>
<th>Experimental Stage</th>
<th>Post-experimental Stage</th>
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<tbody>
<tr>
<td>E</td>
<td>O₁</td>
<td>X</td>
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<td>C</td>
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</tbody>
</table>
It is perhaps misleading to describe the comparison between the groups in the above design as between ‘X’ (treatment) or no ‘X’ (no treatment). The over-simplification as suggested in the diagrammatic representation has been acknowledged by Cook and Campbell (1979). In the case of this study, rather than receiving no treatment, the student nurse educators in the control group were taught in the conventional teaching methods. Given that these students enrolled on the programme for a specific purpose, it would be unethical or indefensible to offer them no teaching at all! Thus, with reference to Figure 3.2, it was the experience of the problem-based learning that represented the ‘X’, and the absence of that experience represented the ‘no X’.

Even though quasi-experiments are designed to render causal inferences as sound as possible, researchers cannot always control all the relevant variables in the complex settings of field research. Often, the validity of the experiment can still be threatened by various extraneous variables. Cook and Campbell (1979) define validity as "the best available approximation to the truth or falsity of propositions" (p.37). They identify two types of validity: internal and external. Internal validity refers to the approximation with which the researcher may infer that a relationship between two variables is causal. External validity refers to the extent that the presumed causal relationship can be generalized or applied to the population (Roberts & Taylor, 1998). The internal and external validity of the findings of a study may be threatened by a number of factors.

Among the threats to internal validity, three are particularly worthy of note in the context of this study. One of the threats is that of selection-maturation. This occurs
when nonequivalent groups are growing at different rates in a common direction, irrespective of the effects of a treatment. This is particularly a problem when respondents self-select themselves into receiving a treatment, as it was the case in this study. Under these circumstances, treatments are more likely to be given to those with keen desires to improve themselves. Since such ‘keen’ people are usually intrinsically more able or more exposed to opportunities for change, they are more likely to change faster over time, hence the phrase ‘the able become more able’. A selection-maturation interaction can thus masquerade as a treatment effect. One way of detecting selection-maturation is to compare the groups in terms of their pretest differences.

Another threat to internal validity is that of history. This happens when events other than the treatment take place during the course of the study, which may affect the experimental group but not the control group. In this study, it was feasible that some of the students nurse educators could have been exposed to innovative methods of developing their thinking abilities or learning skills in their workplace. This event, instead of the treatment, could have affected the study results. In view of this, the plausibility of a local history should always be considered within the particular context of the study.

Internal validity may also be threatened by instrumentation. This refers to the situation when the intervals of a scale may not be equal. As a result, changes at some points on a scale may be easier to detect than others (Cook & Campbell, 1979). Thus, if the nonequivalent groups differ significantly from each other, there is a distinct
possibility of a floor or ceiling effect affecting one group more than the other. For example, the floor effect may cause the higher-scoring group’s true achievement shift from pretest to posttest to be underestimated. An inspection of the pretest and posttest frequency distributions within each group will suggest whether there is a possibility of instrumentation problems, as shown in skewed distributions. Appropriate actions can then be taken to reduce the problem, such as rescaling the raw data.

In addition to the threats to internal validity, the external validity of the results of this study may also be threatened. A threat to external validity is very plausible if the participants are not randomly selected from the population. Since the participants are not randomly selected, they are not representative of the population, and the results can only be applied to the portion of the population from which the sample is drawn and not to the whole population (Roberts & Taylor, 1998; Babbie, 1992).

Having identified the threats to internal and external validity, the use of quasi-experiment is still considered as appropriate for this study as it would allow this researcher to investigate the causal relationships as specified. However, careful consideration will be given to the various threats to validity when the findings are analyzed. Plausible alternative explanations will also be addressed as suggested by LoBiondo-Wood and Haber (1998).
4.2 The Variables

In this study, the independent variable was an experimental learning strategy in the form of problem-based learning. The experimental learning strategy formed the basis of the 42-hour module ‘Clinical Education Techniques’, which was specifically designed for the student nurse educators undertaking the Postgraduate Diploma in Nursing Education.

There were two dependent variables, namely, (1) the student nurse educators’ dispositions toward critical thinking, and (2) their approaches to learning, as a result of their experience of the experiment.

4.3 The Follow-up Study

The value, worth, and credibility of an educational intervention would be reduced significantly if its usefulness could not be demonstrated. Thus, an evaluation of the intervention can serve to provide realistic expectations about what the intervention can and cannot do. Such evaluation can also provide information to educators as to how the intervention may be improved.

Although in most situations, the outcome measures of educational intervention are obtained on completion of the experiment, some outcome measures may not be readily observed until a period of time has lapsed after the completion of the intervention. Thus, when assessing the effect of problem-based learning, a follow-up
study is essential to obtain outcome measures that would indicate the impact of this learning strategy. In the present study, a follow-up study was therefore conducted six months after the intervention to observe the effect of problem-based learning on the student nurse educators.

5. The Module: Clinical Education Techniques

The module 'Clinical Education Techniques' was chosen for the implementation of problem-based learning in this study. While this researcher finds various aspects of nursing education interesting, she is particularly keen to explore the education of nurses in the clinical settings. This interest may have stemmed from her earlier experience as a clinical educator. This researcher noted that students had little hesitation in identifying what did and did not help them to learn in the clinical environment. It was evident that the clinical educator played a key role in student learning. She observed that the support that clinical educators gave to the students, the confidence they engendered in the learners, and the clinical expertise they modelled, were all important for facilitating student learning. Such observation is consistent with what has been documented about clinical education (Fish & Twinn, 1997; Stengelhofen, 1993; White & Ewan, 1991; Watts, 1990; Carpenito & Duespohl, 1981). Clinical educators have indicated that what students see and do in clinical work can often remain at a superficial level unless they are stimulated to analyze and synthesize their observations, and to question the meaning of the learning experience and its implications for future practice. In order to maximize their learning from the clinical experience, students would require guidance from teachers
to help them apply their knowledge to the clinical problems that they encounter.

Clinical education is about learning from clinical problems/situations involving clients and their families. While this learning experience is real and stimulating, the complexity of the clinical situation could leave the clinical educator anxious and bewildered. The skills required for clinical education are unique and complex. Different types of skills are called for, depending on the level of the student, the demands of the situation, and the educational philosophy of the clinical educator. In clinical education, the student, the clinical educator, and the client are involved in the teaching/learning process. The clinical educator's responsibility is to create opportunities for student learning while observing sensitively for unanticipated circumstances that may affect the learning. In essence, clinical educators have to make the most of the clinical environment for the purpose of facilitating student learning.

In contrast with the controlled environment of classroom teaching, the clinical setting is unpredictable, volatile, dynamic, and personal. Without doubt, the presence of a client makes the learning real and stimulating. For the clinical educator, however, trying to capitalize on the diverse learning environment can be a daunting task. A classroom session can be planned beforehand to ensure relevance and sequence of learning. This is not so in clinical education. A planned clinical education session may have to be abandoned at short notice because of sudden changes in the client or clinical situation. Mastering the teaching materials prior to a lesson usually presents no problem to the classroom teacher. However, knowing each client's history and
events in his/her treatment and progress may not be possible in advance of a clinical education session.

Where student nurses are employees instead of learners, the problems associated with clinical education are compounded. Often tasks and schedules take precedence over learning needs. The clinical educator is then faced with a dilemma: should students be socialized into the 'real world' of clinical work at the expense of their learning? Or should student learning be given first priority over service needs? To complicate matters further, in reality, there is often a very fine line between the nursing task to be done and the learning to be gained when performing the task.

Given the challenges in clinical education, a different mind set is required of clinical educators. They need to assist students to formulate their own personal learning objectives. In addition, they must not overlook the fact that for the students, the difference between learning in the classroom and clinical setting can be profound. The anonymity of many classrooms shields students from the teacher's close attention. However, in the clinical setting with a small group situation, students are known to the clinical educator, and they may feel threatened and vulnerable. Few nurse educators, however, have been prepared to integrate subject matters around clinical problems or situations. Hence, there is an urgent need for special attention to be paid to clinical education.

While there is a growing awareness of the complexities of clinical education, relatively little is available to assist teachers to improve their clinical education skills.
Until recently, texts on clinical education have been few and tended to focus on theoretical and philosophical issues. This researcher believes that novice clinical educators, in particular, need a 'what to do and how to do' guide, supported by educational principles. Reflecting this belief, the module 'Clinical Education Techniques' was included in the Postgraduate Diploma in Nursing Education, in the hope that student nurse educators undergoing this programme would be better prepared for their role in clinical education.

The module 'Clinical Education Techniques' was thought to be a suitable context for problem-based learning on three accounts. First, unlike other modules in the same programme that focus on the theory of nursing education, this module emphasizes the practice of clinical education, supported by theory. This 'practice-focus' makes it easier to incorporate a problem-based approach. Second, client problems and clinical situations form the context of learning in this module. This fits in with the philosophy of problem-based learning, which emphasizes that students learn from the process of working toward the understanding or resolution of a problem. Third, the problem situations that are used as a basis of learning in this module can be obtained from the clinical environment, thus increasing their relevance and credibility. This is consistent with the design of problem-based learning.

A total of three problem situations were developed for the purpose of problem-based learning. The three problem situations were so constructed that jointly they covered the aim and objectives of the module. In addition, the problem situations have to meet the following criteria:
1. Relevance - the problem situations should illustrate common clinical education issues likely to be encountered in the clinical settings. They should have current relevance, be appropriate for the local context, and represent the broad base of clinical education.

2. Scope - the problem situations should not be of such a narrow perspective that results in a very focused case. On the other hand, they should not be so broad that the student nurse educators have no chance of achieving the desired learning goals in the allotted time. Thus, they should represent a holistic view of clinical education, with the potential of expansion to greater depth and the possibility of developing different hypotheses or directions.

3. Realism - the problem situations should be based on real cases. They should have prototypical value that allows student nurse educators to form strong anchor points for the understanding of the principles of clinical education. The aim is to motivate them to learn from these problem situations. In this respect, the problems should be open-ended so that there is scope for the pursuit of further knowledge and understanding.

4. Prior knowledge - the problem situations should take into account the relevant prior knowledge of the student nurse educators. They should be so constructed that the existing knowledge can be built upon and the central concepts of clinical education reinforced.

5. Transfer of knowledge - the problem situations should be designed to help student nurse educators to structure their knowledge in the context of clinical education and to apply this knowledge to other situations in the clinical context.
The aim and objectives of the module and the three problems are included in Appendices A and B respectively.

Information comprising the problem situations was obtained from nurse educators, clinical educators, and clinical nurses, who have had extensive experience in clinical education. Based on the information, three problem situations were constructed with due care given to concealing the identity of the people or organizations involved. The problem situations were then forwarded to a panel of three experienced clinical educators and three university lecturers. They were asked to judge the appropriateness of the problem situations according to the aim and objectives of the module and the five criteria as described above. On the advice of the panel members, minor changes were made to one of the problem situations. The other two were approved with no amendment required.

6. **The Outcome Measures**

Two measures were used in this study to evaluate the impact of problem-based learning: the dispositions toward critical thinking and approaches to learning. The California Critical Thinking Disposition Inventory (CCTDI) (Facione & Facione, 1992) was used to measure critical thinking dispositions. The approaches to learning was assessed by the Study Process Questionnaire (SPQ) (Biggs, 1992). The CCTDI and SPQ are included in Appendices C & D respectively.
The California Critical Thinking Disposition Inventory (CCTDI)

The CCTDI is the first instrument designed to measure the dispositional dimension of critical thinking. As described earlier, the CCTDI is conceptually grounded in the Delphi Report on Critical Thinking (American Philosophical Association, 1990), the latter noted for achieving conceptual clarity and cross-disciplinary consensus on the conceptualization of critical thinking.

6.1.1 The Seven CCTDI Dispositional Scales

The CCTDI is a 75-item Likert scale tool with seven scales. In their positive manifestation, these seven scales are: truth-seeking, open-mindedness, analyticity, systematicity, critical thinking self-confidence, inquisitiveness, and cognitive maturity.

With reference to the CCTDI, truth-seeking is conceptualized as "being eager to seek the best knowledge in a given context, courageous about asking questions, and honest and objective about pursuing inquiry even if the findings do not support one's self-interests or one's preconceived opinions" (Facione, Sanchez & Facione, 1994, p.6).

The truth-seeking scale in the CCTDI measures intellectual honesty, the desire to seek the best knowledge, the inclination to ask challenging questions, and the willingness to pursue reasons and evidences wherever they lead. Examples of truth-seeking items in the CCTDI are:

*It's never easy to decide between competing points of view* (item no.5)
Even if the evidence is against me, I'll hold firm to my beliefs (item no.19)

Many questions are just too frightening to ask (item no.62)

As a scale in the CCTDI, Open-mindedness refers to "being tolerant of divergent views and sensitive to the possibility of one's own bias" (Facione, Sanchez & Facione, 1994, p.5). Thus, open-mindedness measures one's tolerance for new ideas and divergent views. A positive disposition to open-mindedness is manifested as an inclination to monitor one's own thinking for possible bias, and a willingness to respect the rights of others to hold different opinions. Examples of CCTDI items that measure open-mindedness are:

*It concerns me that I might have bias of which I’m not aware* (item no. 8)

*Men and women are equally logical* (item no. 13)

*You are not entitled to your opinion if you are obviously mistaken* (item no.20)

Analyticity is about "prizing the application of reasoning and the use of evidence to resolve problems, anticipating potential conceptual or practical difficulties, and consistently being alert to the need to intervene" (Facione, Sanchez & Facione, 1994, p.6). The analyticity scale measures one's alertness to potential difficulties and sensitivity to the need to intervene. Someone who is disposed to analyticity would be inclined to value the use of reasons and evidence in solving problems. The CCTDI items that measure analyticity are, for example:

*You could describe me as logical* (item no.54)

*Getting a clear idea about the problem at hand is the first priority* (item no.57)
There is no way to know whether one situation is better than another
(item no.60)

"Being organized, orderly, focused, and diligent in inquiry" (Facione, Sanchez & Facione, 1994, p.6) is a feature of systematicity. As a scale of the CCTDI, systematicity measures the inclination to be organized, focused, diligent and persevering. A person with a disposition toward systematicity would plan his/her approaches in problem-solving in focused and organized ways, and work with complexity in an orderly manner. Examples of systematicity in the CCTDI items are:

My trouble is that I'm easily distracted (item no. 4)
I can talk about my problems for hours and hours without solving anything (item no. 17)
I'm good at developing orderly plans to address complex problems (item no.74)

Critical thinking self-confidence, as a scale of the CCTDI, refers to the faith that one has in one's own reasoning processes. It is suggested that critical thinking self-confidence "allows one to trust the soundness of one's own reasoned judgments and to lead others in the rational resolution of problems" (Facione, Sanchez & Facione, 1994, p.6). The critical thinking self-confidence scale measures trust in one's own reasoning and ability to guide others to make rational decisions. Items on the CCTDI that measure critical thinking self-confidence include:

My peers call on me to make judgments because I decide things fairly (item no. 27)
I pride myself on coming up with creative alternatives (item no. 40)

Others look to me to establish reasonable standards to apply to decisions

(item no. 46)

Inquisitiveness is "one's intellectual curiosity and one's desire for learning even when the application of the knowledge is not readily apparent" (Facione, Sanchez & Facione, 1994, p.5). In this sense, an inquisitive person is one who is curious, eager to acquire knowledge, and desirous of being well informed. This person is also inclined to ask such questions as 'Why?', 'What is this?' and 'How does it work?'

The scale of inquisitiveness in the CCTDI measures intellectual curiosity and the intention to learn even if the knowledge has no immediate application. Examples of inquisitiveness items in the CCTDI are:

- Studying new things all my life would be wonderful (item no. 2)
- Most college courses are uninteresting and not worth taking (item no. 15)
- I look forward to learning challenging things (item no. 47)

The cognitive mature person is characterized as someone who "approaches problems, inquiry, and decision making with a sense that some problems are necessarily ill-structured, some situations admit of more than one plausible option, and many times judgments must be made based on standards, contexts and evidence which preclude certainty" (Facione, Sanchez & Facione, 1994, p.7). Recognizing that one must be judicious in one's decision making, one would be inclined to look beyond simplistic and absolutistic points of view and be prudent in making, suspending, or revising judgments. At the same time, a cognitive mature person recognizes the need to reach
closure at times in the decision making process even in the absence of complete knowledge. Cognitive maturity as a scale of the CCTDI measures judiciousness which inclines one to see the complexity in problems and to desire prudent decision making, even in uncertain conditions. Examples of test items that measure cognitive maturity are:

*The truth always depends on your point of view* (item no. 7)

*The best way to solve problems is to ask someone else for the answers* (item no. 61)

*We can never really learn the truth about most things* (item no. 11)

The items for the seven scales are interspersed throughout the CCTDI. Respondents are invited to express the extent to which they agree or disagree with each of the 75 item statements. A six-point Likert scale ranging from 'strongly agree' to 'strongly disagree' is used. There is no neutral option on the scale, thus respondents either agree or disagree with each item. To agree with the item is consonant with a recognized critical thinking attribute, while to disagree is in opposition to this attribute. The scores for each of the seven scales can vary between a possible minimum of 10 to a possible maximum of 60. A scoring profile is offered by the test constructors. Scores of 30 or below indicate a negative tendency to that scale, scores of 31 through 39 suggest ambivalent inclination, scores of 40 or above are considered as evidence of a positive inclination, while scores in the 50 to 60 range suggest a strong positive tendency.
6.1.2 The Validity and Reliability of the CCTDI

From the initial 250 item prompts, 75 items were retained on the final version of the CCTDI, after multiple screening by college level critical thinking educators and pilot testings. The 75 items were chosen because of their internal consistency and their ability to discriminate between respondents. The retention of the items within their various CCTDI scales was supported by factor analyses of responses to the pilot CCTDI administrations. When submitted to factor analytical methods, seven common factors in the disposition toward critical thinking were identified. An examination of the content of the items which loaded under each factor revealed that they related to the conceptual dispositional phrases expressed in the Delphi Report. The mean and range of each scale's factor loadings are presented in Table 3.1

<table>
<thead>
<tr>
<th>Scale</th>
<th>Mean Loading</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Truth-seeking</td>
<td>.421</td>
<td>.179 -.587</td>
</tr>
<tr>
<td>Open-mindedness</td>
<td>.407</td>
<td>.190 -.693</td>
</tr>
<tr>
<td>Analyticity</td>
<td>.387</td>
<td>.029 -.583</td>
</tr>
<tr>
<td>Systematicity</td>
<td>.458</td>
<td>.341 -.611</td>
</tr>
<tr>
<td>CT Self-confidence</td>
<td>.528</td>
<td>.369 -.660</td>
</tr>
<tr>
<td>Inquisitiveness</td>
<td>.500</td>
<td>.330 -.646</td>
</tr>
<tr>
<td>Maturity</td>
<td>.470</td>
<td>.219 -.667</td>
</tr>
</tbody>
</table>

The internal consistency reliability of the CCTDI was supported by Cronbach's alpha as shown in Table 3.2. Cronbach alphas for the seven individual scales in the CCTDI pilot administrations ranged from .71 to .80. The alpha reliability for the overall
instrument was .91. To determine if the initial alpha reliability of .91 would hold, the publication version of the CCTDI was administered to two additional samples totalling 1019 freshmen college students. The alpha levels in these samples remained relatively stable (ranging from .60 to .78 on the scales and .90 overall), thus providing empirical support to the internal consistency reliability of the CCTDI.

Table 3.2: Internal Consistency Reliability

<table>
<thead>
<tr>
<th>Scale</th>
<th>Cronbach's Alpha</th>
</tr>
</thead>
<tbody>
<tr>
<td>Truth-seeking</td>
<td>.71</td>
</tr>
<tr>
<td>Open-mindedness</td>
<td>.73</td>
</tr>
<tr>
<td>Analyticity</td>
<td>.72</td>
</tr>
<tr>
<td>Systematicity</td>
<td>.74</td>
</tr>
<tr>
<td>CT Self-confidence</td>
<td>.78</td>
</tr>
<tr>
<td>Inquisitiveness</td>
<td>.80</td>
</tr>
<tr>
<td>Maturity</td>
<td>.75</td>
</tr>
</tbody>
</table>

As the CCTDI is the first objective instrument to measure the dispositional dimension of critical thinking, convergent validity studies are only just emerging. For example, Sanchez (1993) has reported significant correlations supporting the concurrent validity between individual CCTDI scales and established psychological scales targeting those constructs. In a more recent study, CCTDI scores are shown to correlate with those of the California Q-sort, a prototype personality profile of the ideal critical thinker (Giancarlo, 1996).

As the CCTDI involves attitudinal measures, there is always the concern that social desirability response bias may threaten the test results. Empirically there is no
evidence to suggest that social desirability is a threat to the validity of the CCTDI scores. In a sample involving 884 high school students and college graduates, the Pearson correlation between the overall CCTDI scores and a measure of social desirability response bias (a short form of the Crowne Marlowe) was .11. This suggests that social desirability response bias accounts for less than 1% of the variance in the CCTDI scores (Private correspondence with Dr. Noreen Facione, one of the test constructors of the CCTDI, 10 December 1997).

The fear that the CCTDI may induce socially desirable responses is also reduced by the observation that consistently low scores in truth-seeking have been obtained from respondents at baccalaureate level (Facione, Sanchez & Facione, 1994). Clearly, those respondents would not be producing these scores if social desirability were a problem.

To reduce the likelihood of respondents giving socially desirable responses, the scale items are interspersed in the CCTDI, and the names of the seven scales are not revealed in the instrument. The name of the instrument is given only by its initials and no connection is made to critical thinking.

As the CCTDI is conceptualized in North America, whether it is suitable for the Chinese respondents in Hong Kong deserves careful consideration. Several steps were taken in this study to ensure that the issue of culture sensitivity was not overlooked in using a ‘Western’ instrument. These include: (1) A Chinese translation of the CCTDI was obtained from the CCTDI test constructors. This Chinese version
had been tested in China, and found to be comparable with the English CCTDI in terms of validity and reliability version (Private correspondence with Dr. Noreen Facione, 16 November, 1995). (2) Prior to the administration of the instruments, both the Chinese and English CCTDI were submitted to a panel of academics in the disciplines of nursing and psychology, one of whom was a linguistics expert. They were invited to judge the appropriateness of the items in terms of their compatibility with the local values and customs, and to assess how closely the Chinese translation resembled the English CCTDI. The panel unanimously agreed that the Chinese CCTDI accurately reflected the English original. Minor amendments to some of the phrases in the items were suggested to enhance understanding. The instruments were amended as suggested. The panel members were satisfied that both versions of the CCTDI were compatible with the local norms and values. (3) Although the student nurse educators in this study have a good command of English, the English CCTDI was administered with the Chinese translated version to ensure that the subtleties in the original instrument were not lost.

6.2 The Study Process Questionnaire (SPQ)

The SPQ was developed by Biggs (1979) to measure students' approaches to learning. An explanation of the SPQ and its construction, with reliability and validity of the instrument, and its use in Hong Kong is detailed in Biggs (1992). The SPQ that was used in this study is the Hong Kong version that Biggs modified from the Australian original. The Hong Kong version resembles the Australian SPQ in most areas with two exceptions. One is that the Hong Kong version is written in English and Chinese.
The bi-lingual presentation is beneficial as it helps to reduce the barrier created by a foreign language. The other is that the tables of norms for interpreting the results are based on local data. Given the diversity of the courses and academic departments in Hong Kong, local tables of norms are a necessity, as it would not make much sense to compare the Hong Kong results with the Australian norms.

6.2.1 The Three Approaches to Learning in the SPQ

The SPQ comprises of forty-two items, which jointly measure the respondents’ approaches to learning. An approach to learning has two components: motive and strategy. Motive is about ‘Why am I engaging in learning?’ while strategy refers to ‘How, in that case, will I go about my learning?’ The combination of motive and strategy makes up an approach to learning. In the SPQ, an approach to learning is referred to as a scale, and a motive or strategy is known as a subscale. For example, a surface approach scale is comprised of a motive subscale and a strategy subscale. A diagrammatic representation of the scales and the subscales is shown in Figure 3.3

![Figure 3.3: SPQ Scales and Subscales](Adapted from Biggs (1992))

<table>
<thead>
<tr>
<th>Level</th>
<th>Surface</th>
<th>Deep</th>
<th>Achieving</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scale</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Approach</td>
<td>Approach</td>
<td>Approach</td>
</tr>
<tr>
<td>Subscale</td>
<td>Motive</td>
<td>Strategy</td>
<td>Motive</td>
</tr>
</tbody>
</table>
As described earlier, there are three approaches to learning measurable with the SPQ: surface, deep, and achieving. A breakdown of the motives and strategies that form the approaches to learning, with examples of test items, is shown in Table 3.3.

<table>
<thead>
<tr>
<th>Approach</th>
<th>Motive</th>
<th>Strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface</td>
<td>Extrinsic: avoid failure but don’t work too hard</td>
<td>Focus on selected details and reproduce accurately</td>
</tr>
<tr>
<td>Example</td>
<td>“I chose my present subjects mainly to help me get a good job when I leave school, not because I’m particularly interested in them”</td>
<td>“I tend to study what’s set; I don’t do anything extra”</td>
</tr>
<tr>
<td>Deep</td>
<td>Intrinsic: satisfy curiosity about topic</td>
<td>Maximize understanding; read widely, discuss, reflect</td>
</tr>
<tr>
<td>Example</td>
<td>“I find that many subjects can become very interesting once you get into them”</td>
<td>“In reading new material, I am reminded of things I already know, and see them in a new light”</td>
</tr>
<tr>
<td>Achieving</td>
<td>Achievement: compete for highest grades</td>
<td>Optimize organization of time and effort</td>
</tr>
<tr>
<td>Example</td>
<td>“I really want to do better than anyone else in my school work”</td>
<td>“I regularly take notes from suggested readings and put them with my class notes on a topic”</td>
</tr>
</tbody>
</table>

In the 42-item SPQ, 7 items address each of the cells in Table 3.3. Each item is a self-report statement of a motive or a strategy. The respondents rate themselves on a 5-
point scale, from 5 ('This item is always or almost true of me') to 1 ('This item is never or only rarely true of me'). The item-ratings are added up for each subscale and the respective subscales are combined to form the scale scores. The results are then compared with the appropriate table of norms. Norms are expressed in deciles. A decile score of 10 means that the result is in the top 10% (very high), 8 or 9 is above average, 4,5, 6 or 7 is average, 2 or 3 is below average, and a decile of 1 is in the lowest 10% (well below average). The table of norms that is used in this study is shown in Table 3.4

Table 3.4: SPQ - Table of Norms
Adapted from Biggs (1992)

<table>
<thead>
<tr>
<th>Percentile range</th>
<th>Decile scaled score</th>
<th>Approaches</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Surface</td>
<td>Deep</td>
</tr>
<tr>
<td>91-100</td>
<td>10</td>
<td>51+</td>
</tr>
<tr>
<td>81-90</td>
<td>9</td>
<td>47-50</td>
</tr>
<tr>
<td>71-80</td>
<td>8</td>
<td>44-46</td>
</tr>
<tr>
<td>61-70</td>
<td>7</td>
<td>42-43</td>
</tr>
<tr>
<td>51-60</td>
<td>6</td>
<td>40-41</td>
</tr>
<tr>
<td>41-50</td>
<td>5</td>
<td>38-39</td>
</tr>
<tr>
<td>31-40</td>
<td>4</td>
<td>36-37</td>
</tr>
<tr>
<td>21-30</td>
<td>3</td>
<td>34-35</td>
</tr>
<tr>
<td>11-20</td>
<td>2</td>
<td>31-33</td>
</tr>
<tr>
<td>1-10</td>
<td>1</td>
<td>0-30</td>
</tr>
</tbody>
</table>

| Mean       | 40.06 | 44.64 | 39.79 |
| SD         | 7.67  | 8.42  | 8.02  |
6.2.2 The Validity and Reliability of the SPQ

To what extent do the items comprising each subscale in the SPQ give consistent results? Cronbach alphas for each of the subscales for both the Australian and Hong Kong SPQ are shown in Table 3.5. The Cronbach alphas of the Hong Kong SPQ show a degree of internal consistency that is comparable with the Australian SPQ.

**Table 3.5: Internal Consistencies (Cronbach alpha) of SPQ Subscales**

*Adapted from Biggs (1992)*

<table>
<thead>
<tr>
<th>Surface</th>
<th>Deep</th>
<th>Achieving</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>M</td>
</tr>
<tr>
<td></td>
<td>M</td>
<td>S</td>
</tr>
<tr>
<td>HK Universities/Polytechnic</td>
<td>2338</td>
<td>.53</td>
</tr>
<tr>
<td>Australian Universities</td>
<td>823</td>
<td>.61</td>
</tr>
</tbody>
</table>

*M = Motive*

*S = Strategy*

Confirmatory factor analysis was also carried out to assess the reliability of the Hong Kong version of the SPQ (Biggs, 1992). Using the computer package LISREL, estimates of dimensionality were made to see if the scales in the SPQ were indeed unidimensional, as shown in Table 3.6
Table 3.6: LISREL Estimates of Dimensionality
Adapted from Biggs (1992)

<table>
<thead>
<tr>
<th>Goodness of fit</th>
<th>Root Mean Square Residuals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface Motive</td>
<td>.970</td>
</tr>
<tr>
<td>Surface Strategy</td>
<td>.985</td>
</tr>
<tr>
<td>Deep Motive</td>
<td>.995</td>
</tr>
<tr>
<td>Deep Strategy</td>
<td>.983</td>
</tr>
<tr>
<td>Achieving Motive</td>
<td>.980</td>
</tr>
<tr>
<td>Achieving Strategy</td>
<td>.983</td>
</tr>
</tbody>
</table>

It is evident from Table 3.6 that all the SPQ subscales have goodness of fit estimates greater than .97 (a value greater than .95 can be taken as an indication of a good fit). The root mean square residuals, which measures the amount of misfit between the model and the data, are less than .05 for all the subscales. Thus, the figures are satisfactory.

As the SPQ has been used in Hong Kong for a period of time, it is possible to estimate its stability, that is, its consistency over time. This is estimated by correlating a set of scores on one occasion with the scores of the same people on a later occasion. Test-retest correlations suggest that the SPQ has a satisfactory reliability. The test-retest reliability coefficients for the Hong Kong version of the SPQ are shown in Table 3.7.
Table 3.7: Test-retest Reliability Coefficients for the SPQ
Adapted from Biggs (1992)

<table>
<thead>
<tr>
<th></th>
<th>Surface</th>
<th>Deep</th>
<th>Achieving</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test-retest interval</td>
<td>N</td>
<td>M</td>
<td>S</td>
</tr>
<tr>
<td>2 months</td>
<td>180</td>
<td>.67</td>
<td>.55</td>
</tr>
<tr>
<td>4 months</td>
<td>180</td>
<td>.64</td>
<td>.52</td>
</tr>
</tbody>
</table>

M = Motive
S = Strategy

The Australian original and Hong Kong version of the SPQ have been the focus of a vast amount of educational research conducted in Australia and Hong Kong (For examples, Kember & Gow, 1991, 1990; Watkins, Regemi & Astilla, 1991; Biggs, 1989, 1987). The findings of these studies have supported the construct validity of the SPQ scales and the theory on which they are based.

To summarize, the SPQ: Hong Kong version has shown to be satisfactory in validity and reliability by conventional standards.

7. Implementation of the Research Study

In the preceding sections, the research design and outcome measures were examined. This section will describe how the study was implemented and the relevant data
collected for analysis.

7.1 The Approach taken to foster Critical Thinking in this Study

Although the researcher believed that critical thinking could be enhanced through problem-based learning, she was mindful that the student nurse educators might not accept this learning strategy as it was a totally new experience for them. The participants of this study were experienced qualified nurses. The combined effects of upbringing, schooling, cultural background and professional socialization could make them wary of teaching/learning methods that did not follow the conventional approach. Therefore, when implementing problem-based learning in the ‘Clinical Education Techniques’ module, this researcher took time to explain the concept and process of problem-based learning to these student nurse educators, and to create a supportive learning environment as far as possible.

As the student nurse educators worked with the problem situations, they practiced the skills of critical reasoning and learned to develop an inquiring mind. Although they were encouraged to take a critical and thoughtful approach to the learning task, no attempt was made to highlight the critical thinking principles that were involved in the learning process. In this sense, the approach taken to facilitate critical thinking in this study is the immersion method, as described in chapter 2 earlier. In other words, critical thinking was instilled in the students with a subject matter but the principles of critical thinking were not made explicit. The immersion method is justified in this case because specialized knowledge and skills are required in order to become a clinical
educator. Without the support of such skills and knowledge, these student nurse educators would find it hard to understand the context of clinical education, let alone to analyze and evaluate it critically. It was also felt that as the problem-based learning process unfolded, the students would naturally approach the learning task in an analytic and critical manner. If the teacher were to highlight the principles of critical thinking during the learning process, it would interrupt the flow of the group activities and might even make the tutorial teacher-dominated. Hence, a decision was made that the principles of critical thinking would not be made explicit.

Through the use of problem-based learning, student-centred learning was actively promoted in this study. In this context, not only would the student nurse educators be taking an active role in their own learning, they also had to make decisions as to the best ways of solving the problem situations. The students practiced the skill of dialectical thinking during group tutorials when they had to explain and justify their own positions as well as explore and defend opposing points of views. It is hoped that through playing this kind of ‘mental gymnastic’, the student nurse educators would develop a broader perspective in their views and a more flexible frame of mind.

The use of problem situations as the context for fostering critical thinking in this study can be justified on educational ground. Instead of providing ‘right answers’ to these students, open-ended problems gave them an opportunity to explore and analyze the situations and learn to apply their knowledge to problem-solving. In the process, they learned how to think instead of being told what to do.
As a facilitator of problem-based learning, this researcher strived to model the critical spirit that she hoped to foster in these student nurse educators. This in fact happened quite naturally as these students presented their materials and tentative solutions for the problem situations. As some of the information presented was unfamiliar to this researcher, she had to go through the process of critically examining the information with the students. In the process of determining the appropriateness of the information, this researcher had to examine her own frame of reference, justify her reason for accepting or rejecting the new information, and submit her justification to students’ judgment.

Recognizing that Chinese students might not have the opportunity to practice critical debate and analysis, this researcher did not assume that the skill and inclination to critique would come naturally to these student nurse educators. Time was taken to lead them into the process of analysis and critical examination. When these students attempted to use a 'black and white' approach to the problem situations, this was treated with tact, patience, and understanding. This researcher was prepared for the likelihood of resistance and slow response to the new way of learning, and made a great deal of effort to promote an open and trusting learning environment where views, worries, and frustrations could be shared by students and facilitator. In fact, the process of implementing problem-based learning went much smoother than anticipated. The student nurse educators spent the first two weeks trying to understand their role in problem-based learning, at times it was frustrating for them. However, they showed remarkable determination and perseverance, and by the third week, they had already grasped the process of problem-based learning.
7.2 The Sample

The population from which the sample was drawn was the student nurse educators in Hong Kong. As only one institution offered professional preparation for student nurse educators locally, the sample of twenty-seven represented 100% of the total number of student nurse educators in the year when this study took place.

The twenty-seven student nurse educators in this study were, on the whole, quite similar in terms of age, educational qualification, professional preparation, and clinical experience. All but two were between the age of 27 and 33 (mean = 29). There were twenty female and seven male. As mentioned earlier, there were ten unqualified nurse educators, ten clinical educators, and seven clinical nurses. All of them had a baccalaureate degree in nursing or nursing-related subject. One had a master in philosophy degree. The years of post-registration experience ranged from 6 to 20 (mean = 9). Two had experience of working overseas as registered nurses. All the participants were indigenous Chinese who received their schooling locally. None had experience in problem-based learning.

7.3 Ethical Issues for Consideration

As this study involved human subjects, special precaution had to be taken to protect the rights of these human participants. In addition, as the participants were students undergoing an educational programme, they were therefore captive populations involved in an unequal relationship with the researcher who was also the lecturer for
the programme. In such a dependent relationship, these students may feel obliged to participate in this research study. They may fear that they would fail the course if they refuse to participate in a research study conducted by their lecturer. Hence, three ethical principles were of particular relevance for this study, namely, the principles of respect for human dignity, beneficence, and justice.

The principle of respect for human dignity affirms the rights of these students to self-determination, that is, they have the right to decide whether to participate in the research study after full disclosure about the study (Roberts & Taylor, 1998). Full disclosure means that all prospective participants are informed of the identity of the researcher, the purpose and nature of the study, the right to refuse to participate, the right to withdraw at any time without penalty, the responsibilities of the researcher, possible benefits of the study, possible risks or side-effects, and measures taken to protect privacy and to ensure anonymity and confidentiality. Informed consent, which denotes the agreement of the participant to take part in the research study after a thorough briefing about the study and its possible outcomes, confirms the participant’s right to determine his/her own actions.

To uphold the principle of beneficence or ‘doing good’, Roberts and Taylor (1998) suggest that researcher’s aim should be to produce results that will ultimately benefit society or individuals. In addition, there is a need to consider the potential for harm to the participants. Since this study involved dividing the students into two groups, and each group received a different form of teaching/learning method, the risks and benefits of the study had to be made explicit and carefully considered. In particular,
would the benefits of the study outweigh the risks? What potential benefits would this study bring? In making a justification for ‘experimenting’ with problem-based learning, this researcher had to convince the University Ethical Committee that there was sufficient confidence in the merits of this learning method as a valuable learning tool for its use with the experimental group, and yet there were insufficient claim to justify using this method for all the students. There was thus a fine balance between the merits and doubts about problem-based learning. In the absence of any evidence that problem-based learning could be disastrous for students, and in view of the possibility that students may be denied a learning method that would truly help them if problem-based learning were withheld, the ‘trial’ of problem-based learning could be justified on the ground that the potential benefits outweigh the foreseeable risks. Further consideration should be given to the control group to ensure that they were not deprived. In this case, the students in the control group received the ‘standard’ teaching method of lectures and tutorial which was used in all the other subjects of this programme.

The principle of justice includes the participant’s right to fair treatment and privacy (Polit & Hungler, 1995). Fair treatment before, during, and after participation in the research study means that the participant should be treated respectfully and courteously at all times; that the participant should have access to the researcher or an independent person at any point in the study to clarify information; that the researcher should honour all the agreements made with the participants; and there should be nonprejudicial treatment of individuals who decline to participate or who withdraw from the study after agreeing to participate. Further, to safeguard the confidentiality
of the participants, all information related to the research subject should be coded to protect anonymity. No names would be used when making references to the data. The data should be kept locked with access limited to the researcher. Identifying codes should be stored securely and kept separate from the rest of the data. When disseminating the results, great care should be taken to ensure that the identity of the participant would not be revealed in the discussion. This would require considerable effort and skill in the presentation of the research findings and at times, details may have to be sacrificed in order to protect anonymity.

As a further precaution to protect the rights of the prospective participants, the formal procedure of application for ethical approval as stipulated by the University was followed and an application was made to the University Ethical Committee six months before the proposed study. In making the application, a detailed proposal that provided the information about the intended research study was submitted, with an emphasis on the measures that would be taken to protect the rights of the human subjects. An informed consent form detailing the nature and purpose of the study; the right to decide whether to participate in the study; the right to refuse, and to withdraw at any time with no penalty; and the right to privacy and confidentiality was enclosed with the application (Appendix E). The University procedure required the application to be sent to each member of the University Ethical Committee prior to the meeting for ethical clearance. The Committee then met to consider the merits and the ethical aspects of the study, and the adequacy of the measures proposed to protect the rights of the human subjects. Two months before the commencement of the proposed study, the University Ethical Committee gave this researcher the approval to proceed with the study. The
approval was given in writing and a copy of the letter is enclosed in Appendix F.

When implementing this study, the researcher took special care to ensure that the measures to protect the rights of the human subjects as promised in the application for ethical approval were strictly followed. The following account would confirm the implementation of such measures.

On the first day of the course, this researcher met with the whole class. She described her teaching and research activities in problem-based learning and outlined the nature of this study. Care was taken to avoid making any reference to critical thinking. Instead, the class was informed that the purpose of the study was to evaluate problem-based learning. This researcher felt that the omission was justified in order to minimize the likelihood of eliciting socially desirable responses in the CCTDI. Following an explanation of the procedures, risks, and benefits of the study, the rights of the participant, and the intended use of the findings, a consent form (Appendix E) was distributed to each of the student nurse educators. They were assured that participation in the study was not obligatory, and that they were free to withdraw from the study at anytime without having to give reasons and with no penalty. They were given an opportunity to consider if they wanted to participate while this researcher retreated from the classroom. When this researcher returned to the classroom later in the day, all twenty-seven student nurse educators indicated their willingness to participate in the study by signing the consent form.

Having obtained the students' agreement to participate in the study, this researcher then
administered the CCTDI and SPQ to the participants, as the pretest. It was explained to these participants that there were no right or wrong answers and they should try to choose the response that came closest to their opinion. They were assured that although names were asked for in the questionnaires, these would be transposed to code numbers for follow-up purposes only. An undertaking was given by this researcher that all replies would remain confidential, and that at no time would any individual be identified.

After the questionnaires were collected, the participants were asked to decide whether they wanted to join the problem-based learning or lecture group. A 14/13 split was suggested. The reason for having the two groups was explained. Assurance was given that a lecture on problem-based learning would be given to both groups in the following week so that they would have a basic understanding of this learning method. In response to the request, fourteen students volunteered for the experimental group and thirteen for the control group. As small group tutorials were to be used to facilitate problem-based learning, the experimental group was further divided into two subgroups with seven students in each.

7.4 Procedures during the Implementation of the Study

The contact hours assigned to the module ‘Clinical Education Techniques’ were forty-two over a 14-week semester. For the control group, this was implemented as a 3-hour lecture each week. In the case of the experimental group, each of the subgroups met for 90 minutes each week for group tutorial. Judging by the amount of time these students
spent in self-directed study, it would be reasonable to suggest that the experimental group put in more than three hours a week for this module. This researcher acted as the lecturer to the control group and facilitator to the experimental group. Both groups covered the same aim and objectives of the module and were assessed by the same portfolio assessment. There was no examination for this module.

This researcher was aware that her dual role as investigator and lecturer/facilitator could create the potential for bias. Although an attempt was made to find an independent teacher/facilitator for this module, there was no offer from the other teachers either because they already had a full workload or they did not have the experience to facilitate problem-based learning. To minimize the risk of bias, three colleagues were invited to sit in the problem-based group tutorials on three occasions as ‘critical peers’.

The three problem situations were presented to the experimental group as paper cases at different points of the semester: the first one in week two, second one in week six, and the third one in week ten. The students were advised to complete one problem situation before moving onto the next although they could and were indeed encouraged to revisit earlier case(s).

The two experimental sub-groups held their group tutorials separately and at different times for a practical reason - it would not be possible for this researcher to facilitate two groups at the same time! During the group tutorial, the students discussed the problem situation, clarified terms and concepts, and hypothesized problems and solutions. The knowledge of the group members was used to understand and analyze the problems.
They applied what they thought they knew to the problem situation while trying to explain their rationale to the group. Others in the group helped out with the explanation, offered their views, or challenged proposals. As the facilitator, this researcher ensured that opportunities were created for critical discussion. Assistance was provided in the form of challenging the group to critique the problems or resolutions proposed. Sometimes, reassurance was given to the group as members tried to resolve their frustration. Although it was tempting at times to ‘tell them what to do’, this researcher/facilitator refrained from doing so. The atmosphere during the group tutorial was open, supportive, and interactive. Group members took the task seriously. They shared their views freely, sometimes this led to heated debate; at other times the discussion was peppered with good humour. The discussion was never dull. As the group became involved in the discussion, they frequently ‘ignored’ the presence of the facilitator. This was taken as a good sign as the students had taken over the tutorial process, which was as intended by the designer of problem-based learning.

After the initial analysis of the problem situation, the group then identified areas that would require further studying. A list of these would be made and members decided which of these they would seek further information. Both group and individual learning goals would be identified in the process. Usually it would take a 90-minute group tutorial to reach this stage. The group would then proceed to search for information. As a rule they used the library. Interestingly, although they were in regular contact with experienced clinical educators, they seldom sought advice from these experts.
In the next group tutorial, members brought back to the group what they found, and tried to apply this information to the problem situation. The discussion was frequently interrupted by others seeking clarification of or justification for the proposals made. The group discussion often led to the identification of further learning needs. This cycle of application of knowledge - critique of proposed solutions - identification of further learning needs would repeat throughout the group tutorials.

Although the students were encouraged to explore the problem situation until they were more or less satisfied that a satisfactory resolution had been found, in practice they rarely achieved that in four weeks. On the whole, they managed to gain a good understanding of the problems and integrate newly acquired knowledge to what they already knew.

On completion of the 14-week module, the first posttest was carried out. The CCTDI and SPQ were administered again to both control and experimental groups. The same instructions on completing the questionnaires as explained in the pretest were repeated. In addition to the instruments, interviews were conducted with some participants to explore certain issues in more detail. With their consent, five students from the control group and five from the experimental group were randomly chosen for the first interview (n=10). An informal session was also arranged with the whole class. The students were offered the opportunity to ask questions about problem-based learning or this study, and this researcher provided answers for their inquiries. The problem-based students were generally positive about the new way of learning and all the students showed a keen interest in the study.
7.5 The Post-experimental Stage

Six months after the experiment, the second posttest was conducted. The CCTDI and SPQ, with code numbers, were sent to the student nurse educators in the control and experimental groups. A covering letter, which reminded them of the objectives of the study, the guarantee of confidentiality, and the instructions on completing the instruments, was sent with the questionnaires. Of the twenty-seven participants to whom the post-experimental questionnaires were mailed, all completed and returned their forms without a single reminder being sent out. In addition, a second interview was conducted with the ten student nurse educators who were interviewed previously.
CHAPTER FOUR

RESEARCH HYPOTHESES AND STATISTICAL SUMMARY
CHAPTER FOUR
RESEARCH HYPOTHESES AND STATISTICAL SUMMARY

In this study, the main purpose is to implement problem-based learning in order to explore its impact on the student nurse educators' dispositions toward critical thinking and approaches to learning. It is hypothesized that problem-based learning would promote the student nurse educators' critical thinking dispositions and enhance their deep approach to learning. Both of the outcome measures have been discussed previously and are summarized here.

The seven critical thinking dispositions as appear in the CCTDI are:

(1). Truth-seeking: The desire to seek the best knowledge, even if such knowledge fails to support one's beliefs or self interests.

(2). Open-mindedness: The attribute to be able to tolerate divergent views, and the inclination to monitor one's own thinking for possible bias.

(3). Analyticity: The sensitivity to potential difficulties when solving' problems and the alertness to the need to intervene by the use of reason and evidence.

(4). Systematicity: The disposition to value organized, focused and diligent approaches in problem solving.

(5). Critical thinking self-confidence: The faith one has in one's own reasoning processes and ability to guide others in rational decision making.

(6). Inquisitiveness: The eagerness to learn and to be well-informed even when the application of such knowledge is not immediately apparent.

(7). Cognitive maturity: The intention to be prudent in decision making while recognizing the need to reach closure in the absence of complete knowledge.
The three approaches to learning as measured by the SPQ in this study are:

(1). Surface Approach: The learning approach that aims to get the learning task out of the way and to get by without failing. Such an approach avoids detailed planning, on-going monitoring, or in depth involvement with the task. Typically the student learns what appear to be the most important topics or elements by rote and reproduce them.

(2). Deep Approach: The learning approach that is based on intrinsic motivation. There is a personal commitment to learning for understanding. The content is related to personally meaningful contexts or to existing prior knowledge. Compared with the surface approach, a higher cognitive level is involved characterized by wide reading and deep involvement with the learning task.

(3). Achieving Approach: The learning approach that targets cost-effective use of time and effort. Engagement with the learning task depends on what would earn the most marks. Thus, if accurate recall of detail is prized by the teacher, this student will rote learn selected detail to obtain the highest marks. This is a surface-achiever. If, on the other hand, deep understanding is valued, then this student will become deeply involved with the task. This is a deep-achiever. In short, the achieving approach involves using whatever strategy to maximize the chances of getting high marks.
1. **The Null and Non-Directional Hypotheses**

The central hypothesis of this study (null form) is that there is no significant difference between the experimental and control groups in relation to the two outcome measures before the experiment, at the end of, and six months after the implementation of problem-based learning.

By following the common practice of expressing hypotheses in null form, this researcher is aware that such convention incorporates several potential dangers and should not be accepted uncritically. For instance, the researcher may find that the data show no relationship or effect according to the chosen statistical tests and criteria. In other words, the researcher cannot reject the null hypothesis. However, such null result may be due to other explanations rather than the real experimental effects.

These other misleading explanations may exist because:

(1). The trend that the researcher believes does not really exist.

(2). The sample of cases and observations include in the analysis is biased.

(3). There are insufficient cases in the sample to detect the trend, and

(4). The measurement chosen has a very high or low inherent variability.

(Polit & Hungler, 1995)

Therefore, if the researcher obtains such a null result, it is difficult, if not impossible, to determine which one of the above explanations may be responsible.

Despite of the risk, it is thought that expressing hypotheses in null form is appropriate in this study. The decision is based on the following rationale. With regard to the
hypotheses about the relationships between problem-based learning and the two outcome measures, this researcher has some hopes and preferences, but no evidence, to assert or deny that the experimental intervention would make a difference to the critical thinking dispositions and approaches to learning of the student nurse educators, since no published research exists for predicting the direction of the outcome. Thus, the decision to express the hypotheses in null form in the present study is considered to be justified.

In this study, the level of confidence is set at 95%, that is, there is a 5% probability that the results could have happened by chance. With a level of probability of .05 (p=.05), the null hypothesis is rejected if p<.05, or not rejected if p>.05.

When deciding to reject or not to reject the null hypothesis, it is possible to commit two types of errors, namely 'type 1 error' and 'type 2 error'. A type 1 error (an $\alpha$ error) is committed when the null hypothesis is rejected when it is true. On the other hand, when the researcher decides not to reject the null hypothesis when in fact it is false, a type 2 error (a $\beta$ error) is committed. A type 1 error leads the researcher to conclude that a result is significant when it is not, while a type 2 error leads the researcher to conclude that a result is not significant when it is. The decision problem in making inferences from sample data is shown in Table 4.1.
Table 4.1: The Decision Problem in Making Inferences from Sample Data (Adapted from Shavelson, 1988)

<table>
<thead>
<tr>
<th>Decision alternatives based on inferences from sample data</th>
<th>True situation in the population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do not reject $H_0$</td>
<td>$H_0$ is true</td>
</tr>
<tr>
<td></td>
<td>Correct</td>
</tr>
<tr>
<td>Reject $H_0$</td>
<td>Type 1 error ($\alpha$)</td>
</tr>
</tbody>
</table>

In choosing a suitable statistical test for this study, while this researcher had some initial reservations of using the parametric test and was wondering whether, a non-parametric statistic was more appropriate, she noted that there was virtually no difference in the results obtained using both parametric and non-parametric tests. The University statistician was consulted on this matter, and the use of a parametric test (that is, $t$-test for independent samples) was suggested. The rationale for using the parametric test is as follows: (1) A parametric test will have a greater chance of picking up differences between the groups which a non-parametric test may fail to do. (2) Based on the central limit theorem, when the scores are added together (as in the outcome measures used in this study), they tend to resemble the normal distribution, which is the most important consideration in determining the use of a parametric test. To determine if the data resemble a normal distribution, a histogram was performed. No skewness was detected thus suggesting that the scores were normally distributed. Hence, after consulting the University statistician, $t$-test for independent samples was chosen to compare the sample means of the experimental and control groups in the
pretest, first posttest and second posttest, with the aid of the Statistical Package for the Social Sciences (SPSS).

2. **Statement of Hypotheses**

2.1 **Hypotheses relating to the Pretest**

(A) **Dispositions toward critical thinking:**

1. There is no significant difference at the pretest of the experiment between the experimental and control groups with respect to the disposition toward:
   
   1.1 Truth-seeking  
   1.2 Open-mindedness  
   1.3 Analyticity  
   1.4 Systematicity  
   1.5 Critical thinking self-confidence  
   1.6 Inquisitiveness  
   1.7 Cognitive maturity  

(B) **Approaches to learning:**

2. There is no significant difference at the pretest of the experiment between the experimental and control groups with respect to:

2.1 Surface approach  
2.2 Deep approach  
2.3 Achieving approach
2.2 Hypotheses relating to the First Posttest

(C) Dispositions toward critical thinking:

3. There is no significant difference at the end of the experiment between the experimental and control groups with respect to the disposition toward:

3.1 Truth-seeking
3.2 Open-mindedness
3.3 Analyticity
3.4 Systematicity
3.5 Critical thinking self-confidence
3.6 Inquisitiveness
3.7 Cognitive maturity

(D) Approaches to learning:

4. There is no significant difference at the end of the experiment between the experimental and control groups with respect to:

4.1 Surface approach
4.2 Deep approach
4.3 Achieving approach
2.3 Hypotheses relating to the Second Posttest

(E) Dispositions toward critical thinking:

5. There is no significant difference six months after the experiment between the experimental and control groups with respect to the disposition toward:

5.1 Truth-seeking
5.2 Open-mindedness
5.3 Analyticity
5.4 Systematicity
5.5 Critical thinking self-confidence
5.6 Inquisitiveness
5.7 Cognitive maturity

(F) Approaches to learning:

6. There is no significant difference six months after the experiment between the experimental and control groups with respect to:

6.1 Surface approach
6.2 Deep approach
6.3 Achieving approach
3. **Statistical Summary**

The pretest, first posttest and second posttest scores of the CCTDI scales and the SPQ subscales of the experimental and control groups are enclosed in Appendices G to L.

3.1 **Hypotheses relating to differences between the experimental and control groups with respect to disposition toward truth-seeking (Hypotheses 1.1, 3.1, and 5.1).**

3.1.1 **Hypotheses 1.1, 3.1, and 5.1**

**Hypothesis 1.1**

There is no significant difference at the pretest of the experiment between the experimental and control groups with respect to disposition toward truth-seeking.

The statistics relevant to hypothesis 1.1 are summarized in Table 4.2 below.

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>S.D.</th>
<th>S.E.</th>
<th>t-value</th>
<th>d.f.</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>13</td>
<td>33.8</td>
<td>7.77</td>
<td>2.15</td>
<td>.02</td>
<td>25</td>
<td>.984</td>
</tr>
<tr>
<td>E</td>
<td>14</td>
<td>33.7</td>
<td>7.94</td>
<td>2.12</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Decision  Since $P > .05$, the null hypothesis is not rejected. The difference between the experimental and control groups with respect to disposition toward truth-seeking at pretest is not significant.

**Hypothesis 3.1**

There is no significant difference at the end of the experiment between the experimental and control groups with respect to disposition toward truth-seeking.

The statistics relevant to hypothesis 3.1 are summarized in Table 4.3 below.

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>S.D.</th>
<th>S.E.</th>
<th>t-value</th>
<th>d.f.</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>13</td>
<td>34.1</td>
<td>7.58</td>
<td>2.10</td>
<td>.03</td>
<td>25</td>
<td>.977</td>
</tr>
<tr>
<td>E</td>
<td>14</td>
<td>34.0</td>
<td>6.86</td>
<td>1.83</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Decision  Since $P > .05$, the null hypothesis is not rejected. The difference between the experimental and control groups with respect to disposition toward truth-seeking at first posttest is not significant.

**Hypothesis 5.1**

There is no significant difference six months after the experiment between the experimental and control groups with respect to disposition toward truth-seeking.
The statistics relevant to hypothesis 5.1 are summarized in Table 4.4 below.

**Table 4.4: Analysis of t-test for Experimental and Control Groups with respect to Disposition toward Truth-seeking at Second Posttest**

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>S.D.</th>
<th>S.E.</th>
<th>t-value</th>
<th>d.f.</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>13</td>
<td>34.6</td>
<td>6.42</td>
<td>1.78</td>
<td>.04</td>
<td>25</td>
<td>.972</td>
</tr>
<tr>
<td>E</td>
<td>14</td>
<td>34.7</td>
<td>7.89</td>
<td>2.11</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Decision** Since P > .05, the null hypothesis is not rejected. The difference between the experimental and control groups with respect to disposition toward truth-seeking at second posttest is not significant.
3.2 Hypotheses relating to differences between the experimental and control groups with respect to disposition toward open-mindedness (Hypotheses 1.2, 3.2, and 5.2).

3.2.1 Hypotheses 1.2, 3.2, and 5.2

Hypothesis 1.2

There is no significant difference at the pretest of the experiment between the experimental and control groups with respect to disposition toward open-mindedness.

The statistics relevant to hypothesis 1.2 are summarized in Table 4.5 below.

Table 4.5: Analysis of t-test for Experimental and Control Groups with respect to Disposition toward Open-mindedness at Pretest

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>S.D.</th>
<th>S.E.</th>
<th>t-value</th>
<th>d.f.</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>13</td>
<td>41.2</td>
<td>7.35</td>
<td>2.03</td>
<td>.08</td>
<td>25</td>
<td>.937</td>
</tr>
<tr>
<td>E</td>
<td>14</td>
<td>41.0</td>
<td>7.63</td>
<td>2.04</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Decision Since P > .05, the null hypothesis is not rejected. The difference between the experimental and control groups with respect to disposition toward open-mindedness at pretest is not significant.
Hypothesis 3.2

There is no significant difference at the end of the experiment between the experimental and control groups with respect to disposition toward open-mindedness.

The statistics relevant to hypothesis 3.2 are summarized in Table 4.6 below.

Table 4.6: Analysis of t-test for Experimental and Control Groups with respect to Disposition toward Open-mindedness at First Posttest

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>S.D.</th>
<th>S.E.</th>
<th>t-value</th>
<th>d.f.</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>13</td>
<td>41.6</td>
<td>6.89</td>
<td>1.91</td>
<td>.12</td>
<td>25</td>
<td>.907</td>
</tr>
<tr>
<td>E</td>
<td>14</td>
<td>42.0</td>
<td>6.64</td>
<td>1.77</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Decision Since P > .05, the null hypothesis is not rejected. The difference between the experimental and control groups with respect to disposition toward open-mindedness at first posttest is not significant.

Hypothesis 5.2

There is no significant difference six months after the experiment between the experimental and control groups with respect to disposition toward open-mindedness.
The statistics relevant to hypothesis 5.2 are summarized in Table 4.7 below.

**Table 4.7: Analysis of t-test for Experimental and Control Groups with respect to Disposition toward Open-mindedness at Second Posttest**

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>S.D.</th>
<th>S.E.</th>
<th>t-value</th>
<th>d.f.</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>13</td>
<td>42.0</td>
<td>6.39</td>
<td>1.77</td>
<td>.08</td>
<td>25</td>
<td>.940</td>
</tr>
<tr>
<td>E</td>
<td>14</td>
<td>42.2</td>
<td>7.84</td>
<td>2.09</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Decision** Since P > .05, the null hypothesis is not rejected. The difference between the experimental and control groups with respect to disposition toward open-mindedness at second posttest is not significant.
3.3 Hypotheses relating to differences between the experimental and control groups with respect to disposition toward analyticity (Hypotheses 1.3, 3.3, and 5.3).

3.3.1 Hypotheses 1.3, 3.3, and 5.3

Hypothesis 1.3
There is no significant difference at the pretest of the experiment between the experimental and control groups with respect to disposition toward analyticity.

The statistics relevant to hypothesis 1.3 are summarized in Table 4.8 below.

Table 4.8: Analysis of t-test for Experimental and Control Groups with respect to Disposition toward Analyticity at Pretest

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>S.D.</th>
<th>S.E.</th>
<th>t-value</th>
<th>d.f.</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>13</td>
<td>36.0</td>
<td>5.54</td>
<td>1.53</td>
<td>.07</td>
<td>25</td>
<td>.945</td>
</tr>
<tr>
<td>E</td>
<td>14</td>
<td>35.9</td>
<td>5.58</td>
<td>1.49</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Decision Since P> .05, the null hypothesis is not rejected. The difference between the experimental and control groups with respect to disposition toward analyticity at pretest is not significant.
Hypothesis 3.3

There is no significant difference at the end of the experiment between the experimental and control groups with respect to disposition toward analyticity.

The statistics relevant to hypothesis 3.3 are summarized in Table 4.9 below.

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>S.D.</th>
<th>S.E.</th>
<th>t-value</th>
<th>d.f.</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>13</td>
<td>42.3</td>
<td>5.96</td>
<td>1.65</td>
<td>2.65</td>
<td>25</td>
<td>.014</td>
</tr>
<tr>
<td>E</td>
<td>14</td>
<td>48.2</td>
<td>5.61</td>
<td>1.50</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Decision Since P< .05, the null hypothesis is rejected. The difference between the experimental and control groups with respect to disposition toward analyticity at first posttest is significant.

Hypothesis 5.3

There is no significant difference six months after the experiment between the experimental and control groups with respect to disposition toward analyticity.
The statistics relevant to hypothesis 5.3 are summarized in Table 4.10 below.

**Table 4.10: Analysis of t-test for Experimental and Control Groups with respect to Disposition toward Analyticity at Second Posttest**

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>S.D.</th>
<th>S.E.</th>
<th>t-value</th>
<th>d.f.</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>13</td>
<td>42.2</td>
<td>5.13</td>
<td>1.42</td>
<td>2.71</td>
<td>25</td>
<td>.012</td>
</tr>
<tr>
<td>E</td>
<td>14</td>
<td>48.0</td>
<td>5.98</td>
<td>1.59</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Decision** Since P < .05, the null hypothesis is rejected. The difference between the experimental and control groups with respect to disposition toward analyticity at second posttest is significant.
3.4 Hypotheses relating to differences between the experimental and control groups with respect to disposition toward systematicity (Hypotheses 1.4, 3.4, and 5.4).

3.4.1 Hypotheses 1.4, 3.4, and 5.4

Hypothesis 1.4

There is no significant difference at the pretest of the experiment between the experimental and control groups with respect to disposition toward systematicity.

The statistics relevant to hypothesis 1.4 are summarized in Table 4.11 below.

Table 4.11: Analysis of t-test for Experimental and Control Groups with respect to Disposition toward Systematicity at Pretest

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>S.D.</th>
<th>S.E.</th>
<th>t-value</th>
<th>d.f.</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>13</td>
<td>34.9</td>
<td>5.54</td>
<td>1.53</td>
<td>.09</td>
<td>25</td>
<td>.926</td>
</tr>
<tr>
<td>E</td>
<td>14</td>
<td>34.7</td>
<td>6.04</td>
<td>1.61</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Decision Since $p > .05$, the null hypothesis is not rejected. The difference between the experimental and control groups with respect to disposition toward systematicity at pretest is not significant.
Hypothesis 3.4

There is no significant difference at the end of the experiment between the experimental and control groups with respect to disposition toward systematicity.

The statistics relevant to hypothesis 3.4 are summarized in Table 4.12 below.

Table 4.12: Analysis of t-test for Experimental and Control Groups with respect to Disposition toward Systematicity at First Posttest

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>S.D.</th>
<th>S.E.</th>
<th>t-value</th>
<th>d.f.</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>13</td>
<td>41.9</td>
<td>5.75</td>
<td>1.59</td>
<td>2.12</td>
<td>25</td>
<td>.04</td>
</tr>
<tr>
<td>E</td>
<td>14</td>
<td>46.7</td>
<td>6.12</td>
<td>1.63</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Decision Since P < .05, the null hypothesis is rejected. The difference between the experimental and control groups with respect to disposition toward systematicity at first posttest is significant.

Hypothesis 5.4

There is no significant difference six months after the experiment between the experimental and control groups with respect to disposition toward systematicity.
The statistics relevant to hypothesis 5.4 are summarized in Table 4.13 below.

Table 4.13: Analysis of t-test for Experimental and Control Groups with respect to Disposition toward Systematicity at Second Posttest

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>S.D.</th>
<th>S.E.</th>
<th>t-value</th>
<th>d.f.</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>13</td>
<td>41.4</td>
<td>5.47</td>
<td>1.51</td>
<td>2.49</td>
<td>25</td>
<td>.02</td>
</tr>
<tr>
<td>E</td>
<td>14</td>
<td>47.0</td>
<td>6.17</td>
<td>1.64</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Decision Since $P < .05$, the null hypothesis is rejected. The difference between the experimental and control groups with respect to disposition toward systematicity at second posttest is significant.
3.5 Hypotheses relating to differences between the experimental and control groups with respect to disposition toward critical thinking self-confidence (Hypotheses 1.5, 3.5, and 5.5).

3.5.1 Hypotheses 1.5, 3.5, and 5.5

Hypothesis 1.5
There is no significant difference at the pretest of the experiment between the experimental and control groups with respect to disposition toward critical thinking self-confidence.

The statistics relevant to hypothesis 1.5 are summarized in Table 4.14 below.

Table 4.14: Analysis of t-test for Experimental and Control Groups with respect to Disposition toward Critical Thinking Self-confidence at Pretest

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>S.D.</th>
<th>S.E.</th>
<th>t-value</th>
<th>d.f.</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>13</td>
<td>34.4</td>
<td>5.59</td>
<td>1.55</td>
<td>.14</td>
<td>25</td>
<td>.886</td>
</tr>
<tr>
<td>E</td>
<td>14</td>
<td>34.1</td>
<td>5.84</td>
<td>1.56</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Decision: Since P > .05, the null hypothesis is not rejected. The difference between the experimental and control groups with respect to disposition toward critical thinking self-confidence at pretest is not significant.
Hypothesis 3.5

There is no significant difference at the end of the experiment between the experimental and control groups with respect to disposition toward critical thinking self-confidence.

The statistics relevant to hypothesis 3.5 are summarized in Table 4.15 below.

Table 4.15: Analysis of t-test for Experimental and Control Groups with respect to Disposition toward Critical Thinking Self-confidence at First Posttest

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>S.D.</th>
<th>S.E.</th>
<th>t-value</th>
<th>d.f.</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>13</td>
<td>41.3</td>
<td>5.12</td>
<td>1.42</td>
<td>3.60</td>
<td>25</td>
<td>.001</td>
</tr>
<tr>
<td>E</td>
<td>14</td>
<td>48.0</td>
<td>4.51</td>
<td>1.20</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Decision Since P < .05, the null hypothesis is rejected. The difference between the experimental and control groups with respect to disposition toward critical thinking self-confidence at first posttest is significant.

Hypothesis 5.5

There is no significant difference six months after the experiment between the experimental and control groups with respect to disposition toward critical thinking self-confidence.
The statistics relevant to hypothesis 5.5 are summarized in Table 4.16 below.

Table 4.16: Analysis of t-test for Experimental and Control Groups with respect to Disposition toward Critical Thinking Self-confidence at Second Posttest

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>S.D.</th>
<th>S.E.</th>
<th>t-value</th>
<th>d.f.</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>13</td>
<td>41.0</td>
<td>4.87</td>
<td>1.35</td>
<td>4.65</td>
<td>25</td>
<td>.000</td>
</tr>
<tr>
<td>E</td>
<td>14</td>
<td>49.2</td>
<td>4.20</td>
<td>1.12</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Decision Since P< .05, the null hypothesis is rejected. The difference between the experimental and control groups with respect to disposition toward critical thinking self-confidence at second posttest is significant.
3.6 Hypotheses relating to differences between the experimental and control groups with respect to disposition toward inquisitiveness (Hypotheses 1.6, 3.6, and 5.6).

3.6.1 Hypotheses 1.6, 3.6, and 5.6

Hypothesis 1.6

There is no significant difference at the pretest of the experiment between the experimental and control groups with respect to disposition toward inquisitiveness.

The statistics relevant to hypothesis 1.6 are summarized in Table 4.17 below.

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>S.D.</th>
<th>S.E.</th>
<th>t-value</th>
<th>d.f.</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>13</td>
<td>48.9</td>
<td>4.83</td>
<td>1.34</td>
<td>.34</td>
<td>25</td>
<td>.737</td>
</tr>
<tr>
<td>E</td>
<td>14</td>
<td>49.5</td>
<td>5.04</td>
<td>1.34</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Decision Since P > .05, the null hypothesis is not rejected. The difference between the experimental and control groups with respect to disposition toward inquisitiveness at pretest is not significant.
Hypothesis 3.6

There is no significant difference at the end of the experiment between the experimental and control groups with respect to disposition toward inquisitiveness.

The statistics relevant to hypothesis 3.6 are summarized in Table 4.18 below.

Table 4.18: Analysis of t-test for Experimental and Control Groups with respect to Disposition toward Inquisitiveness at First Posttest

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>S.D.</th>
<th>S.E.</th>
<th>t-value</th>
<th>d.f.</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>13</td>
<td>49.5</td>
<td>4.35</td>
<td>1.20</td>
<td>.06</td>
<td>25</td>
<td>.951</td>
</tr>
<tr>
<td>E</td>
<td>14</td>
<td>49.6</td>
<td>4.34</td>
<td>1.16</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Decision Since $P > .05$, the null hypothesis is not rejected. The difference between the experimental and control groups with respect to disposition toward inquisitiveness at first posttest is not significant.

Hypothesis 5.6

There is no significant difference six months after the experiment between the experimental and control groups with respect to disposition toward inquisitiveness.
The statistics relevant to hypothesis 5.6 are summarized in Table 4.19 below.

Table 4.19: Analysis of t-test for Experimental and Control Groups with respect to Disposition toward Inquisitiveness at Second Posttest

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>S.D.</th>
<th>S.E.</th>
<th>t-value</th>
<th>d.f.</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>13</td>
<td>49.0</td>
<td>3.27</td>
<td>.909</td>
<td>.23</td>
<td>25</td>
<td>.817</td>
</tr>
<tr>
<td>E</td>
<td>14</td>
<td>49.4</td>
<td>4.41</td>
<td>1.18</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Decision** Since P > .05, the null hypothesis is not rejected. The difference between the experimental and control groups with respect to disposition toward inquisitiveness at second posttest is not significant.
3.7 Hypotheses relating to differences between the experimental and control groups with respect to disposition toward cognitive maturity (Hypotheses 1.7, 3.7, and 5.7).

3.7.1 Hypotheses 1.7, 3.7, and 5.7

Hypothesis 1.7

There is no significant difference at the pretest of the experiment between the experimental and control groups with respect to disposition toward cognitive maturity.

The statistics relevant to hypothesis 1.7 are summarized in Table 4.20 below.

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>S.D.</th>
<th>S.E.</th>
<th>t-value</th>
<th>d.f.</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>13</td>
<td>35.1</td>
<td>5.49</td>
<td>1.52</td>
<td>.17</td>
<td>25</td>
<td>.870</td>
</tr>
<tr>
<td>E</td>
<td>14</td>
<td>35.5</td>
<td>5.36</td>
<td>1.43</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Decision Since $P > .05$, the null hypothesis is not rejected. The difference between the experimental and control groups with respect to disposition toward cognitive maturity at pretest is not significant.
Hypothesis 3.7

There is no significant difference at the end of the experiment between the experimental and control groups with respect to disposition toward cognitive maturity.

The statistics relevant to hypothesis 3.7 are summarized in Table 4.21 below.

Table 4.21: Analysis of t-test for Experimental and Control Groups with respect to Disposition toward Cognitive Maturity at First Posttest

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>S.D.</th>
<th>S.E.</th>
<th>t-value</th>
<th>d.f.</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>13</td>
<td>41.8</td>
<td>5.92</td>
<td>1.64</td>
<td>2.71</td>
<td>25</td>
<td>.012</td>
</tr>
<tr>
<td>E</td>
<td>14</td>
<td>47.8</td>
<td>5.61</td>
<td>1.50</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Decision Since P< .05, the null hypothesis is rejected. The difference between the experimental and control groups with respect to disposition toward cognitive maturity at first posttest is significant.

Hypothesis 5.7

There is no significant difference six months after the experiment between the experimental and control groups with respect to disposition toward cognitive maturity.
The statistics relevant to hypothesis 5.7 are summarized in Table 4.22 below.

Table 4.22: Analysis of t-test for Experimental and Control Groups with respect to Disposition toward Cognitive Maturity at Second Posttest

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>S.D.</th>
<th>S.E.</th>
<th>t-value</th>
<th>d.f.</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>13</td>
<td>41.6</td>
<td>5.04</td>
<td>1.39</td>
<td>2.77</td>
<td>25</td>
<td>.01</td>
</tr>
<tr>
<td>E</td>
<td>14</td>
<td>47.2</td>
<td>5.41</td>
<td>1.44</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Decision Since $P < .05$, the null hypothesis is rejected. The difference between the experimental and control groups with respect to disposition toward cognitive maturity at second posttest is significant.
3.8 Hypotheses relating to differences between the experimental and control groups with respect to surface approach (Hypotheses 2.1, 4.1, and 6.1).

3.8.1 Hypotheses 2.1, 4.1, and 6.1

Hypothesis 2.1

There is no significant difference at the pretest of the experiment between the experimental and control groups with respect to surface approach.

The statistics relevant to hypothesis 2.1 are summarized in Table 4.23 below.

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>S.D.</th>
<th>S.E.</th>
<th>t-value</th>
<th>d.f.</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>13</td>
<td>43.0</td>
<td>7.52</td>
<td>2.08</td>
<td>1.40</td>
<td>25</td>
<td>.173</td>
</tr>
<tr>
<td>E</td>
<td>14</td>
<td>41.2</td>
<td>4.17</td>
<td>1.11</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Decision Since P > .05, the null hypothesis is not rejected. The difference between the experimental and control groups with respect to surface approach at pretest is not significant.
Hypothesis 4.1

There is no significant difference at the end of the experiment between the experimental and control groups with respect to surface approach.

The statistics relevant to hypothesis 4.1 are summarized in Table 4.24 below.

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>S.D.</th>
<th>S.E.</th>
<th>t-value</th>
<th>d.f.</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>13</td>
<td>42.5</td>
<td>8.13</td>
<td>2.25</td>
<td>1.21</td>
<td>25</td>
<td>.237</td>
</tr>
<tr>
<td>E</td>
<td>14</td>
<td>40.0</td>
<td>4.76</td>
<td>1.27</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Decision Since P > .05, the null hypothesis is not rejected. The difference between the experimental and control groups with respect to surface approach at first posttest is not significant.

Hypothesis 6.1

There is no significant difference six months after the experiment between the experimental and control groups with respect to surface approach.
The statistics relevant to hypothesis 6.1 are summarized in Table 4.25 below.

Table 4.25: Analysis of t-test for Experimental and Control Groups with respect to Surface Approach at Second Posttest

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>S.D.</th>
<th>S.E.</th>
<th>t-value</th>
<th>d.f.</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>13</td>
<td>42.6</td>
<td>5.04</td>
<td>1.39</td>
<td>1.03</td>
<td>25</td>
<td>.312</td>
</tr>
<tr>
<td>E</td>
<td>14</td>
<td>41.0</td>
<td>4.53</td>
<td>1.21</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Decision. Since $P > .05$, the null hypothesis is not rejected. The difference between the experimental and control groups with respect to surface approach at second posttest is not significant.
3.9 Hypotheses relating to differences between the experimental and control groups with respect to deep approach (Hypotheses 2.2, 4.2, and 6.2).

3.9.1 Hypotheses 2.2, 4.2, and 6.2

Hypothesis 2.2

There is no significant difference at the pretest of the experiment between the experimental and control groups with respect to deep approach.

The statistics relevant to hypothesis 2.2 are summarized in Table 4.26 below.

Table 4.26: Analysis of t-test for Experimental and Control Groups with respect to Deep Approach at Pretest

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>S.D.</th>
<th>S.E.</th>
<th>t-value</th>
<th>d.f</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>13</td>
<td>50.6</td>
<td>6.61</td>
<td>1.83</td>
<td>.497</td>
<td>25</td>
<td>.624</td>
</tr>
<tr>
<td>E</td>
<td>14</td>
<td>49.2</td>
<td>7.24</td>
<td>1.93</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Decision Since P > .05, the null hypothesis is not rejected. The difference between the experimental and control groups with respect to deep approach at pretest is not significant.
Hypothesis 4.2

There is no significant difference at the end of the experiment between the experimental and control groups with respect to deep approach.

The statistics relevant to hypothesis 4.2 are summarized in Table 4.27 below.

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>S.D.</th>
<th>S.E.</th>
<th>t-value</th>
<th>d.f.</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>13</td>
<td>49.5</td>
<td>6.34</td>
<td>1.76</td>
<td>.73</td>
<td>25</td>
<td>.472</td>
</tr>
<tr>
<td>E</td>
<td>14</td>
<td>51.3</td>
<td>6.58</td>
<td>1.75</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Decision: Since P > .05, the null hypothesis is not rejected. The difference between the experimental and control groups with respect to deep approach at first posttest is not significant.

Hypothesis 6.2

There is no significant difference six months after the experiment between the experimental and control groups with respect to deep approach.
The statistics relevant to hypothesis 6.2 are summarized in Table 4.28 below.

Table 4.28: Analysis of t-test for Experimental and Control Groups with respect to Deep Approach at Second Posttest

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>S.D.</th>
<th>S.E.</th>
<th>t-value</th>
<th>d.f.</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>13</td>
<td>51.8</td>
<td>4.77</td>
<td>1.32</td>
<td>.082</td>
<td>25</td>
<td>.936</td>
</tr>
<tr>
<td>E</td>
<td>14</td>
<td>51.6</td>
<td>7.69</td>
<td>2.05</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Decision Since $P > .05$, the null hypothesis is not rejected. The difference between the experimental and control groups with respect to deep approach at second posttest is not significant.
3.10 Hypotheses relating to differences between the experimental and control

groups with respect to achieving approach (Hypotheses 2.3, 4.3, and 6.3).

3.10.1 Hypotheses 2.3, 4.3, and 6.3

Hypothesis 2.3

There is no significant difference at the pretest of the experiment between the
experimental and control groups with respect to achieving approach.

The statistics relevant to hypothesis 2.3 are summarized in Table 4.29 below.

Table 4.29: Analysis of t-test for Experimental and Control Groups

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>S.D.</th>
<th>S.E.</th>
<th>t-value</th>
<th>d.f.</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>13</td>
<td>43.3</td>
<td>8.58</td>
<td>2.38</td>
<td>.617</td>
<td>25</td>
<td>.543</td>
</tr>
<tr>
<td>E</td>
<td>14</td>
<td>45.3</td>
<td>8.67</td>
<td>2.31</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Decision Since P > .05, the null hypothesis is not rejected. The difference
between the experimental and control groups with respect to achieving approach at
pretest is not significant.
Hypothesis 4.3

There is no significant difference at the end of the experiment between the experimental and control groups with respect to achieving approach.

The statistics relevant to hypothesis 4.3 are summarized in Table 4.30 below.

Table 4.30: Analysis of t-test for Experimental and Control Groups with respect to Achieving Approach at First Posttest

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>S.D.</th>
<th>S.E.</th>
<th>t-value</th>
<th>d.f.</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>13</td>
<td>40.4</td>
<td>6.46</td>
<td>1.79</td>
<td>1.33</td>
<td>25</td>
<td>.195</td>
</tr>
<tr>
<td>E</td>
<td>14</td>
<td>44.0</td>
<td>7.26</td>
<td>1.94</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Decision: Since P > .05, the null hypothesis is not rejected. The difference between the experimental and control groups with respect to achieving approach at first posttest is not significant.

Hypothesis 6.3

There is no significant difference six months after the experiment between the experimental and control groups with respect to achieving approach.
The statistics relevant to hypothesis 6.3 are summarized in Table 4.31 below.

Table 4.31: Analysis of t-test for Experimental and Control Groups with respect to Achieving Approach at Second Posttest

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>S.D.</th>
<th>S.E.</th>
<th>t-value</th>
<th>d.f.</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>13</td>
<td>41.1</td>
<td>7.23</td>
<td>2.00</td>
<td>1.34</td>
<td>25</td>
<td>.192</td>
</tr>
<tr>
<td>E</td>
<td>14</td>
<td>45.4</td>
<td>9.12</td>
<td>2.43</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Decision Since P > .05, the null hypothesis is not rejected. The difference between the experimental and control groups with respect to achieving approach at second posttest is not significant.
4. **Validating the t-test Results**

While the t-test for independent samples is a valid and efficient means of testing the differences between two group means, there is a relatively high risk of committing a Type 1 error when repeated comparisons are made within a sample (Portney & Watkins, 1993; Norusis, 1995). According to these authors, the more comparisons one makes within one set of data using the t-test, the more likely one is to commit a Type 1 error, that is, to find a significant difference when none actually exists. This is known as the multiple comparison problem. In other words, at $\alpha = .05$, there is a 5% chance that this researcher could be in error if she suggests that the group means are significantly different. However, as the comparisons are repeated, the potential cumulative error is actually greater than .05. To follow this argument, the more that one repeats comparisons within a sample, the greater the chances that one or more of the comparisons will fall into that 5% category. Hence, when making repeated comparisons, one cannot know for sure if the significant finding represents one of the potentially correct or incorrect decisions. To control the Type 1 error rate, the complementary use of a statistical procedure known as analysis of variance (ANOVA) has been suggested as a means of validating the results of the t-tests. Described as a logical extension of the t-test, ANOVA is specifically designed to compare the means of two or more groups and to make multiple comparisons without increasing the probability of a Type 1 error. The latter is accomplished by adjusting the observed significance level for the number of comparisons made (Norusis, 1995). Similar to the t statistic in the t-test, the F statistic in ANOVA is a ratio of between-group treatment effects to within-group variability.
As a precaution against committing a Type 1 error, in addition to using the t-test statistics, ANOVA was also employed in this study to validate the results of the pre- and post-tests derived from the t-tests. The results of the ANOVA are now reported.

4.1 Hypotheses relating to differences between the experimental and control groups with respect to disposition toward truth-seeking (Hypotheses 1.1, 3.1, and 5.1).

4.1.1 Hypotheses 1.1, 3.1, and 5.1

Hypothesis 1.1

There is no significant difference at the pretest of the experiment between the experimental and control groups with respect to disposition toward truth-seeking.

The statistics relevant to hypothesis 1.1 are summarized in Table 4.32 below.

Table 4.32: Analysis-of-variance (ANOVA) for Experimental and Control Groups with respect to Disposition toward Truth-seeking at Pretest

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>Sum of Squares</th>
<th>Mean Squares</th>
<th>F Ratio</th>
<th>F Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>1</td>
<td>.0246</td>
<td>.0246</td>
<td>.0004</td>
<td>.9842</td>
</tr>
<tr>
<td>Within Groups</td>
<td>25</td>
<td>1546.05</td>
<td>61.84</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>26</td>
<td>1546.07</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Decision Since $F$ Probability $> .05$, the null hypothesis is not rejected. The difference between the experimental and control groups with respect to disposition toward truth-seeking at pretest is not significant. The results of the ANOVA therefore confirm the previous t-test findings.

Hypothesis 3.1

There is no significant difference at the end of the experiment between the experimental and control groups with respect to disposition toward truth-seeking.

The statistics relevant to hypothesis 3.1 are summarized in Table 4.33 below.

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>Sum of Squares</th>
<th>Mean Squares</th>
<th>$F$ Ratio</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>1</td>
<td>.0458</td>
<td>.0458</td>
<td>.0009</td>
<td>.9766</td>
</tr>
<tr>
<td>Within Groups</td>
<td>25</td>
<td>1302.62</td>
<td>52.10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>26</td>
<td>1302.67</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Decision Since $F$ Probability $> .05$, the null hypothesis is not rejected. The difference between the experimental and control groups with respect to disposition toward truth-seeking at first posttest is not significant. The results of the ANOVA therefore confirm the previous t-test findings.
Hypothesis 5.1

There is no significant difference six months after the experiment between the experimental and control groups with respect to disposition toward truth-seeking.

The statistics relevant to hypothesis 5.1 are summarized in Table 4.34 below.

Table 4.34: Analysis-of-variance (ANOVA) for Experimental and Control Groups with respect to Disposition toward Truth-seeking at Second Posttest

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>Sum of Squares</th>
<th>Mean Squares</th>
<th>F Ratio</th>
<th>F Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>1</td>
<td>.0659</td>
<td>.0659</td>
<td>.0013</td>
<td>.9719</td>
</tr>
<tr>
<td>Within Groups</td>
<td>25</td>
<td>1305.93</td>
<td>52.24</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>26</td>
<td>1306.00</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Decision Since F Probability > .05, the null hypothesis is not rejected. The difference between the experimental and control groups with respect to disposition toward truth-seeking at second posttest is not significant. The results of the ANOVA therefore confirm the previous t-test findings.
4.2 Hypotheses relating to differences between the experimental and control groups with respect to disposition toward open-mindedness (Hypotheses 1.2, 3.2, and 5.2).

4.2.1 Hypotheses 1.2, 3.2, and 5.2

Hypothesis 1.2

There is no significant difference at the pretest of the experiment between the experimental and control groups with respect to disposition toward open-mindedness.

The statistics relevant to hypothesis 1.2 are summarized in Table 4.35 below.

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>Sum of Squares</th>
<th>Mean Squares</th>
<th>F Ratio</th>
<th>F Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>1</td>
<td>.359</td>
<td>.359</td>
<td>.0064</td>
<td>.9370</td>
</tr>
<tr>
<td>Within Groups</td>
<td>25</td>
<td>1406.30</td>
<td>56.25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>26</td>
<td>1406.66</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Decision: Since F Probability > .05, the null hypothesis is not rejected. The difference between the experimental and control groups with respect to disposition toward open-mindedness at pretest is not significant. The results of the ANOVA therefore confirm the previous t-test findings.
Hypothesis 3.2

There is no significant difference at the end of the experiment between the experimental and control groups with respect to disposition toward open-mindedness.

The statistics relevant to hypothesis 3.2 are summarized in Table 4.36 below.

Table 4.36: Analysis-of-variance (ANOVA) Experimental and Control Groups with respect to Disposition toward Open-mindedness at First Posttest

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>Sum of Squares</th>
<th>Mean Squares</th>
<th>F Ratio</th>
<th>F Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>1</td>
<td>.6382</td>
<td>.6382</td>
<td>.0139</td>
<td>.9070</td>
</tr>
<tr>
<td>Within Groups</td>
<td>25</td>
<td>1144.77</td>
<td>45.79</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>26</td>
<td>1145.41</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Decision Since F Probability > .05, the null hypothesis is not rejected. The difference between the experimental and control groups with respect to disposition toward open-mindedness at first posttest is not significant. The results of the ANOVA therefore confirm the previous t-test findings.

Hypothesis 5.2

There is no significant difference six months after the experiment between the experimental and control groups with respect to disposition toward open-mindedness.
The statistics relevant to hypothesis 5.2 are summarized in Table 4.37 below.

Table 4.37: Analysis-of-variance (ANOVA) for Experimental and Control Groups with respect to Disposition toward Open-mindedness at Second Posttest

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>Sum of Squares</th>
<th>Mean Squares</th>
<th>F Ratio</th>
<th>F Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>1</td>
<td>.2939</td>
<td>.2939</td>
<td>.0057</td>
<td>.9405</td>
</tr>
<tr>
<td>Within Groups</td>
<td>25</td>
<td>1291.78</td>
<td>51.67</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>26</td>
<td>1292.07</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Decision**  
Since F Probability > .05, the null hypothesis is not rejected. The difference between the experimental and control groups with respect to disposition toward open-mindedness at second posttest is not significant. The results of the ANOVA therefore confirm the previous t-test findings.
4.3 Hypotheses relating to differences between the experimental and control groups with respect to disposition toward analyticity (Hypotheses 1.3, 3.3, and 5.3).

4.3.1 Hypotheses 1.3, 3.3, and 5.3

Hypothesis 1.3

There is no significant difference at the pretest of the experiment between the experimental and control groups with respect to disposition toward analyticity.

The statistics relevant to hypothesis 1.3 are summarized in Table 4.38 below.

Table 4.38: Analysis-of-variance (ANOVA) for Experimental and Control Groups with respect to Disposition toward Analyticity at Pretest

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>Sum of Squares</th>
<th>Mean Squares</th>
<th>F Ratio</th>
<th>F Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>1</td>
<td>.1484</td>
<td>.1484</td>
<td>.0048</td>
<td>.9454</td>
</tr>
<tr>
<td>Within Groups</td>
<td>25</td>
<td>773.85</td>
<td>30.95</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>26</td>
<td>774.00</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Decision Since F Probability > .05, the null hypothesis is not rejected. The difference between the experimental and control groups with respect to disposition toward open-mindedness at pretest is not significant. The results of the ANOVA therefore confirm the previous t-test findings.
Hypothesis 3.3

There is no significant difference at the end of the experiment between the experimental and control groups with respect to disposition toward analyticity.

The statistics relevant to hypothesis 3.3 are summarized in Table 4.39 below.

Table 4.39: Analysis-of-variance (ANOVA) for Experimental and Control Groups with respect to Disposition toward Analyticity at First Posttest

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>Sum of Squares</th>
<th>Mean Squares</th>
<th>F Ratio</th>
<th>F Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>1</td>
<td>235.17</td>
<td>235.17</td>
<td>7.0231</td>
<td>.0138</td>
</tr>
<tr>
<td>Within Groups</td>
<td>25</td>
<td>837.13</td>
<td>33.48</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>26</td>
<td>1072.30</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Decision Since $F$ Probability < .05, the null hypothesis is rejected. The difference between the experimental and control groups with respect to disposition toward analyticity at first posttest is significant. The results of the ANOVA therefore confirm the previous t-test findings.

Hypothesis 5.3

There is no significant difference six months after the experiment between the experimental and control groups with respect to disposition toward analyticity.
The statistics relevant to hypothesis 5.3 are summarized in Table 4.40 below.

Table 4.40: Analysis-of-variance (ANOVA) for Experimental and Control Groups with respect to Disposition toward Analyticity at Second Posttest

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>Sum of Squares</th>
<th>Mean Squares</th>
<th>F Ratio</th>
<th>F Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>1</td>
<td>229.95</td>
<td>229.95</td>
<td>7.3585</td>
<td>.0119</td>
</tr>
<tr>
<td>Within Groups</td>
<td>25</td>
<td>781.23</td>
<td>31.24</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>26</td>
<td>1011.18</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Decision Since F Probability< .05, the null hypothesis is rejected. The difference between the experimental and control groups with respect to disposition toward analyticity at second posttest is significant. The results of the ANOVA therefore confirm the previous t-test findings.
4.4 Hypotheses relating to differences between the experimental and control groups with respect to disposition toward systematicity (Hypotheses 1.4, 3.4, and 5.4).

4.4.1 Hypotheses 1.4, 3.4, and 5.4

Hypothesis 1.4

There is no significant difference at the pretest of the experiment between the experimental and control groups with respect to disposition toward systematicity.

The statistics relevant to hypothesis 1.4 are summarized in Table 4.41 below.

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>Sum of Squares</th>
<th>Mean Squares</th>
<th>F Ratio</th>
<th>F Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>1</td>
<td>.2939</td>
<td>.2939</td>
<td>.0087</td>
<td>.9264</td>
</tr>
<tr>
<td>Within Groups</td>
<td>25</td>
<td>843.78</td>
<td>33.75</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>26</td>
<td>844.07</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Decision Since F Probability > .05, the null hypothesis is not rejected. The difference between the experimental and control groups with respect to disposition toward systematicity at pretest is not significant. The results of the ANOVA therefore confirm the previous t-test findings.
Hypothesis 3.4

There is no significant difference at the end of the experiment between the experimental and control groups with respect to disposition toward systematicity.

The statistics relevant to hypothesis 3.4 are summarized in Table 4.42 below.

Table 4.42: Analysis-of-variance (ANOVA) for Experimental and Control Groups with respect to Disposition toward Systematicity at First Posttest

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>Sum of Squares</th>
<th>Mean Squares</th>
<th>F Ratio</th>
<th>F Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>1</td>
<td>159.38</td>
<td>158.38</td>
<td>4.5010</td>
<td>.0440</td>
</tr>
<tr>
<td>Within Groups</td>
<td>25</td>
<td>885.28</td>
<td>35.41</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>26</td>
<td>1044.66</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Decision

Since F Probability< .05, the null hypothesis is rejected. The difference between the experimental and control groups with respect to disposition toward systematicity at first posttest is significant. The results of the ANOVA therefore confirm the previous t-test findings.

Hypothesis 5.4

There is no significant difference six months after the experiment between the experimental and control groups with respect to disposition toward systematicity.
The statistics relevant to hypothesis 5.4 are summarized in Table 4.43 below.

**Table 4.43: Analysis-of-variance (ANOVA) for Experimental and Control Groups with respect to Disposition toward Systematicity at Second Posttest**

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>Sum of Squares</th>
<th>Mean Squares</th>
<th>F Ratio</th>
<th>F Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>1</td>
<td>212.13</td>
<td>212.13</td>
<td>6.2089</td>
<td>.0197</td>
</tr>
<tr>
<td>Within Groups</td>
<td>25</td>
<td>854.15</td>
<td>34.16</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>26</td>
<td>1066.29</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Decision** Since F Probability< .05, the null hypothesis is rejected. The difference between the experimental and control groups with respect to disposition toward systematicity at second posttest is significant. The results of the ANOVA therefore confirm the previous t-test findings.
4.5 Hypotheses relating to differences between the experimental and control groups with respect to disposition toward critical thinking self-confidence (Hypotheses 1.5, 3.5, and 5.5).

4.5.1 Hypotheses 1.5, 3.5, and 5.5

**Hypothesis 1.5**

There is no significant difference at the pretest of the experiment between the experimental and control groups with respect to disposition toward critical thinking self-confidence.

The statistics relevant to hypothesis 1.5 are summarized in Table 4.44 below.

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>Sum of Squares</th>
<th>Mean Squares</th>
<th>F Ratio</th>
<th>F Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>1</td>
<td>.68</td>
<td>.68</td>
<td>.0209</td>
<td>.8862</td>
</tr>
<tr>
<td>Within Groups</td>
<td>25</td>
<td>818.94</td>
<td>32.75</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>26</td>
<td>819.62</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Decision** Since F Probability > .05, the null hypothesis is not rejected. The difference between the experimental and control groups with respect to disposition...
toward critical thinking self-confidence at pretest is not significant. The results of the ANOVA therefore confirm the previous t-test findings.

**Hypothesis 3.5**

There is no significant difference at the end of the experiment between the experimental and control groups with respect to disposition toward critical thinking self-confidence.

The statistics relevant to hypothesis 3.5 are summarized in Table 4.45 below.

**Table 4.45: Analysis-of-variance (ANOVA) for Experimental and Control Groups with respect to Disposition toward Critical Thinking Self-confidence at First Posttest**

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>Sum of Squares</th>
<th>Mean Squares</th>
<th>F Ratio</th>
<th>F Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>1</td>
<td>301.40</td>
<td>301.40</td>
<td>12.9913</td>
<td>.0014</td>
</tr>
<tr>
<td>Within Groups</td>
<td>25</td>
<td>580.00</td>
<td>23.20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>26</td>
<td>881.40</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Decision** Since F Probability< .05, the null hypothesis is rejected. The difference between the experimental and control groups with respect to disposition toward critical thinking self-confidence at first posttest is significant. The results of the ANOVA therefore confirm the previous t-test findings.
Hypothesis 5.5

There is no significant difference six months after the experiment between the experimental and control groups with respect to disposition toward critical thinking self-confidence.

The statistics relevant to hypothesis 5.5 are summarized in Table 4.46 below.

Table 4.46: Analysis-of-variance (ANOVA) for Experimental and Control Groups with respect to Disposition toward Critical Thinking Self-confidence at Second Posttest

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>Sum of Squares</th>
<th>Mean Squares</th>
<th>F Ratio</th>
<th>F Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>1</td>
<td>446.34</td>
<td>446.34</td>
<td>21.6557</td>
<td>.0001</td>
</tr>
<tr>
<td>Within Groups</td>
<td>25</td>
<td>515.28</td>
<td>20.61</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>26</td>
<td>961.62</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Decision Since F Probability< .05, the null hypothesis is rejected. The difference between the experimental and control groups with respect to disposition toward critical thinking self-confidence at second posttest is significant. The results of the ANOVA therefore confirm the previous t-test findings.
4.6 Hypotheses relating to differences between the experimental and control groups with respect to disposition toward inquisitiveness (Hypotheses 1.6, 3.6, and 5.6).

4.6.1 Hypotheses 1.6, 3.6, and 5.6

**Hypothesis 1.6**

There is no significant difference at the pretest of the experiment between the experimental and control groups with respect to disposition toward inquisitiveness.

The statistics relevant to hypothesis 1.6 are summarized in Table 4.47 below.

**Table 4.47: Analysis-of-variance (ANOVA) for Experimental and Control Groups with respect to Disposition toward Inquisitiveness at Pretest**

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>Sum of Squares</th>
<th>Mean Squares</th>
<th>F Ratio</th>
<th>F Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>1</td>
<td>2.83</td>
<td>2.83</td>
<td>.1157</td>
<td>.7366</td>
</tr>
<tr>
<td>Within Groups</td>
<td>25</td>
<td>612.35</td>
<td>24.49</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>26</td>
<td>615.18</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Decision** Since F Probability > .05, the null hypothesis is not rejected. The difference between the experimental and control groups with respect to disposition toward inquisitiveness at pretest is not significant. The results of the ANOVA therefore confirm the previous t-test findings.
Hypothesis 3.6

There is no significant difference at the end of the experiment between the experimental and control groups with respect to disposition toward inquisitiveness.

The statistics relevant to hypothesis 3.6 are summarized in Table 4.48 below.

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>Sum of Squares</th>
<th>Mean Squares</th>
<th>F Ratio</th>
<th>F Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>1</td>
<td>.07</td>
<td>.07</td>
<td>.0039</td>
<td>.9508</td>
</tr>
<tr>
<td>Within Groups</td>
<td>25</td>
<td>372.44</td>
<td>18.89</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>26</td>
<td>472.51</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Decision Since $F$ Probability > .05, the null hypothesis is not rejected. The difference between the experimental and control groups with respect to disposition toward inquisitiveness at first posttest is not significant. The results of the ANOVA therefore confirm the previous t-test findings.

Hypothesis 5.6

There is no significant difference six months after the experiment between the experimental and control groups with respect to disposition toward inquisitiveness.
The statistics relevant to hypothesis 5.6 are summarized in Table 4.49 below.

Table 4.49: Analysis-of-variance (ANOVA) for Experimental and Control Groups with respect to Disposition toward Inquisitiveness at Second Posttest

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>Sum of Squares</th>
<th>Mean Squares</th>
<th>F Ratio</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>1</td>
<td>.83</td>
<td>.83</td>
<td>.0545</td>
<td>.8173</td>
</tr>
<tr>
<td>Within Groups</td>
<td>25</td>
<td>382.35</td>
<td>15.29</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>26</td>
<td>383.18</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Decision** Since F Probability > .05, the null hypothesis is not rejected. The difference between the experimental and control groups with respect to disposition toward inquisitiveness at second posttest is not significant. The results of the ANOVA therefore confirm the previous t-test findings.
4.7 Hypotheses relating to differences between the experimental and control groups with respect to disposition toward cognitive maturity (Hypotheses 1.7, 3.7, and 5.7).

4.7.1 Hypotheses 1.7, 3.7, and 5.7

Hypothesis 1.7

There is no significant difference at the pretest of the experiment between the experimental and control groups with respect to disposition toward cognitive maturity.

The statistics relevant to hypothesis 1.7 are summarized in Table 4.50 below.

Table 4.50: Analysis-of-variance (ANOVA) for Experimental and Control Groups with respect to Disposition toward Cognitive Maturity at Pretest

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>Sum of Squares</th>
<th>Mean Squares</th>
<th>F Ratio</th>
<th>F Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>1</td>
<td>.80</td>
<td>.80</td>
<td>.0275</td>
<td>.8697</td>
</tr>
<tr>
<td>Within Groups</td>
<td>25</td>
<td>735.19</td>
<td>29.40</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>26</td>
<td>736.00</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Decision Since F Probability> .05, the null hypothesis is not rejected. The difference between the experimental and control groups with respect to disposition
toward cognitive maturity at pretest is not significant. The results of the ANOVA therefore confirm the previous t-test findings.

**Hypothesis 3.7**

There is no significant difference at the end of the experiment between the experimental and control groups with respect to disposition toward cognitive maturity.

The statistics relevant to hypothesis 3.7 are summarized in Table 4.51 below.

**Table 4.5 1: Analysis-of-variance (ANOVA) for Experimental and Control Groups with respect to Disposition toward Cognitive Maturity at First Posttest**

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>Sum of Squares</th>
<th>Mean Squares</th>
<th>F Ratio</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>1</td>
<td>243.55</td>
<td>243.55</td>
<td>7.3236</td>
<td>.0121</td>
</tr>
<tr>
<td>Within Groups</td>
<td>25</td>
<td>831.40</td>
<td>33.25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>26</td>
<td>1074.96</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Decision** Since F Probability < .05, the null hypothesis is rejected. The difference between the experimental and control groups with respect to disposition toward cognitive maturity at first posttest is significant. The results of the ANOVA therefore confirm the previous t-test findings.
Hypothesis 5.7

There is no significant difference six months after the experiment between the experimental and control groups with respect to disposition toward cognitive maturity.

The statistics relevant to hypothesis 5.7 are summarized in Table 4.52 below.

**Table 4.52: Analysis-of-variance (ANOVA) for Experimental and Control Groups with respect to Disposition toward Cognitive Maturity at Second Posttest**

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>Sum of Squares</th>
<th>Mean Squares</th>
<th>F Ratio</th>
<th>F Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>1</td>
<td>210.89</td>
<td>210.89</td>
<td>7.6898</td>
<td>.0103</td>
</tr>
<tr>
<td>Within Groups</td>
<td>25</td>
<td>685.62</td>
<td>27.42</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>26</td>
<td>896.51</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Decision Since F Probability < .05, the null hypothesis is rejected. The difference between the experimental and control groups with respect to disposition toward cognitive maturity at second posttest is significant. The results of the ANOVA therefore confirm the previous t-test findings.
4.8 Hypotheses relating to differences between the experimental and control groups with respect to surface approach (Hypotheses 2.1, 4.1, and 6.1).

4.8.1 Hypotheses 2.1, 4.1, and 6.1

**Hypothesis 2.1**

There is no significant difference at the pretest of the experiment between the experimental and control groups with respect to surface approach.

The statistics relevant to hypothesis 2.1 are summarized in Table 4.53 below.

**Table 4.53: Analysis-of-variance (ANOVA) for Experimental and Control Groups with respect to Surface Approach at Pretest**

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>Sum of Squares</th>
<th>Mean Squares</th>
<th>F Ratio</th>
<th>F Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>1</td>
<td>71.319</td>
<td>71.319</td>
<td>1.968</td>
<td>.173</td>
</tr>
<tr>
<td>Within Groups</td>
<td>25</td>
<td>906.08</td>
<td>36.24</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>26</td>
<td>977.40</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Decision** Since F Probability> .05, the null hypothesis is not rejected. The difference between the experimental and control groups with respect to surface approach at pretest is not significant. The results of the ANOVA therefore confirm the previous t-test findings.
Hypothesis 4.1

There is no significant difference at the end of the experiment between the experimental and control groups with respect to surface approach.

The statistics relevant to hypothesis 4.1 are summarized in Table 4.54 below.

Table 4.54: Analysis-of-variance (ANOVA) for Experimental and Control Groups with respect to Surface Approach at First Posttest

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>Sum of Squares</th>
<th>Mean Squares</th>
<th>F Ratio</th>
<th>F Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>1</td>
<td>64.04</td>
<td>64.04</td>
<td>1.471</td>
<td>.237</td>
</tr>
<tr>
<td>Within Groups</td>
<td>25</td>
<td>1088.62</td>
<td>63.54</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>26</td>
<td>1152.66</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Decision Since F Probability > .05, the null hypothesis is not rejected. The difference between the experimental and control groups with respect to surface approach at first posttest is not significant. The results of the ANOVA therefore confirm the previous t-test findings.

Hypothesis 6.1

There is no significant difference six months after the experiment between the experimental and control groups with respect to surface approach.
The statistics relevant to hypothesis 6.1 are summarized in Table 4.55 below.

Table 4.55: Analysis-of-variance (ANOVA) for Experimental and Control Groups with respect to Surface Approach at Second Posttest

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>Sum of Squares</th>
<th>Mean Squares</th>
<th>F Ratio</th>
<th>F Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>1</td>
<td>24.36</td>
<td>24.36</td>
<td>1.064</td>
<td>.312</td>
</tr>
<tr>
<td>Within Groups</td>
<td>25</td>
<td>571.93</td>
<td>22.87</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>26</td>
<td>596.29</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Decision Since F Probability>.05, the null hypothesis is not rejected. The difference between the experimental and control groups with respect to surface approach at second posttest is not significant. The results of the ANOVA therefore confirm the previous t-test findings.
4.9 Hypotheses relating to differences between the experimental and control groups with respect to deep approach (Hypotheses 2.2, 4.2, and 6.2).

4.9.1 Hypotheses 2.2, 4.2, and 6.2

Hypothesis 2.2

There is no significant difference at the pretest of the experiment between the experimental and control groups with respect to deep approach.

The statistics relevant to hypothesis 2.2 are summarized in Table 4.56 below.

Table 4.56: Analysis-of-variance (ANOVA) for Experimental and Control Groups with respect to Deep Approach at Pretest

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>Sum of Squares</th>
<th>Mean Squares</th>
<th>F Ratio</th>
<th>F Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>1</td>
<td>11.91</td>
<td>11.91</td>
<td>.247</td>
<td>.624</td>
</tr>
<tr>
<td>Within Groups</td>
<td>25</td>
<td>1207.93</td>
<td>48.31</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>26</td>
<td>1219.85</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Decision Since F Probability > .05, the null hypothesis is not rejected. The difference between the experimental and control groups with respect to deep approach at pretest is not significant. The results of the ANOVA therefore confirm the previous t-test findings.
Hypothesis 4.2

There is no significant difference at the end of the experiment between the experimental and control groups with respect to deep approach.

The statistics relevant to hypothesis 4.2 are summarized in Table 4.57 below.

Table 4.57: Analysis-of-variance (ANOVA) for Experimental and Control Groups with respect to Deep Approach at First Posttest

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>Sum of Squares</th>
<th>Mean Squares</th>
<th>F Ratio</th>
<th>F Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>1</td>
<td>22.29</td>
<td>22.29</td>
<td>.533</td>
<td>.472</td>
</tr>
<tr>
<td>Within Groups</td>
<td>25</td>
<td>1046.44</td>
<td>41.85</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>26</td>
<td>1068.74</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Decision Since F Probability > .05, the null hypothesis is not rejected. The difference between the experimental and control groups with respect to deep approach at first posttest is not significant. The results of the ANOVA therefore confirm the previous t-test findings.

Hypothesis 6.2

There is no significant difference six months after the experiment between the experimental and control groups with respect to deep approach.
The statistics relevant to hypothesis 6.2 are summarized in Table 4.58 below.

Table 4.58: Analysis-of-variance (ANOVA) for Experimental and Control Groups with respect to Deep Approach at Second Posttest

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>Sum of Squares</th>
<th>Mean Squares</th>
<th>F Ratio</th>
<th>F Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>1</td>
<td>.27</td>
<td>.27</td>
<td>.0067</td>
<td>.9355</td>
</tr>
<tr>
<td>Within Groups</td>
<td>25</td>
<td>1042.90</td>
<td>41.71</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>26</td>
<td>1043.18</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Decision** Since F Probability> .05, the null hypothesis is not rejected. The difference between the experimental and control groups with respect to deep approach at second posttest is not significant. The results of the ANOVA therefore confirm the previous t-test findings.
4.10 Hypotheses relating to differences between the experimental and control groups with respect to achieving approach (Hypotheses 2.3, 4.3, and 6.3).

4.10.1 Hypotheses 2.3, 4.3, and 6.3

Hypothesis 2.3

There is no significant difference at the pretest of the experiment between the experimental and control groups with respect to achieving approach.

The statistics relevant to hypothesis 2.3 are summarized in Table 4.59 below.

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>Sum of Squares</th>
<th>Mean Squares</th>
<th>F Ratio</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>1</td>
<td>28.31</td>
<td>28.31</td>
<td>.380</td>
<td>.543</td>
</tr>
<tr>
<td>Within Groups</td>
<td>25</td>
<td>1061.98</td>
<td>74.47</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>26</td>
<td>1890.29</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Decision Since F Probability > .05, the null hypothesis is not rejected. The difference between the experimental and control groups with respect to achieving approach at pretest is not significant. The results of the ANOVA therefore confirm the previous t-test findings.
Hypothesis 4.3

There is no significant difference at the end of the experiment between the experimental and control groups with respect to achieving approach.

The statistics relevant to hypothesis 4.3 are summarized in Table 4.60 below.

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>Sum of Squares</th>
<th>Mean Squares</th>
<th>F Ratio</th>
<th>F Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>1</td>
<td>84.39</td>
<td>84.39</td>
<td>1.777</td>
<td>.195</td>
</tr>
<tr>
<td>Within Groups</td>
<td>25</td>
<td>1187.23</td>
<td>47.48</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>26</td>
<td>1271.63</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Decision Since F Probability > .05, the null hypothesis is not rejected. The difference between the experimental and control groups with respect to achieving approach at first posttest is not significant. The results of the ANOVA therefore confirm the previous t-test findings.

Hypothesis 6.3

There is no significant difference six months after the experiment between the experimental and control groups with respect to achieving approach.
The statistics relevant to hypothesis 6.3 are summarized in Table 4.61 below.

**Table 4.61: Analysis-of-variance (ANOVA) for Experimental and Control Groups with respect to Achieving Approach at Second Posttest**

<table>
<thead>
<tr>
<th>Source</th>
<th>df</th>
<th>Sum of Squares</th>
<th>Mean Squares</th>
<th>F Ratio</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>1</td>
<td>123.17</td>
<td>123.17</td>
<td>1.7996</td>
<td>.1918</td>
</tr>
<tr>
<td>Within Groups</td>
<td>25</td>
<td>1711.12</td>
<td>68.44</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>26</td>
<td>1834.29</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Decision** Since F Probability > .05, the null hypothesis is not rejected. The difference between the experimental and control groups with respect to achieving approach at second posttest is not significant. The results of the ANOVA therefore confirm the previous t-test findings.
5. Summary

This chapter has presented the analysis of the data in relation to the implementation of problem-based learning. First, it compared the experimental and control groups at the beginning, and end of the experiment, and six months later on two outcome measures. Secondly, it analyzed the relative changes over time in the experimental and control groups at different points, namely, between the pretest and first posttest, and between the first posttest and second posttest. The t-test for independent samples was used to compare the means between the experimental and control groups. In addition, the analysis of variance (ANOVA) was employed to validate the results derived from the t-tests. For all the hypotheses tested, the results of ANOVA concur with those of the t-test.

The findings revealed that there were no significant differences between the experimental and control groups at the pretest on all seven critical thinking dispositions. At the beginning of the experiment, both groups demonstrated ambivalent tendency toward truth-seeking, analyticity, systematicity, critical thinking self-confidence and cognitive maturity, but were positively disposed toward open-mindedness and inquisitiveness.

At the end of the experiment, significant differences were noted between the experimental and control groups on four of the dispositions: analyticity, systematicity, critical thinking self-confidence and cognitive maturity. While both groups became more positively inclined toward these four dispositions, the experimental group had
made more substantial gains. There were, however, no significant differences between the two groups on truth-seeking, open-mindedness and inquisitiveness. The groups continued to be ambivalent to truth-seeking while positively disposed toward open-mindedness and inquisitiveness at the first posttest.

Six months after the experiment, the significant differences between the experimental and control groups in relation to analyticity, systematicity, critical thinking self-confidence and cognitive maturity remained. The experimental group still maintained the gains in these dispositions. The pattern of no significant differences between the groups on truth-seeking, open-mindedness and inquisitiveness also continued.

In terms of approaches to learning, no significant differences were observed at the pretest, first posttest and second posttest between the experimental and control groups on surface approach, deep approach and achieving approach.

With reference to the above findings, three issues are worthy of note. (1) The groups' ambivalence toward truth-seeking is disturbing. With such an ambivalent attitude, what kind of role modelling would these future nurse educators portray for their students? Should they be ‘counselling’ out of the teaching profession? There is therefore a need to find out whether they are really ambivalent toward truth-seeking. (2) Since both truth-seeking and inquisitiveness are concerned with the search for knowledge, an ambivalence toward the former coupled with a positive disposition to the latter makes intriguing reading. This apparent contradiction deserves further exploration. (3) Similar patterns of development over time and group differences are
observed in analyticity, systematicity, critical thinking self-confidence and cognitive maturity. Is there any commonality among these four dispositions?

With these issues in mind, the next chapter, using the qualitative method, will explore some of the underlying factors that may have given rise to these observations.
CHAPTER FIVE

THE INTERVIEWS AND QUALITATIVE ANALYSIS
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THE INTERVIEWS AND QUALITATIVE ANALYSIS

1. The Interviews

In the previous chapter, three issues were raised that deserved further consideration. The first was to explore whether the student nurse educators were really ambivalent toward truth-seeking. The second was the need to find out if ambivalence toward truth-seeking would contradict the positive disposition toward inquisitiveness. The third consideration was to seek an explanation for the similarity in the development and group differences observed in analyticity, systematicity, critical thinking self-confidence and cognitive maturity.

This researcher believes that while the quantitative method is a valid and reliable scientific investigatory approach, numerical analysis alone cannot provide a complete and definitive description of the reality for the purpose of this study. In order to identify the features or attributes that make the phenomenon what it is, the qualitative method such as interview is a legitimate means of seeking and validating the relevant aspects of the phenomenon. Specifically, the goal of the qualitative interview method is to document and interpret as fully as possible the totality of the phenomenon being studied in particular contexts and from the participants' points of view. In the case of this study, qualitative data are collected to explain the results gathered by the quantitative method, with the richness and detail that would give the reader an understanding of the student nurse educators' internal and external world. This form
of knowing is essential to ascertain the student nurse educators' feelings, views, and interpretations, and help to explain the way they are.

Instead of the qualitative interview, this researcher could have used other methods to elicit information from the respondents. For example, observation could be used to find out whether these nurse educators are really ambivalent toward the pursuit of truth in reality. However, the problem with observation is that once the respondents realize that they are being watched they may behave differently. This Hawthorne effect may, therefore, elicit invalid data. It is possible also to ask these student nurse educators to write an essay on how analytical, systematic, mature and confident they are in solving problems and making judgment. The difficulty here is that individuals vary in their ability to communicate on paper, thus some may give limited information only and fail to explain the situation fully.

To elicit qualitative information from the student nurse educators, the semi-structured interview is used in this study. This interview method is chosen because it has the advantage of being open-ended, thus encouraging a free flow of ideas and views from the respondents while at the same time eliciting specific responses to specific questions. By conducting a face to face interview, this researcher hopes to gain a more thorough understanding of the respondent's world view and explore his/her affective responses. In order to promote a comfortable face to face relationship, every effort is made to relax the respondent throughout the interviewing process including the conduction of the interview in private and in a congenial atmosphere. Although the questions are posed in both English and Chinese, the respondents may
reply in the language in which they feel comfortable. All the ten respondents gave their replies in a mix of English and Cantonese (the latter being the dialect used in Hong Kong). Typically, the conversational part was in Cantonese and the technical terms in English. This kind of response is quite common in Hong Kong. As this researcher is fluent in English and Cantonese, this did not create a problem either in the interview or in the subsequent data analysis. With the respondents’ permission, the interviews were taped recorded. The appearance of a tape recorder did not appear to interfere with the conversation.

Two interviews were conducted, the first one was at the end of the experiment and the second one six months later. Ten student nurse educators in this study were randomly selected from the twenty-seven in the study, with five from the experimental group and five from the control group. By coincidence rather than by design, there was an equal split of gender among the ten chosen.

The three issues highlighted in the quantitative findings became the focus for the qualitative investigation. Specifically, in order to explore whether the student nurse educators were really ambivalent toward truth-seeking, attempts were made to find out how they would act in the pursuit of truth. Further, to ascertain if the ambivalence toward truth-seeking would contradict the positive disposition toward inquisitiveness, truth-seeking and inquisitiveness were compared in terms of their similarities and differences. Also, evidence of inquisitiveness was sought as revealed by the respondents' motivation to learn. Finally, efforts were made to identify what the four dispositions (analyticity, systematicity, critical thinking self-confidence and
cognitive maturity) had in common and what might have accounted for the group differences was also explored. A list of the questions used in the interviews is included in Appendix M.

For some of the issues, for example, how keen they are in the pursuit of truth and how motivated they are to learn, the posing of direct questions is not appropriate as it may encourage the respondents to give socially desirable answers. Instead, an indirect way of soliciting the respondents' views was tried. For example, in order to ascertain their tendency to pursue the truth, at the first interview the respondents were asked to describe a critical incident related to their work and to comment on an official report on a tragic fire disaster that attracted massive attention in Hong Kong at around the time of the interview. The same tactic was used again at the second interview. This time they were asked to describe what a good nurse should be. It is hoped that during the course of explaining their views about the critical incident, the official report, or a good nurse, they would reveal how, what and why they would accept as 'truth' in various situations. The indirect approach was also used to find out how motivated they were to learn. In this respect, the respondents were asked to comment on their current learning experience in both interviews.

In addition to the meticulous care taken to collect the interview data, the rigour of the research process was maintained when analyzing the qualitative data. As a single researcher is involved in the collection and transcribing of the interview data in this study, analysis of the qualitative data requires careful handling to ensure that the conclusions drawn really represent the 'truth'. When analyzing the interview data,
what the respondents said was interpreted in the context of the interview questions. As a safeguard against subjective interpretation, this researcher tried to (1) eliminate the possible alternative explanations for what the respondents said before coming to a conclusion, and (2) use low inference descriptors in the form of verbatim accounts provided by the respondents as far as possible to enhance accuracy. It is hoped that through such measures, meaningful and accurate information can be gleaned from the qualitative data. In the following section, findings of the interview data are reported.

2. Analysis of the Interview Data

The theoretical framework underlying the dispositions toward critical thinking as espoused by Facione, Sanchez, and Facione (1994) guided the way that this researcher analyzed the interview data. In addition, the data analysis in this study reflected the guiding principles set forth by Parse, Coyne, and Smith (1985) for discovering and interpreting meanings embedded in qualitative data. The principles incorporate the rigorous process of:

(i) searching for major themes articulated by the research subject about the phenomenon. This occurs through analysis-synthesis during which emerging themes are separated according to the major elements in the objectives of the study, and reconstructed to form a unified description of the phenomenon as lived by the subject; and,

(ii) transforming the major themes to a higher level of discourse by making a shift from the subject's language to the language of the researcher. In other words,
the themes in the language of the subject are synthesized and transformed into hypothetical statements.

In this study, interview data were elicited from ten respondents. Each response from each respondent on each question was transcribed. Data analysis began with a careful examination of the respondent-researcher interactions. The themes inherent in the respondent’s utterances were identified and described in the language of the respondent. These themes were then sorted under the following major elements:

(i) disposition toward truth-seeking,
(ii) disposition toward inquisitiveness,
(iii) disposition toward analyticity,
(iv) disposition toward systematicity,
(v) disposition toward critical thinking self-confidence,
(vi) disposition toward cognitive maturity,
(vii) students’ evaluations of problem-based learning.

After sorting, the themes were reconstructed to provide a coherent, integrated picture. For example, the themes under the dispositions toward analyticity, systematicity, critical thinking self-confidence, and cognitive maturity were summarized to form a unified description of the respondents’ problem-solving process.

For the transformation of the major themes to a higher level of abstraction, the themes expressed in the language of the respondents were synthesized into hypothetical
statements. For example, under the element of disposition toward truth-seeking, the themes in the language of the respondents were:

A. There is no point to confront the person who has treated you unfairly in front of other people.
B. There is no reason to question the competence of the fire investigating team.
C. There is no reason to doubt the findings of the official report.
D. One can judge whether a nurse is good or not from one’s own experience.
E. The promotion system is fair.

When transformed to a higher level of abstraction, the above themes in the language of the respondents were synthesized to the following hypothetical statement:

Chinese people are reluctant to challenge authority or ask searching questions if such action is likely to disrupt social harmony.

In order to ensure valid analysis of the interview data, this researcher adopted the following procedures to guard against subjective or erroneous interpretation:

(i) The interpretation of the meaning of each interview was shared and checked with the respondents. A draft of each set of the transcribed data was given to the respective respondent to check the validity of this researcher's impression against the respondent's own impression of the interview and to offer
feedback to the researcher. In addition, the final analysis was forwarded to
the respondents for their checking to ensure validity.

(ii) Low inference descriptors in the form of verbatim accounts provided by the
respondents were used in the data analysis as far as possible to enhance
accuracy.

(iii) Before coming to a conclusion, all possible alternative explanations for what
the respondents said were elicited and considered carefully. Only when such
alternatives failed to give a satisfactory explanation would the final conclusion
be accepted.

It was intended that through such a rigorous data analysis process, not only would
meaningful and accurate information be gleaned from the interview data, the
conclusions so arrived indeed represent the 'truth'.

2.1 Truth-seeking

Truth-seeking, as a disposition of critical thinking is conceptualized as "being eager
to seek the best knowledge in a given context, courageous about asking questions, and
honest and objective about pursuing inquiry even if the findings do not support one's
self-interests or one's preconceived opinions" (Facione, Sanchez & Facione, 1994,
p.6). As described earlier, the quantitative findings indicate that both experimental
and control groups showed ambivalence toward this disposition throughout the study.
It is hoped that the interview data would provide further information about the student
nurse educators' truth-seeking tendency.
Having analyzed the interview data, it seems that there is no reason to dismiss the ambivalent scores, as the following examples would show.

At the first interview, in describing a critical incident, respondent E1 in the experimental group revealed how she was ‘showed up’ by another colleague in front of a group of students in a practical session:

“I know she should not treat me like that in front of the students. I don't know why she behaved like that. What I told the students was basically correct although it might differ from what she would teach herself. There was nothing unsafe about what I said. I really feel bad about what she did to me, in front of the students...no, I am not going to talk to her about it...I did not ask her why she thought my method was wrong.”

Respondent E1 has a cheerful disposition and often acts as the spokesperson for her study group. During the problem-based learning tutorials, she was observed to tackle problems critically, raising such questions as “Why do we think it is this and not that?” and “Is there a better way of doing this?” Against this background, her description of how she responded to being ‘showed-up’ is unexpected. One would expect her to have at least approached this colleague after the incident and asked why she was wrong in what she taught the students. But she took no action despite her anger about the incident. When asked why she did not confront her colleague, E1 simply referred to a Chinese adage “Liu mianzi” meaning “Face must be left for others in conflict, even defeated adversaries”.
Another example of ambivalence toward truth-seeking was demonstrated by another respondent (E5) when he was asked to comment on the official report of the tragic ‘Carley Fire’ during the first interview:

“I don’t think the report tells us why so many people perished in the fire. There may be a good reason why the report has left out so many things...I would imagine that it is difficult, if not impossible, to find out what really happened in the ‘Carley Fire’.”

This ambivalence was also observed in the comment of another respondent (E4):

“What can we learn from this report? Well, not much really but then I don’t expect the report to come up with anything new. There has been such extensive coverage of the fire, by the newspapers and television, that I think everything about the fire has been looked at already.”

As it is unlikely that the official report of the ‘Carley Fire’ has provided a satisfactory answer for all aspects of this tragedy, one would expect the respondents to ask questions or even challenge the findings. However, this was not the case at the interview. They seemed to accept the report uncritically:

“I think the report has established the cause of the fire and explained why it went out of control. I am satisfied the report has done that. It is important that we
learn from this and do everything possible to prevent such tragedy from happening again.” (Respondent E3).

“I have not read the report in detail but I am sure that those people who did the investigation would be very experienced in these things. I heard that the team was made up of experts from the Fire Department, Police, and Rescue Services. Oh yes, there was a judge as well.” (Respondent E2).

The lack of inclination to subject their own beliefs to critical examination was also evident at the second interview when these respondents expressed what they thought a good nurse should be. For example:

“The traditional view is that to be a good nurse, she should be gentle, diligent, loyal and obedient whereas the contemporary view emphasizes the importance of being competent, autonomous and proactive. As to which view is the correct one, well, it is very difficult to prove which one is right and which one is wrong. Really, one instinctively knows if a nurse is good or not. Our experience should tell us that.” (Respondent E4).

It is evident that this respondent made little attempt to weigh up the traditional and contemporary views and offered no justification to support her faith in the power of instinct and experience.
Another respondent (E3) stated, “In psychiatric nursing, the nurse must be a good communicator because communication has a therapeutic effect for these patients. In general nursing, because the patients’ problems are physical ones, they would still get better even if the nurse does not talk to them.” It is obvious that this respondent has a misconception about communication in general nursing. In response to further prompting, he held on to his view, “Of course it would be ideal if general nurses would talk to their patients as well. The point I am making is that the lack of good communication is unlikely to delay these patients’ recovery, unlike the psychiatric setting.” Judging by his reply, E3 did not seem to recognize that his opinion could be wrong or should be re-examined.

Respondent E5 thought that, “Getting promoted is a way of showing that this is a good nurse. If I am not a good nurse, then it is unlikely that I will get promoted.” When asked if he believed that the promotion system was fair, his reply was, “On the whole, the system is fair. If you are a good nurse, you will be noticed. Similarly, if you are a bad nurse, you cannot cover up your shortcomings all the time.” E5’s reply indicated his uncritical acceptance of the promotion system and his faith in the fairness of the system.

The above excerpts suggest that some of the respondents were not inclined to ask searching questions even when there was an apparent need to do so. Also they were not prepared to subject their beliefs to critical examination. These observations, however, are not only confined to the experimental group, as similar examples are observed in the control group as well. For example:
At the first interview, when asked to comment on the official report, respondent C4 said, “I have no reason to doubt the competence of the investigating team. They are experts and should have the knowledge and experience to conduct a good inquiry.” However, her apparent faith in the expertise of the team contradicted what she said earlier, “How did a small fire that started at the bottom of the lift shaft manage to spread so quickly that it engulfed the whole building in a matter of minutes? This is not adequately explained by the report.” Despite this, she still thought the report was acceptable.

The inclination to hold onto one’s own belief was also demonstrated by respondent C2 who stated, “To be a good nurse, one must have good attitude. With a good attitude, this nurse will be able to get on with colleagues. A harmonious atmosphere is important in nursing.” When questioned why he rated ‘attitude’ higher than ‘knowledge’ or ‘skill’, his reply was, “A nurse with a good attitude makes a good learner. Without a good attitude, it is impossible to learn the necessary knowledge or skill.” When this respondent was asked to justify his assertion that ‘attitude’ was a precursor for the learning of knowledge and skill, he was unable to do so. This, however, did not alter his belief that ‘attitude’ was more important as he revealed, “When I select candidates for student nurse training, I look for evidence of good attitude. You cannot instill good attitude in someone if it is not there already.” Respondent C2, an experienced nurse and a nurse educator, seemed unable to recognize the risks caused by knowledge deficit or incompetent practice. Further, he made no attempt to modify his opinion on subsequent questioning. Such an observation was rather unexpected.
What may be the reason for the ambivalence toward truth-seeking as shown in these interview data? As experienced nurses, one would expect them to be well rehearsed in the nursing process, which includes systematic fact-finding, cross-checking of references, and evaluation of patient problems based on objective evidence. Yet, there is little evidence of their employing this line of inquiry when asked to comment on non-clinical situations during the interviews. Respondent E1's response may have given us a clue when she said "Liu mianzi". Could she be referring to some sort of unspoken customs that may have influenced her way of managing the conflict with her colleague? Specifically, does one have to be culturally sensitive in order to appreciate how the Chinese pursue the truth? In the following, the interview data will be interpreted in the cultural context to see if there is another way of understanding what was said.

Since harmony is the foundation of the Chinese culture and it underpins the communication processes and interpersonal relationships in the Chinese society (Gao, Ting-Toomey & Gudykunst, 1996; Bond, 1991), it will be the basis for our interpretation of the interview data. To the Chinese, maintaining harmony is of paramount importance, whether this is in the form of living in harmony with family members, or to be on good terms with friends and neighbours. Communication is an important means of maintaining harmony in Chinese culture, and there are unique features in the Chinese communication processes which help to preserve peaceful relations with one's family, friends and neighbours. Two of these features are of particular relevance here, namely, hanxu (implicit communication) and mianzi (face-directed communication strategies).
2.1.1 \textit{Hanxu (Implicit Communication)}

Chinese communication tends to be contained, reserved, implicit, and indirect (Gao, Ting-Toomey & Gudykunst, 1996; Bond, 1991), aptly described by the Chinese phrase ‘\textit{hanxu}’ (‘\textit{han}’ means ‘to contain or reserve’ and ‘\textit{xu}’ means ‘to store or save’). In this mode of communication, one does not spell out everything but leaves the ‘unspoken’ to the listeners. Implicit communication helps to maintain group harmony because when there are things left to be said, there is room for ‘free advance and retreat’. This apparent lack of expressiveness observed in the everyday life of the Chinese is the opposite of the overt expression seen in the Western culture and is documented in various cross-cultural studies (Bi, 1994; Zhang, 1994; Smith, 1991; Argyle et al., 1986). Under this code of practice, Chinese are reluctant to express their personal emotions openly, especially strong and negative ones. Indeed, revelation of one’s deep and personal feelings is considered to be ‘shameful’ (Kleinman, 1980). Further, verbal exchanges are seen as means of expressing affect and strengthening relationships. This code of practice may explain why argumentative and confrontational modes of communication are avoided by the Chinese at all costs. In this context, it is understandable that Respondent E1 chose not to confront her colleague, for the fear that confrontation might place them in an unmanageable situation and cause damage to their existing relationship.

2.1.2 \textit{Mianzi (Face-directed Communication Strategies)}

The notion of ‘face’ permeates every aspect of interpersonal relationships in the Chinese culture (Gabrenya & Hwang, 1996; Gao, Ting-Toomey & Gudykunst,
The importance of ‘face’ is succinctly described by the famous Chinese writer Lin Yu-Tang who once said “... Not to give a person face is the utmost height of rudeness and is like throwing down a gauntlet to him in the West” (Lin, 1935, p.201). In this respect, face management is essential to maintain the existing role relationships and preserve interpersonal harmony, and the concern for face significantly influences Chinese communication processes (Gabrenya & Hwang, 1996; Gao, 1994; Bond & Lee, 1981). Situations that are likely to threaten one’s and/or others face are avoided by the Chinese. Conflict is considered as a face-threatening situation as it invites direct confrontation and overt disagreement with the other person, particularly if the disagreement becomes public. Amongst the Chinese, conflict is typically handled in a non-confrontational manner (such as avoiding the issue) so as to protect the ‘face’ and preserve harmony. This may be another reason why respondent E1 decided not to confront her colleague.

Another way of protecting ‘face’ is to use an unassertive style of communication in interpersonal interactions. In this manner of communication, intentions or disagreements are deliberately articulated indirectly, thus leaving room for negotiation in private. Contrary to the Western culture, assertiveness does not have positive connotations in Chinese culture. To the Chinese, assertiveness is seen as something that threatens the harmony and cohesion of interpersonal relationships, and is generally avoided. It may be argued that the comments given by respondents E4 and E5 about the official report belongs to this unassertive style of communication. Even though these respondents detected incompleteness in the official report, they
expressed their views in such a way that direct confrontation with the ‘official’ was avoided. As quoted earlier, respondent E5 said:

“I don’t think the report tells us why so many people perished in the fire. There may be a good reason why the report has left out so many things...I would imagine that it is difficult, if not impossible, to find out what really happened in the ‘Carley Fire’.”

Respondent E4 also expressed, “What can we learn from this report? Well, not much really but then I don’t expect the report to come up with anything new. There has been such extensive coverage of the fire, by the newspapers and television, that I think everything about the fire has been looked at already.”

There have been suggestions that the face-saving and face-negotiating strategies used by the Chinese may not be compatible with honesty and truthfulness (Gao, Ting-Toomey & Gudykunst, 1996; Bond, 1991). Gao and associates suggest that the Chinese would consider the provision of appropriate information at the appropriate time and context with the appropriate persons as a more desirable process than is honest and truthful communication. Bond also refers to a basic rule honoured in the Chinese culture: ‘Honor the hierarchy first, your vision of truth second’ (p.83). In his view, most Chinese would sacrifice their credibility to save face. Seen in this light, the apparent reluctance of the respondents to ask challenging questions for the fear of hurting people’s face and disrupting harmonious relationship is understandable, and they are merely reflecting a facet of the social behaviour so ingrained in the Chinese.
To an outsider who is used to having impersonal rules, frankness and equality as the social norms, the Chinese social behaviour of 'bending reality' and 'side-stepping differences' may be unacceptable. Indeed, Chinese have been accused as 'evasive' and 'duplicitous' by Westerners while Chinese consider Westerners to be 'insensitive' and 'blunt' (Bond, 1991). These differences of opinions may be better understood in the cultural context. In Western cultures where the pursuit of truth supersedes the maintenance of relationships, false utterance is a serious matter. On the other hand, in Chinese culture, protection of relationships is construed to be of a higher good than a slavish adherence to the so-called 'truth'. This difference in social thinking is of significant importance when we analyze the student nurse educators' disposition to truth-seeking in this study. It may be argued that these respondents have been socialized to put harmony first even though this may interfere with the pursuit of truth.

In addition to the use of implicit communication and 'face-protecting' strategies, uncritical acceptance of 'expert opinion' is evidenced in the interview data. The expert opinion may be in the form of an official report, promotion decision, or expert judgment. While it is understandable that these respondents, all of them experienced nurses, should value the importance of expertise, their uncritical acceptance of 'the experts' and 'the system' is interesting. It is inconceivable that in their experience, they have not come across conflicting views of the experts, given that different schools of thoughts do exist in the management of medical conditions. Further, it would be unlikely that they have not seen a dubious case of promotion decision under
the existing system. What then may account for their uncritical acceptance of expert opinion?

When such uncritical acceptance of expert opinion is examined within the framework of the Chinese culture, then their behaviour is explainable. It may be that what is observed here is a reflection of the Confucian ethic, a pervasive feature that has regulated Chinese social behaviour over the centuries and sustained the marked status differentials still evident in the Chinese society today. In this context, hierarchy is emphasized in role relations and Chinese people are oriented towards finding their place in this hierarchy. In such a hierarchical structure, not everyone is entitled to speak as there are conditions associated with speaking (Gao, Ting-Toomey & Gudykunst, 1996). Usually recognition is derived from one’s expertise on a subject based on years of experience, education, or power position. Speaking is generally reserved for those with such recognition, for example, parents (as in the case of family) and superiors (as in the case of work). Hence, a ‘spoken’ voice is equated with seniority, authority, experience, knowledge, or expertise. The official report as referred to in the interview belongs to this category. Chinese people are socialized to accept what is said by those in authority (e.g. parents, teachers, employers, and government officials). This uncritical acceptance is known as ‘tinghua’ (to be obedient, to listen and not to voice own opinions), a cultural belief that has permeated the Chinese socialization process. Chinese children are expected to listen while their elders talk, to respect and never to challenge. The same expectation also exists in work relationships. A good employee is one who practices ‘tinghua’, that is, to do
what s/he is told, is willing to meet others' expectations, and to accept others' criticism (Zhuang, 1990).

The opposite of 'tinghua' is 'buanzuei' (talk back). Challenging and questioning others is a form of buanzuei. Buanzuei is considered as highly undesirable as the authority of the elders or superiors is seen to be challenged. Such challenging behaviour is considered as disobedient and it upsets the established hierarchical relationships and social harmony (Wu, 1986). Thus, Chinese people have been socialized not to engage in buanzuei from a very young age. In this cultural context, perhaps one can understand why the respondents are reluctant to ask challenging questions in this study.

While culture may have provided a useful backdrop for interpreting some of the utterances in the interviews, it should be pointed out that it has not provided all the answers. For example, how does one explain the seemingly 'stubbornness' of Respondents E3 and C2: the former believes that good communication is important for the psychiatric patients only, while the latter fails to acknowledge that knowledge, skill, and attitude play an equally important part in ensuring safe practice. Factors other than culture are likely to have influenced their beliefs. As they both referred to their own experiences when expressing their beliefs, it is likely that personal experience and work socialization may have influenced their thinking.

It should also be said that the Chinese are not the only people that have their social behaviour controlled by culture. Indeed, culture and society as controlling
mechanisms of behaviour has been postulated in non-Chinese cultures and societies as well. Notably, the postulation of Durkheim (1964) which states that cultural order and normative regulation are instrumental in preventing sociocultural collapse and eruption of chaos. However, what is significant about the Chinese socialization of behaviour is its pervasive nature and the form it takes. It is pervasive in that not only does it permeate the Chinese societal structure, it has also remained relatively unchanged through centuries of tradition. The pervasiveness is largely due to the grip that Confucianism has on Chinese society. The form of Chinese social behaviour is also distinctive, with an emphasis on moderation and harmony that reflects the Confucian Doctrine of ‘Zhong Yong’ (the Mean).

To summarize, there is no evidence in the interview data that the respondents are positively disposed to truth-seeking. It is suggested that within the Chinese cultural context, much of this observation can be explained. The Chinese simply value harmony in interpersonal relationships more than the pursuit of truth. They are, therefore, reluctant to challenge authority or ask searching questions if it means that social harmony is likely to be disrupted by their action.

2.2 Inquisitiveness

Inquisitiveness as a critical thinking disposition refers to "one's intellectual curiosity and one's desire for learning even when the application of the knowledge is not readily apparent" (Facione, Sanchez & Facione, 1994, p.5). Earlier, the quantitative data have shown that the student nurse educators were positively disposed to
inquisitiveness throughout the study but consistently showed ambivalence toward truth-seeking. As the search for knowledge is involved in both inquisitiveness and truth-seeking, would positive score in inquisitiveness contradict ambivalent score in truth-seeking?

A close examination of the CCTDI test items, however, reveals that there are subtle differences between inquisitiveness and truth-seeking. In truth-seeking, the emphasis is on making judgment and forming opinions, as demonstrated in the following test items:–

*It's never easy to decide between competing points of views*

*Even if the evidence is against me, I'll hold firm to my beliefs*

*It's impossible to know what standards to apply to most questions*

Thus, in the context of truth-seeking, knowledge is seen as a means to an end – one seeks the best knowledge in order to make objective and sound judgment. On the other hand, inquisitiveness emphasizes the motivation to learn, as shown by the following test items:–

*Studying new things all my life would be wonderful*

*I look forward to learning challenging things*

*Learn everything you can, you never know when it could come in handy*
In the context of inquisitiveness, knowledge is seen as an end in itself. Hence, although the pursuit of knowledge features in both inquisitiveness and truth-seeking, the purpose it serves for each is quite different. It would appear that a positive score in inquisitiveness does not necessarily contradict an ambivalent score in truth-seeking. Further, a positive disposition toward inquisitiveness shown as a keenness to learn is evident in the interview data and this is observed in the experimental and control groups, as demonstrated by the following examples:

At the first interview, when asked to comment on her current learning experience, respondent E1 of the experimental group was positive:

"One good thing about using the PBL method is that while I am looking for information, I may stumble across issues that I have never given any thought to before. For example, I was looking for something on 'how to conduct clinical teaching' the other day, quite accidentally I noticed this book on 'Ethics of Education' by R.S. Peters. I had never thought about the association of ethics and education before then. I read the book and it was thought provoking. Well, it did not help me to solve the problem which I was supposed to be working on but it certainly made me re-think my role as an educator."
Respondent C1, in the control group, was equally positive:

"I try to read as much of the study materials as I can. It takes a lot of time, as I have to work out the meaning and understand what I read. It's hard work but I enjoy it though. It is exciting finding out all these new things and it has helped me to develop a deeper understanding of what's happening around me. I hope I can still do this after the course."

The positive attitude toward learning was undiminished when the respondents were asked again to comment on their learning experience at the second interview six months later. Respondent E4, in the experimental group, said:

"After spending a long time reading the articles, I then realize that most of them are not appropriate for the assignment. But I don't consider that as time wasted because I have learned something new. Even though the information may not be relevant for the assignment, it has increased my knowledge and that could be useful later."

Similar enthusiasm was detected in the control group at the second interview, as respondent C3 explained:

"Sure, I have learned a lot since coming on this course. Some of the topics such as the philosophy of education may not be applicable to my work right
now. However, the new knowledge has broadened my thinking and I am glad that I have chosen to study this course."

The above comments were typical of the replies received from the respondents. They appeared to be highly motivated and eager to get the maximum benefits from the learning experience. As one of the key objectives of problem-based learning is increased motivation for learning (Barrows, 1986), the high level of motivation reported by the experiment group is not unexpected. Interestingly, similar reports are also obtained from the control group. With both groups reporting high level of motivation in learning, one has to look beyond problem-based learning as the sole driving force behind their desire to learn. When the educational experience of the respondents is examined, it is obvious that they share certain common factors: they are local people who have been socialized into the Chinese culture and have come through the local educational system. Indeed they would fit the label of the ‘Chinese Learner’ as described by Watkins and Biggs (1996). The authors describe a Chinese learner as someone whose conceptions of and approaches to learning is derived from a Confucian-heritage culture; and unless this learner is viewed within that cultural context, it is easy to misinterpret the puzzling phenomena, resulting in the so-called ‘paradox of the Chinese learner’ (p.269).

In order to understand the attitude of the Chinese learner toward learning, one has to appreciate the value of learning in the Confucian tradition. Within the Confucian-heritage culture, learning is highly regarded. Confucius himself depicted his life-span development as a learning process and the opening sentence of Confucius’s Analects
(1.1) refers to the significance and joy of learning: "Is it not pleasant to learn with a constant perseverance and application?" Confucius's conception of learning was a process of "studying extensively, enquiring carefully, pondering thoroughly, sifting clearly, and practising earnestly" (The Mean, XX.19). For those who are raised in the Confucian-heritage culture, they would be socialized from a very young age to value the importance of learning. Specifically it is learning for self-realization, which embodies personal growth and ultimate human perfection. Self-realization reflects the Confucian belief in the intrinsic significance of education (Lee, 1996). In the excerpts cited earlier, all four respondents made direct or indirect references to this intrinsic significance. Respondent E1 referred to her re-thinking her role as an educator after reading R.S. Peters' chapter. Respondent E4 valued the new information even though it was not be relevant for the immediate task. Respondent C1 found that he had developed a deeper understanding of the circumstances through having to work out the meanings of what he read. Respondent C3 thought that the new knowledge had broadened her thinking.

While intrinsic motivation is an important driving force for learning, the Chinese are also pragmatic enough to recognize the utilitarian function of education (Lee, 1996; Salili, 1996). The following idioms confirm the Chinese belief in the extrinsic rewards of learning:

"Although studying anonymously for ten years, once you are successful, you will become well-known in the world" and,

"There are golden houses in books and there are beautiful girls in books".
It seems that paradoxically in the Confucian tradition, the aspiration for extrinsic rewards coexists with the ideal of human perfection. Extrinsic factor as a motivation of learning was evident among the respondents, as some of them said:

"The qualification of a postgraduate diploma would be useful for gaining promotion." (Respondent E4, experimental group, at the second interview)

"I have not decided yet if I am going to find a teaching job after this course. I may try to use the PgD qualification to get into management."

(Respondent C3, control group, at the second interview)

The belief that upward social mobility could be achieved through educational success is evident in the above excerpts, and it seems to co-exist with the ideal of personal growth as expressed earlier by the same respondents. Judging by what they said, these respondents appeared to accept the intrinsic and extrinsic importance of learning.

Apart from the influence of the Confucian tradition, one may argue that the educational system in Hong Kong is likely to have influenced the motivation of these respondents as well. Hong Kong education is strongly influenced by the highly-competitive public examinations system (Tang & Biggs, 1996). The examinations are conducted by an agency external to the school system itself, and in English which is a foreign language to virtually all the local students. With limited places in tertiary education, there is great pressure on the students to achieve good examination results.
In addition to the highly-competitive examination system, the school curriculum in Hong Kong is set at an unreasonably high standard (Salili, 1996). In this harsh learning environment, many less able students are screened out; and for those who survive, they would have developed a high level of motivation in order to keep up with the demands. The respondents in this study belong to the latter as they have successfully come through the educational process. Thus, it may be argued that their high motivation in learning as observed here is to be expected.

In addition to the cultural and educational influences, parental expectation is an important factor in sustaining the high motivation of the local students. Many of the parents are immigrants from China. They are highly ambitious people and see education as a means of gaining upward social mobility for their children. They would go to great length to help their children achieve in school, including the hiring of private tutors. In return, their children feel obliged to achieve academic excellence as in the Confucian tradition academic success is pride for the entire family. Failure, on the other hand, is a stigma and the face of the family is threatened (Salili, 1996).

With the combination of the Confucian emphasis on learning, the parental expectation of academic achievement, and the need to survive the highly competitive educational system, it is not surprising that the local students are highly motivated and socialized for achievement. The diligence and will power of the respondents in this study is best summed up by the following excerpts:-
"We divide up the task of gathering information between us. Then I read the
articles, underline the important points and make notes. I try to understand as
much as possible because that helps me to relate what I read to the problem
situation in the scenario. If I don't understand something, I take it to our
group discussion and share it with the group. I find the PBL tutorial very
useful as we can examine information in detail, debate about its meaning,
apply it to the scenario, and decide whether it is appropriate or not. At first, I
was not used to this method of learning and found it very difficult as there
were no lecture notes or handouts. Also, I did not know where to begin when
I went to the library to find information. The scenario did not seem to offer
any hint either. I got very frustrated at one point. I think everyone in the PBL
group felt the same. Then gradually I figured out what was relevant for the
scenario and what wasn't and I learned to focus on the learning task. As a
group, we also developed an understanding of the PBL method and a strategy
of working through the scenario before rushing off to the library to get
information. It was not an easy process, more like trial and error at first. But
we finally grasped what PBL was about and became quite good at it, I think!"
(Respondent E2, experimental group, at the first interview).

"Because there is so much to read for the portfolio assignment, we share out
the reading in the group. This way each of us has only to read a few articles.
It allows us to really understand what we read and think about what we should
include in the assignment. In the beginning, we were very unsure about what
to include in the portfolio as we had no experience with this kind of
assessment. The discussion was very useful, we debated about what was required for the portfolio. It was hard at first as we had no idea whether we were right or not. But bit by bit, we came to understand what was required of us in the portfolio assessment. Then we felt better. I think the portfolio is a much better way of testing what we know. The discussion is good for the thinking process too because in the discussion some one might challenge my thinking and I have to justify what I say. Sometimes I get stuck on a point, and the others would come in and help me out. It is useful to hear different views because it makes me think.” (Respondent C5, control group, at the first interview).

Respondent E2’s detailed description of how she and her group ‘learned’ their way through the problem-based learning process was quite typical of the accounts given by the other respondents in the experimental group. Through their determination and effort, this group successfully overcame the initial difficulties when they first embarked on the problem-based learning process. Similarly, respondent C5’s account of how his group came to grips with the portfolio assessment was also mentioned by the others in the control group. These accounts are indicative of these respondents’ commitment and diligence to learning.

While the interview data indicate that the respondents are highly motivated, another interesting finding is also noted. The respondents from both groups mentioned the use of group learning. As problem-based learning encourages students to work as a group in the learning process, the adoption of group learning by the experimental
group is not unexpected. However, the use of group discussion as observed in the control group is a surprise finding. The portfolio assessment that respondent C5 refers to is an individual assignment and group work is not required. From the description given, it appears that the group learning as employed by the control group is rather effective. It has provided opportunities for clarification of confusing points and generation of alternative views, all of which would help them prepare for their assignment. As the respondents did not offer much explanation for using this approach other than "we have found this to be a more effective way of working"; a speculation will be made here as to why the control group also adopts a group learning approach.

The spontaneous forming of study groups without any prior instruction from the teacher is referred to as 'Spontaneous Collaborative Learning' (SCOLL) by Tang (1996, p.188). In addition to the spontaneous initiation of the learning group, the students also decide their own structure of the group and the types of group activities. Within this student-centred collaborative learning, there are no teacher-student interactions. Often the teacher is not even aware of the existence of such an arrangement, as in the case of this study. It has been suggested that students form collaborative learning group because they perceive a felt need to do so and the felt need may be explained from both cultural and contextual perspectives (Tang, 1996).

According to Tang, the preference for collectivism in the Chinese culture may be responsible for the formation of spontaneous collaborative learning group. In a collectivistic culture, achievement through cooperation and mutual dependence is
encouraged (Hofstede, 1980). Thus, forming collaborative learning group is a natural process in such a culture. Further, from a contextual perspective, the formation of a spontaneous collaborative learning group may be prompted by the nature of the assessment and the students' competency in the English language. Writing a portfolio assignment was a new experience for the respondents in this study and a discussion group would be perceived as a means of providing mutual support. The reading and comprehension of reference materials, an integral part in the preparation of the assignment, requires the students to have a reasonable command of English. For those who fall short of this requirement, comprehension of the reference materials would be perceived as a difficulty requiring assistance. By forming a collaborative group in learning, understanding can be facilitated through group discussion. In this way, collaborative learning serves as a mutual support system. Whatever may be the reason for collaborative learning in the control group, it seems to have helped them understand the requirements of the portfolio assessment and approach their learning task in a positive manner.

Spontaneous collaborative learning is not just confined to the Chinese culture (Goodnow, 1991). However, what is significant about the Chinese SCOLL is the high incidence of its occurrence. Tang (1996) reported that nearly 90% of the students in her study engaged in SCOLL. In this study, the self-reports of the respondents suggested that all those in the control group were involved in spontaneous collaborative learning, a rather unexpected and interesting finding.
In conclusion, a high level of motivation was expressed by the respondents at the first and second interviews. While problem-based learning may be responsible for promoting the motivation of the experimental group, it cannot account for the equally high level of diligence and commitment demonstrated by the control group. Thus, consideration has to be given to the possibility that certain factors may be responsible for initiating and sustaining the high level of motivation in these respondents. The Confucian ethic of valuing the importance of education, the harsh and highly competitive educational system in Hong Kong, and the parental expectation of academic achievement have been suggested as the possible factors. This may explain why all the respondents have demonstrated a high level of motivation to learn regardless of which group they are in.

2.3 Analyticity, Systematicity, Critical Thinking Self-confidence and Cognitive Maturity

As described earlier in the quantitative findings, similar patterns of development and group differences were observed in the dispositions of analyticity, systematicity, critical thinking self-confidence and cognitive maturity. Specifically, at the beginning of the experiment, both experimental and control groups were ambivalent toward these four dispositions. By the end of the experiment, the experimental group was significantly more positive toward the dispositions compared with the control group. The group differences continued six months after the experiment, with the experimental group maintaining a positive tendency to all four dispositions. In view
of the similarity observed, is it possible that these four dispositions have something in common?

A careful examination of the descriptions of analyticity, systematicity, critical thinking self-confidence and cognitive maturity reveal that there could be a common factor. As analyticity is about valuing the use of reasoning and evidence when solving problems, systematicity is being organized, orderly, focused and diligent in problem-solving, critical thinking self-confidence is the faith one has in one's own ability to resolve problems rationally, and cognitive maturity is being prudent when solving problems, it is apparent that problem-solving features in all the four dispositions. With this in mind, the respondents were asked to describe what they would do when faced with a problem.

Some of the respondents in the experimental group used the problem-based learning experience as an example of how they overcame problems:

"The first time when we were presented with the PBL scenario, we had no idea as to what we were supposed to do with it. It was nothing like what we had before. We were even more puzzled when we were asked to raise more and more questions about the scenario instead of coming up with solutions! In the past, when we had scenario given to us, we were required to find solutions to the problems. In the PBL scenario, the problems were not always obvious, and we had to sieve through the information in order to identify the problems. We gradually learned to do this with some sort of focus and organization,
otherwise we could talk for hours and get nowhere. After a bit of practice, I think we did quite well. Our reasoning and decisions were generally sound. Perhaps it was because we have been used to solving problems every day. In fact when we solved problems in PBL, we had more time to think and more people to help us in making decision, unlike the work situation.” (Respondent E3, at the first interview)

“We soon realized that the best way to handle the scenario was to treat it as a problem situation. We worked out what the problems were, what did we know already that might help solve the problems, what was it that we didn’t know and had to find out. Once we had enough information, we then put together a number of possible solutions. Finally we had to weigh up the pros and cons of each and decide on the best solution. What happened was that although PBL was new to us, problem-solving was not, and once we worked out the similarity between the two, we became quite good in reasoning our way through the problem-solving process and came up with some really good solutions.” (Respondent E5, at the first interview)

The problem-solving process, as revealed in the above excerpts, was representative of those described by the other respondents in the experimental group.

Some of the respondents in the control group also described how they solved problems in relation to their learning experience:
"Well, before I started on this course, I seldom reflected on the way I solved problems. There was so much to do already and I tried to do the best I could. Since I started here, I have learned to think a little before I tackle a problem. The thinking is useful because it allows me to consider the consequences of my action. Often what I do has a knock-on effect on the other staff. The thinking enables me to plan my action so that it is more effective and fits in better with the rest of the team." (Respondent C1, at the first interview)

"The lectures are useful but they don’t necessarily teach me how to deal with real situations in clinical teaching. I have to mentally apply the text-book examples to the real situations that I have to face every day. The lectures are nothing like the real clinical teaching situation where I have to teach different students in front of the patients on a busy surgical ward. When I relate what I learn in class to my work situation, I am then able to work out what is relevant and what isn’t. Also, I try to identify common problems that I face in clinical teaching, and see if better solutions could be found in the books." (Respondent C5, at the first interview)

Judging by their responses, these respondents appear to be used to solving problems. As experienced front-line nurses actively involved in professional practice, perhaps this observation is to be expected. Schon (1991) likens the reality of professional practice to a swampy lowland where messy, confusing problems that defy technical solution confront the practitioner. In these “indeterminate zones of practice” (p.6) as described by Schon, the professional practitioners (which include the respondents in
this study) have to frame problems out of messy, indeterminate situations, to implement actions in uncertain environments that "escape the canons of technical rationality" (p.6), and to do so with "an art of improvisation" (p.13).

Schon’s ‘messy lowland indeterminate zones of practice’ is clearly portrayed in the 1996-97 Annual Plan of the Hospital Authority (Hospital Authority, 1996), the period when this study was conducted. The five Corporate Strategies, as stated in the Annual Plan, were to be achieved in a 12-month period and had major implications for users as well as practitioners of the local health care services. Initiatives such as re-organization of health care provisions, organization transformation, and corporate innovation would have major impact on the local health care environment. The Core Strategies required practitioners to assess health needs, establish health care priorities, implement seamless care, and evaluate the efficiency and effectiveness of health care interventions. In short, practitioners operating within this environment would be familiar with the problem-solving process of assessment, planning, implementation, and evaluation. Working in such an environment, it is not surprising that the respondents from both experimental and control groups are familiar with problem-solving, as shown in the excerpts of the interview data. In addition, the two respondents from the experimental group clearly demonstrated how they used their problem-solving experience to manage the novel problem-based learning process, as demonstrated by the following:
"...After a bit of practice, I think we did quite well. Our reasoning and decisions were generally sound. Perhaps it was because we have been used to solving problems every day..." (Respondent E3, at the first interview)

"...What happened was that although PBL was new to us, problem-solving was not, and once we worked out the similarity between the two, we became quite good in reasoning our way through the problem-solving process and came up with some really good solutions." (Respondent E5, at the first interview)

In the above excerpts, respondents E3 and E5 seemed to be quite confident about their own problem-solving ability. This supports the quantitative findings that the experimental group was positively disposed toward critical thinking self-confidence at the end of the experiment.

In the case of the control group, the respondents talked about problem solving in a more general way. They made some references to their problem-solving ability though they did not express it as confidently as the experimental group:-

"...The thinking enables me to plan my action so that it is more effective and fits in better with the rest of the team." (Respondent C1, at the first interview)
"...When I relate what I learn in class to my work situation, I am then able to work out what is relevant and what isn't..." (Respondent C5, at the first interview)

Further, when the experimental group talked about their problem-based learning experience, their approach in problem-solving became quite obvious. Earlier, E3 explained how his group tackled PBL problems in a focused and organized manner. Similarly, the problem-solving process described by E5 had the hallmark of a systematic and analytical approach. Further examples of an organized, focused, and analytical approach in handling PBL problem situations were offered by other experimental group members:-

"It was important to examine carefully all the questions that we came up with in relation to the problem situation. There was no way that we could find answers for all the questions. It meant that we had to analyze each of the questions and decide which ones were more relevant to the problem and would be worked on." (Respondent E1, at the first interview).

"I found the PBL tutorial very useful as we were able to examine information in detail, debate about its meaning, apply it to the scenario, and decide whether it was appropriate or not." (Respondent E2, at the first interview)

The organized, focused and analytical approach in problem-solving as described by these respondents gave support to the quantitative findings that the experimental
group was positively disposed to systematicity and analyticity at the end of the experiment.

Also, the realization that some problem situations were inevitably ill-structured was acknowledged by some of the respondents in the experimental group:-

"Quite often it was difficult to decide which was the most suitable solution for the problem that was implied in the scenario. There were always missing data in the scenario. We found that most of the solutions were tentative only, and could be modified or even rejected when new information came to light. Just like the real-world! You never know for sure if the decision you make today is still good enough tomorrow. Well, such is life!" (Respondent E4, at the first interview)

"One good thing that I have learned from PBL is that there is nothing absolute about a decision!" (Respondent E1, at the first interview)

Such acknowledgment supported the quantitative findings that the experimental group was positively disposed to cognitive maturity at the end of the experiment.

Comparatively speaking, as the earlier examples showed, respondents of the control group talked about problem-solving in a more general manner, such as relating theory to practice and considering consequences of own decisions. They seemed to recognize the importance of finding the best solutions but did not give specific details
as to how such solutions would be formulated. Thus, based on the interview data, it was not possible to say if the control group was positively disposed toward analyticity, systematicity, critical thinking self-confidence, and cognitive maturity. The question is thus raised: could the different learning experiences be responsible for the group differences observed in the interview data? To be precise, is it possible that as a result of the problem-based learning experience, the students develop an approach in problem-solving that is different from that of the students taught by the traditional method? In order to answer this, the possible association between problem-solving and learning experience will now be examined.

As explained earlier, the traditional approach to teaching views knowledge as a commodity to be transmitted to students whose responsibility is to learn it. Lecturing, a primary mode of the traditional teaching method, has a long tradition and continued predominance but fails to recognize students as active agents. In this passive mode of learning, students simply accumulate knowledge provided by the teacher (Biggs, 1993; Meyers, 1986; Gilbert & Watts, 1983). Knowledge acquired in this manner is detached from the students, who would not readily apply it to novel problem situations (Lai, Tiwari & Tze, 1997).

Problem-based learning, on the other hand, incorporates the contemporary views of education, which emphasize active construction of knowledge by students as they engage thoughtfully with information (Cobb, 1994; Driver, Hilary & Leach, 1994). Rather than a commodity that can be simply transmitted from teachers to students, knowledge in the contemporary sense is seen as a product of students’ processing and
making connections between the new information and their prior knowledge. Through the use of real world cases or problems, problem-based learning encourages students to acquire new knowledge in an active and meaningful way and to apply their newly acquired knowledge to novel problem situations when it is needed (Lai, Tiwari & Tze, 1997; Williams, 1993; Needham & Begg, 1991). It has also been suggested that the experience of solving problems during problem-based learning may facilitate later problems to be solved on the basis of similarity (Kolodner, 1993; Brooks, Norman & Allen, 1991). In this study, students who have undergone the problem-based learning process have been shown to be more analytical, systematic, confident and mature about the way they solve problems than their peers in the control group. The same was also observed at the second interview. In particular, the experimental group attributed their enhanced problem solving ability to problem-based learning, as respondent E5 explained:

“I thought I was quite used to solving problems before this course. But having gone through the process of solving paper problems in our PBL, I am now much better in solving problems, real ones! ... Why? ... I think it’s because the paper problems are so typical of the real ones. When I have to deal with similar problems in real situations, I try to remember what our group did when we solved the paper problems. Having examined the problems in such detail in our PBL tutorials and debated the pros and cons of the various solutions at great length, I feel quite confident to apply the solutions to real problems. PBL has helped me to understand problem situations and solve clinical problems.”
Respondent E3 also confirmed this, "I have read somewhere that PBL is not
the same as problem-solving, but the experience of learning to solve the
problems in the PBL scenarios has made me better in problem-solving. For
example, having to plan a comprehensive clinical education programme for
nursing students is a challenge to most nurse educators, especially for novice
like me. This is precisely what I had to do recently. Fortunately, in our PBL
we had to work through a scenario quite similar to this. When I did the
programme for real, I remembered what we discussed in the tutorials and the
essential principles we applied to the scenario. I realize now how much I have
learned from solving problems in PBL."

Both of these respondents remarked that problem-based learning had helped them
solve problems in real-life. They also mentioned the recall of previously learned
knowledge and applying it to similar problem situations. There is a theoretical basis
for what they said. It has been suggested that knowledge is much better remembered
or recalled in the context in which it was originally learned (Norman et al., 1985).
That is to say, if the knowledge is required to solve a particular problem, then it
should be learned in the same context as that particular problem. Indeed, in a
comparison of PBL and non-PBL students, Claessen and Boshuisen (1985) found that
PBL students were better able to recall information in the context of patient problems
- the context in which they learned their knowledge and skills. Based on the self-
reports of the experimental group respondents, it would appear that they acquired
certain knowledge while solving clinical education problems in the problem-based
learning process, and were able to recall and apply it to similar real-life situations
later. It should be pointed out that the enhancing effect of problem-based learning on problem-solving was still acknowledged by these respondents six months after the experience of problem-based learning.

On the contrary, the control group did not associate their enhanced problem-solving ability with the educational experience, as seen in the following excerpts obtained at the second interview:

"I learn to solve problems and make decisions by physically doing them. There are always problems in the work situation and I have to know what to do for each of them. I was so unprepared at first, but gradually I learned the skills of solving these problems through practice and trial and error, and some of them were quite tricky indeed." (Respondent C2).

"The clinical situation is so demanding. I have to deal with problems a lot of the time. Through having to solve problems, I have become a better problem-solver. I have learned from situations in which I did badly, as well as the ones that I did well. It is learning from experience, I suppose." (Respondent C4)

Unlike the experimental group, the control group attributed improvement in their problem-solving ability to the experience gained from real situations.

At the second interviews, differences were also noted between the groups in the way the respondents described how they dealt with a problem. The experimental group
typically described the problem-solving process in a detailed and structured manner, with minimum prompting, as in the following example:

When I encounter a problem nowadays, I look at the face-value of the problem, then I look at the not so-obvious. Sometimes, what may appear to be the problem is in fact not the real problem. For example, a patient may complain that he can’t sleep because of the noise in the ward, but in fact he is so worried about his operation the next morning that he is unable to sleep. In this case, there is a physical as well as a psychological cause to his problem. If I only focus on the physical cause, I won’t help him very much. Thus, it is important to analyze the problem, work out the possible causes and see how the causes could relate to each other. Then, it’s time to collect information, this would help me confirm or reject the initial diagnosis. Once the problem and its causes are confirmed, I have to work on the solutions. Some of the solutions are better than others, so I have to make a choice as to which is the best solution for the situation. Generally speaking, if I have enough information about the problem, choosing the best solution is not too difficult. Having applied the solution, I have to see if the problem has been resolved or not. Often the problem is not solved just like that and there are areas that still require further attention.” (Respondent E4)

In this detailed and structured account, problem analysis and confirmation of initial diagnosis were clearly demonstrated and described in an orderly and organized
manner. Evaluation of the solution was also evident, implying that the problem-solver was alert to the potential difficulties when solving problems.

Compared with the experimental group, the control group did not describe the problem-solving process in as detailed and structured manner, for example:-

"The most frequent problem that I have to sort out is getting the old ladies to walk again after their hip operation, otherwise they cannot be discharged home. There is a regime for mobilizing these patients after the surgery. We help them get out of bed and start walking on the third day with the help of the physiotherapist. We have to have a lot of patience as we need to persuade them to take the first step after the operation. We know after they have taken the first step, they will improve after that. It is the initial fear that they have to overcome." (Respondent C3)

Instead of analyzing the clients' problems on an individual basis, this respondent seemed to think that the problems were the same for all the clients:

"The most frequent problem that I have to sort out is getting the old ladies to walk again after their hip operation, otherwise they cannot be discharged home."

Also, no attempt was made to confirm the initial diagnosis. Nor was there any evidence of evaluating the effectiveness of solutions:
"We know after they have taken the first step, they will improve after that."

The explanation given by this respondent failed to demonstrate that an analytical approach in problem-solving was adopted. Similarly, there was little awareness of the potential difficulties that may be involved.

Having examined the interview data, a summary can now be made about the respondents' dispositions to analyticity, systematicity, critical thinking self-confidence and cognitive maturity. At both interviews, the experimental group appeared to be more analytical, systematic, confident and mature about how they would solve problems than the control group. While the experimental group attributed their enhanced problem-solving ability to problem-based learning, the control group attributed their improvement to the experience gained from solving real problems in the clinical setting. The similarity of patterns observed in the quantitative findings is confirmed by the interview data. The dispositions of analyticity, systematicity, critical thinking self-confidence and cognitive maturity appear to have one thing in common - they are related to problem-solving.

2.4 Students' Evaluation of Problem-based Learning

When commenting on their learning experience at the end of the experiment, the experimental group gave detailed accounts about their problem-based learning experience. Their evaluation of this experience is reported here so as to provide a more comprehensive picture of their learning process. In turn, this may create a more
meaningful context for understanding these student nurse educators and how they perceive their world.

All five respondents indicated that they enjoyed their participation in the problem-based learning, in preference to the traditional teaching method. All wanted to have problem-based learning again. In this respect, the students' satisfaction was similar to that expressed by other PBL students (Albanese & Mitchell, 1993). Indeed, one of the students liked it so much that he decided to use problem-based learning to teach his own students:

“I use PBL in the programme that I design for student nurses during their operating theatre experience. I notice that they are much more active and motivated as a result. Before PBL, even though I had all the learning materials prepared for them, they had to be reminded again and again before they would read them. Now, the students take the initiative to find the information themselves.” (Respondent E5).

During the interview, the respondents verbalized their approval and criticism of problem-based learning. In terms of approval, they identified the positive effects associated with the change in their pedagogical practice, as a result of adopting problem-based learning. Their criticism of problem-based learning related to the stressors associated with this learning method.
2.4.1 Change in Pedagogical Practice

The change in their pedagogical practice is evidenced by the respondents taking a more active role in their own learning:

"PBL requires me to know what information I need and where to find it. As a result of PBL, I now have the skills to work out the gaps in my knowledge and know the best way of finding information." (Respondent E3)

"The experience of having to look up information and digest the facts has made me more active in my learning. I am pleased that I am really an independent learner now - something that I was not able to do when I studied for my bachelor degree." (Respondent E5).

The learning approach as described above is very different from that of the traditional teaching method. Instead of passively receiving information from the teacher, these respondents described how they had to find the information themselves and then apply it back to the problem. In other words, they had to be self-directed in seeking the knowledge as well as actively constructing it for application. The adoption of an active and self-directed approach in learning as reported here concurs with the claim that problem-based learning encourages students to become self-directed learners (Norman & Schmidt, 1992; Barrows, 1986). The possession of self-directed learning skill is an asset because as proficient self-directed learners, these respondents would be able to exercise more personal control over their own learning and to use such
metacognitive ability to advance their knowledge (Murray-Harvey, 1993). Keeping up-to-date with the latest knowledge is important in this era of rapid change and development because new knowledge cannot always be envisioned in advance (Rand & Baglioni, 1997).

In addition to being self-directed in learning, the respondents also identified better retention of knowledge as one of the benefits of problem-based learning:

“I find that I learn a lot more from solving the problems in PBL. Also, I can remember much more of what I learn. I think most people learn better and remember more of it if given the chance to solve the problem instead of given the solution.” (Respondent E1)

“Unlike lectures, I have to be much, much more active in PBL. I have to think about what I read in the books and decide how I can solve the problems. The thinking helps me to remember what I learn.” (Respondent E2)

The respondents’ accounts indicate that as a result of having to develop, apply, and evaluate their understanding of the new information, their retention of the newly acquired knowledge has improved. Their accounts concur with the suggestion that better understanding and retention of the learning material is facilitated by problem-based learning (Creedy & Hand, 1995). Working with problems in problem-based learning allows students to select what information to focus on, make judgment about what information is relevant, and determine what is appropriate as a solution. In
essence, they are engaging in student-centred learning through which they construct their own meaning of the situation. During this process of focus, negotiation, and analysis, networks of knowledge are developed (Prawat, 1989). It is the construction of such networks that promote better understanding and retention of the new knowledge (Creedy & Hand, 1995).

The change in the pedagogical practice seems to have a motivational effect on these respondents:

"I am more motivated to learn because I know that what I learn from the scenario will help me do my work later." (Respondent E1)

"PBL motivates me to learn so as to really understand the problem and find a way of solving it. This method of learning is more meaningful to me." (Respondent E2)

The motivation, as described by these respondents, is of an intrinsic nature, that is, it is born from their own interest and their thirst for knowledge (Heron, 1988). Problem-based learning facilitates intrinsic motivation by encouraging students to recognize the significance of, and develop their interest in the learning task (Conrick, 1995). It is evident that both significance ("...what I learn from the scenario will help me do my work later...") and interest ("...motivates me to learn so as to really understand the problem and find a way of solving it...") feature in the respondents' accounts. In addition, these respondents saw their learning as personally relevant. Research in motivation has shown that students who view their academic work as
personally relevant will set high learning goals for themselves and seek to gain mastery over the material rather than merely reproducing it (Hessami, 1995). The respondents' accounts seem to support the suggestion that problem-based learning motivates students to learn.

The respondents' accounts indicate that they have adopted a different pedagogical practice during the problem-based learning process. They take an active role in their own learning and are self-directed in the learning process. The changed pedagogical practice results in better retention of the new knowledge and increased motivation for learning. In all, the respondents are positive about using problem-based learning as a learning strategy.

2.4.2 Stressors associated with Problem-based Learning

Despite the positive benefits, it should be recognized that problem-based learning challenges students to take more responsibility for their own learning - a challenge that could make some of them feel anxious and uncertain (Mullins, 1995). Indeed, the change to problem-based learning could be stressful enough as to elicit a grief response in some students (Cornick, 1995; Woods, 1994). Such reactions are not surprising and are due to the role change thrust upon the students as they abandon their familiar way of learning. A number of concerns about problem-based learning have been expressed by students in various evaluative studies (Albanese & Mitchell, 1993). The experimental group in this study was particularly unhappy about the lack
of resources to support this new learning approach and the extra time needed to complete the problem-based tasks, as described below.

All five respondents complained about the lack of learning resources required for learning the problem-based way, for example:

"We cannot get the information we need. There are not enough books in the library. The books we need are always out on loan. Despite all the periodicals in the library, what we need is never on the shelf! It can be very frustrating indeed." (Respondent E3)

While the complaint of inadequate learning resources is not unique in this case and has been reported in other studies (Prechanond & Poomaporn, 1997; Johnston & James, 1995), the hindering effect should not be underestimated. Without adequate resources, the students would not be able to complete their learning tasks, and could be so discouraged as to abandon their efforts. However, just providing the necessary learning resources is not enough. Students should be helped to improve their information-seeking skills in order to gain maximum benefit from the learning resources available. Also, it should be pointed out to them that one book/journal article is unlikely to provide all the information they need. They should, therefore, aim to develop the skills that would help them select appropriate information from a variety of sources, including those not tried before.
With hindsight, more assistance could have been provided to the experimental group. For example, in addition to the advice given by the facilitator, the library staff should have been involved in working with these students. Not only would this reduce their frustration, it would also help them develop their information-seeking skills, which after all is one of the objectives of problem-based learning.

While all the respondents expressed their concern about the lack of learning resources, the complaint about the extra time needed for problem-based learning was not unanimous. Some of the students were concerned that they had to spend more time in problem-based learning:

"I spend more time looking up information in the library and working through the books than I would have done previously." (Respondent E2)

The difficulty of finding the time for group discussion was also identified as a problem:

"As we are part-time students, getting together in between tutorials is difficult. It does affect our discussion during the tutorial because we don’t know what information other people may bring.” (Respondent E4)

However, not all the respondents thought that problem-based learning demanded more of their time as this one said:
"I have not had to put in more time in this course because of using PBL."

(Respondent E1)

The criticism that problem-based learning is more time-consuming is not new and has been reported in a number of studies (Rand & Baglioni, 1997; Albanese & Mitchell, 1993). Often the problem is due to the mechanics of getting information, which can be quite substantial in problem-based learning. There are means of helping the students to overcome this. One possibility is to make the information more accessible, thus reducing the time needed to collect the necessary information (Rand & Baglioni, 1997). Also, some students may be too anxious about what and how much they should study (Moore, 1991), and are spending more time on the subject than is required. In this case, advising students as to how much time they are expected to spend on the subject per week may help ease the problem. Studies have also revealed that although problem-based students tend to spend more time studying, they are more likely to study for understanding, the kind of quality learning not usually observed in the traditional method (Albanese & Mitchell, 1993). This should be pointed out to the students so that they realize that the time spent in problem-based learning is not wasted. The difficulty of arranging meetings for part-time students is something that was not foreseen by this researcher and would be carefully considered if problem-based learning were to be used again for part-time programmes.

Not surprisingly, all five respondents were unsure about this new approach when they first embarked on problem-based learning:
“The first time when we were presented with the PBL scenario, we had no idea as to what we were supposed to do with it. It was nothing like what we had before. We were even more puzzled when we were asked to raise more and more questions about the scenario instead of coming up with solutions!” (Respondent E3)

To some of them, the uncertainty had a negative effect:

“After this experience, I realize that one has to be very careful when introducing a new learning method such as PBL to students for the first time. If the students do not understand what PBL is and cannot accept it, it can be very depressing for them, just like I was in the beginning.” (Respondent E4)

By giving feedback promptly to students about their group performance in the problem-based learning tutorial and their progress in solving the problem, this could provide the much needed assurance and help reduce anxiety. Although such feedback was given in this study, the respondents’ comments suggested that perhaps it should have been given earlier in the learning process. Also, an introductory lecture session could be incorporated into the problem-based learning process so as to bridge the gap between the familiar didactic method and the totally unfamiliar problem-based learning approach (Tang et al., 1997). Students should also be adequately informed about the concepts of problem-based learning, the study skills required for this mode of learning, and the ground rules for working in problem-based learning groups (Walsh, Aldred, & Aldred, 1997). In this study, all of the above suggestions were
tried, to a greater or lesser extent, and some were more effective than others. It was noted that irrespective of the support provided, the students came to term with problem-based learning through their own effort:

"...But we finally grasped what PBL was about and became quite good at it, I think!" (Respondent E2)

"...After a bit of practice, I think we did quite well..." (Respondent E3)

Such expressions of satisfaction suggest that despite their concerns about some aspects of problem-based learning, these respondents have no desire to reject this form of learning and are positive about their problem-based learning experience. The respondents' approval of problem-based learning is significant as it has been suggested that problem-based learning may not be suitable in Hong Kong, due to the educational and cultural background of the local students (Dixon, Lam, Lam & Ho, 1997). In the following section, accounts of their problem-based learning experience will be examined in the local context.

2.4.3 The Local Context

Dixon and associates suggest that the educational and cultural background of the Hong Kong students may compromise their ability to adopt problem-based learning because they:

- are too used to 'spoon-feeding',
are not willing to speak up in small group sessions,
are only interested in passing their examinations,
like to be told what to learn.

From the respondents' descriptions of their problem-based learning experience, they do not appear to fit the stereotypical image said of the local students. While they may have been used to being spoon-fed in their earlier educational experience, they seem to value the opportunity to be independent in their learning:

"The experience of having to look up information and digest the facts has made me more active in my learning. I am pleased that I am really an independent learner now - something that I was not able to do when I studied for my bachelor degree." (Respondent E5).

Similarly, rather than being reluctant to speak up in small group sessions, these respondents have actively participated in problem-based learning tutorials:

"...If I don't understand something, I take it to our group discussion and share it with the group. I find the PBL tutorial very helpful as we can examine information in detail, debate about its meaning, apply it to the scenario, and decide whether it is appropriate or not..." (Respondent E2)

Furthermore, to these respondents, learning is more than just fulfilling their obligation to complete assignments:
"...After spending a long time reading the articles, I then realize that most of them are not appropriate for the assignment, but I don't consider that as time wasted because I have learned something new. Even though the information may not be relevant for the assignment, it has increased my knowledge and that would be useful later..." (Respondent E4)

In this respect, they seem to learn for an altruistic reason. It should be noted, however, that continuous assessment rather than examination is the mode of assessment for this course. One does not know if they would behave differently in an examination-oriented system.

Finally, instead of taking a passive role in learning, these respondents use their initiatives to decide what to learn:

"...We soon realized that the best way to handle the scenario was to treat it as a problem situation. We worked out what the problems were, what did we know already that might help solve the problems, what was it that we didn’t know and needed to find out..." (Respondent E5)

On the basis of the above accounts, these respondents do not conform to the stereotypical image of the local students. What could be the explanation for this? The study by Kember and Gow (1991) may offer some insight. According to these authors, the stereotype of Chinese students as non-analytical, non-reflective rote learners may be explained more by the curriculum itself and the environment in
which it is delivered, rather than the inherent characteristics of the students. In other words, it is the teaching style, learning environment, and assessment strategy that influence the learning behaviours of the students. In an educational environment that emphasizes authoritative teaching styles, teacher-centred activities, and an orientation to examination achievement, students will take on a passive role in learning. On the other hand, educational methods that promote participatory, student-centred learning will encourage learners to be active and self-directed in learning. Kember and Gow argue that Hong Kong students are just as capable of adopting an active role in learning as the Western students if given the right learning environment. Their claim is supported by other studies which show that Chinese students would approach their learning deeply if exposed to a learning context that encourages the deep approach. Similarly, they would take on a surface approach to learning if the environment favours surface learning (Watkins & Biggs, 1996). All of which suggest that learning environment rather than the inherent characteristics of the students influence their approach to learning.

The active participation in learning as reported by the respondents in this study adds weight to the suggestion that the passive role taken by the local students in their learning is caused by the educational climate rather than the students themselves, and that Hong Kong students are just as willing and able to participate actively in learning.

In conclusion, the students interviewed were generally positive about their problem-based learning experience. The pedagogical practice that they adopt in problem-
based learning is essential for professional education. While much of their anxieties may be an inevitable part of the change process, it is important to reflect on the concerns expressed and ensure that appropriate measures are taken to address the problem areas if problem-based learning is to be implemented in future.

3. **Summary**

The interview data have revealed some interesting findings. The student nurse educators' ambivalence toward truth-seeking could be due to cultural influence. Also, the ambivalence toward truth-seeking does not contradict the positive disposition toward inquisitiveness, and a high motivation to learn has been observed throughout the study in both experimental and control groups. Further, problem-solving appears to be the common factor for the dispositions of analyticity, systematicity, critical thinking self-confidence and cognitive maturity. In this respect, the respondents in the experimental group are more analytical, systematic, confident and mature about how they would solve problems than their peers in the control group. Finally, the experimental group is generally positive about their problem-based learning experience.
CHAPTER SIX

SUMMARY AND RECOMMENDATIONS
CHAPTER SIX

DISCUSSION, CONCLUSIONS, AND RECOMMENDATIONS

This chapter presents the discussion of the results obtained in this study. It further compares the findings with the existing literature. In light of the discussion, a conclusion will be made. Finally, recommendation of areas that require further study are suggested.

1. Discussion

This section examines the results of the pretest, first posttest, and second posttest. In the first place, it compares the experimental and control groups in relation to their critical thinking dispositions. Secondly, it analyzes the relative differences or similarities related to their approaches to learning. Thirdly, the effectiveness of problem-based learning, as identified in this study, are compared with the findings of earlier studies.

1.1 Critical Thinking

The inclination to give serious consideration to additional facts or reasons and to adjust one's beliefs accordingly is important for competent clinical judgment. The extent to which the experimental and control groups are disposed to truth-seeking is thus of significant interest.
An interpretation of the truth-seeking scores is made in accordance with the scoring profile (Facione & Facione, 1997) as described in chapter 3. When the mean scores are examined, there is a striking similarity between the experimental and control groups. This similarity in mean scores continued throughout the experiment and beyond. Also, the pretest, first posttest and second posttest mean scores indicate that both groups consistently show an ambivalent disposition toward truth-seeking.

When compared at the pretest, the mean score of the experimental group is 33.7 and the control group 33.8. Thus, in terms of disposition toward truth-seeking, there is no significant difference between the experimental and control groups at the pretest. Also, a mean score of around 34 suggests that both groups are ambivalent to the need to reconsider decisions in light of new evidence.

It is noted that for the experimental group, there was a mean gain in truth-seeking from 33.8 to 34.0 from pretest to first posttest. However, the gain is too small to suggest any significant growth in truth-seeking. A similar trend was also observed for the control group. Exposure to the educational experience, whether it is in the form of problem-based learning or conventional teaching method, does not appear to have made these student nurse educators more eager to ask challenging questions or more objective in the pursuit of truth. This is certainly not a comforting thought for those involved in educating these students as one would hope that the disposition toward truth-seeking would be promoted through the educational process.

Six months after the experiment, the disposition toward truth-seeking for the
experimental group moved from the first posttest mean score of 34.0 to 34.7, and the control group from 34.2 to 34.6. Again, the gain is not substantial enough to indicate any significant growth in the students' disposition toward truth-seeking. The ambivalent scores demonstrated by the experimental and control groups at the second posttest suggest that they are not particularly keen to seek knowledge which threatens their preconceptions or interests.

While there is little evidence that these nurse educators have become more receptive to a courageous pursuit of inquiry, perhaps one should be relieved that there is no deterioration in this disposition during or after the completion of the experiment.

With regard to open-mindedness, the pretest, first posttest and second posttest mean scores suggest that there is no significant difference between the experimental and control groups in terms of their disposition toward open-mindedness before, during and after the experiment.

With the mean scores for both groups being above 40 in the pre- and post-tests, all the student nurse educators in this study can be considered as positively disposed to open-mindedness. This is encouraging as the results suggest that they are tolerant of new ideas and divergent views and are inclined to monitor their own thinking. Moreover, this positive habit of mind was sustained for the experimental group as these students went through the experience of problem-based learning and continued to do so six months after the experiment.
While the results are positive, a closer examination of the first and second posttests, however, is less reassuring as there is no significant difference between the experimental and control groups immediately and six months after the experiment. In the case of the experimental group, the shift of the mean scores from 41 at the pretest to 42 at the first posttest does not suggest significant gain. With a pretest mean score of 41.2 and a first posttest mean score of 41.6, a similar picture of negligible gain is also observed in the control group. A question is thus raised about the influence of the educational experience in fostering the habit of open-mindedness in these students. If problem-based learning is supposed to assist students to develop a critical awareness of their thinking process and to be open to competing hypotheses, then it has done no better than the conventional lecture method in nurturing these students' open-mindedness.

Earlier, it was revealed that both experimental and control groups demonstrated ambivalence toward truth-seeking throughout the experiment. By examining this ambivalence with the positive inclination toward open-mindedness, one may suggest that while both groups may not be inclined to actively testing the validity of their own views against the differing opinions and evidence advanced by others, they appear to be open-minded enough to respect the rights of others to hold opinions that differ from their own.

The inclination to use reasoning and evidence in problem-solving is a virtue that one would hope to foster in the professional nurse. When the mean scores of analyticity are inspected, the experimental group, although almost identical to the control group
at the pretest, was more positive toward analyticity after the experience of problem-based learning. This positive disposition was maintained six months after the experiment. The control group had also developed a positive disposition toward analyticity, though not as much as the experimental group, as shown in the first and second posttests.

The pretest mean scores of the experimental and control groups are 35.9 and 36.0 respectively. Such midrange scores indicate ambivalence toward analyticity for both of the groups. However, by the first posttest, the experimental group had scored significantly higher than the control group (experimental mean score = 48.2, control mean score = 42.3). Unlike the dispositions toward truth-seeking and open-mindedness, the difference between the groups is significant at the end of the experiment. This result suggests that a positive inclination toward analyticity had developed in the experimental group between the pretest and first posttest. As a positive disposition toward analyticity implies that the person would value the use of reasons and evidence and be sensitive to potential difficulties when resolving problems, this is an encouraging finding. Hopefully, the student nurse educators in the experimental group would be better equipped to solve problems as a result of this educational experience. Problem-based learning encourages students to critically analyze problems and proposed solutions in the learning process. Therefore, it is quite feasible that the experimental group has become more sympathetic to the importance of reasoning and evidence as a result.

Although the control group was not making as much gain as the experimental group
at the end of the experiment in terms of disposition toward analyticity, it was nevertheless becoming more positive compared with the pretest score. One possible explanation is that despite being 'deprived' of structured learning opportunities to practice the reasoning process, the control group was still exposed to problems encountered in clinical education during the lectures. Perhaps even this passive way of learning how to analyze problems had made its impact on the students. Another reassuring sign is that six months after the experiment, the positive disposition toward analyticity was still sustained in the experimental group (mean score = 48.0). While the control group also maintained their positive disposition (mean score = 42.2), the experimental group was significantly more positive toward analyticity.

It was asserted through hypothesis 1.4 that there was no significant difference between the experimental and control group at the pretest with respect to disposition toward systematicity. The pretest result indicates that there is no significant difference between the two groups (experimental mean score = 34.7, control mean score = 34.9). Similar to analyticity, these midrange scores indicate that both groups are ambivalent toward systematicity at the beginning of the experiment.

Had the group scores remained at this level, it would have made worrying reading. One would be rather concerned if professional nurses habitually show ambivalence toward systematic thinking. Happily, the experimental group made a substantial gain from the pretest mean score of 34.7 to the first posttest mean score of 46.7. Thus, by the end of the experiment, the experimental group was positively disposed toward systematicity. One would hope that this improvement is due to the experimental
effect of problem-based learning. As these student nurse educators learn to solve problems during the process of problem-based learning, they develop the skill to approach problems systematically. The acquisition of such skill may have influenced them to value the importance of being organized and focused in thinking.

Six months after the experiment, the experimental group still showed a positive disposition (mean score = 47.0). This finding suggests that the problem-based learning process may still have consequential effect beyond the end of the experiment.

At the first posttest, the control group also made substantial gain, shifting from the pretest mean score of 34.9 to the first posttest mean score of 41.9. However, as indicated in the result of the first posttest, there is significant difference between the experimental and control groups. In other words, while both groups have become more positive toward systematicity, the experimental group has improved more significantly than the control group.

The control group continued on the positive direction toward systematicity six months after the experiment (mean score = 41.4), although not at as high a level as the experimental group (mean score = 47.0). What could have caused the control group to become more positive toward systematicity also? One possibility is that through the experience of being a part-time student, they learn to appreciate the need to be organized and focused in balancing course requirements and work commitments.
The results of the critical thinking self-confidence scale closely resemble the patterns of the scores observed in analyticity and systematicity. The mean scores of the experimental and control groups show that there is no significant difference between the two groups at the pretest. With mean scores of 34.1 for the experimental group and 34.4 for the control group, ambivalence toward this disposition is suggested. However, by the end of the experiment, there is a significant difference between the groups with the experimental group making a remarkable gain between the pretest and first posttest. Although the control group had improved its score also, it was not as substantial as that of the experimental group. Six months after the experiment, both groups had maintained their positive gains, but again there was significant difference between the experimental and control groups in terms of their disposition toward critical thinking self-confidence.

Compared with the pretest, a very different picture emerged at the first posttest. The experimental group reported a mean score of 48, which was a big leap from the pretest score of 34.1. From the position of ambivalence, the experimental group was, by the end of the experiment, positively inclined to trust their own reasoning. While not making as much a gain as the experimental group, the control group also became more positive in this habit of mind, with a first posttest score of 41.3.

The first posttest results suggest that both groups have developed more confidence in critical thinking between the beginning and end of the experiment. In the case of the experimental group, this positive development could be attributed to the experimental effect. During the process of problem-based learning, the students are encouraged to
challenge others' assertions and to defend their own positions. Consequently, they become more confident about their own reasoning ability. Thus, the substantial growth in critical thinking self-confidence as demonstrated by the experimental group at the end of the experiment could be a positive sign that problem-based learning can help students to develop confidence in critical thinking.

As for the control group, the shift from ambivalence to positive disposition at the first posttest could also be due to the educational experience. They learn from the teacher how to solve problems in clinical education. Together with a better understanding of the subject matter, they become more confident about their own ability to reason and make rational decisions. However, due to the didactic method, they are more reliant on the teacher for answers and have less opportunity to practice their critical thinking, as compared with the experimental group. Thus, although they did become more confident, they failed to match the level reached by the experimental group.

It was encouraging to see that both groups had maintained their growth in critical thinking self-confidence beyond the experiment. In addition, with a mean score of 49.2 six months later, the experimental group was edging toward a strong disposition and was significantly different from the control group which scored 41.

When the mean scores of inquisitiveness are examined, it can be seen that the experimental group is positively inclined toward inquisitiveness. This positive disposition was reported at the pretest (mean score = 49.5) and sustained through the first posttest (mean score = 49.6) and second posttest (mean score = 49.4). A similar
It is encouraging to see a mean score of 49.6 for the experimental group at the first posttest. This score indicates that the experimental group is close to a strong positive disposition toward inquisitiveness. This is reassuring because intellectual curiosity and eagerness to learn is a virtue that one would like these future nurse educators to have. On the surface, one may attribute such positive result to problem-base learning as the latter is supposed to promote students' motivation for learning. However, on closer examination, the results fail to support such an assumption. While the gain between the pretest and first posttest is positive, it is very small. Also, there is no significant difference between the experimental and control groups as clearly indicated by the results relating to hypotheses 3.6 and 5.6. Hence, the experimental effect of problem-based learning is not visible. In fact, the concurrent positive inclination toward inquisitiveness in the control group may suggest another plausible explanation. It is possible that such positive scores may indicate a selection affect: those who choose to pursue postgraduate study are more motivated to learn, or the admissions committee only selects highly motivated students. Moreover, the positive disposition toward inquisitiveness could be due to the local learning culture, which emphasizes the need to learn and perform well academically.

Interestingly, the results of cognitive maturity also resemble those observed earlier in analyticity, systematicity, and critical thinking self-confidence. Prudence in decision making is highly valued by professional groups such as nurses. On examining the
mean scores in relation to hypotheses 1.7, 3.7, and 5.7, although both experimental
and control groups were ambivalent toward cognitive maturity at the beginning of the
experiment, they became positively disposed to this virtue by the end of the
experiment, with the experimental group making a more impressive improvement
than the control group. This positive growth was still sustained six months later.

The first posttest reveals that the experimental group has a mean score of 47.8. This
is considerably different from the pretest score of 35.5. As the control group also
shows a positive shift of scores from 35.1 at pretest to 41.8 at first posttest, one
wonders if there is a common factor responsible for this shift in both of the groups.
Although the tendency to be prudent could be associated with development, that is,
one becomes more judicious as one gets older, this argument cannot fully explain
why the experimental group is significantly more prudent than the control group at
the first posttest. Surely, if the passage of time has influenced their inclination
toward cognitive maturity, it should have affected both groups alike. In addition, one
must question whether a time frame of fourteen weeks is long enough in terms of
developmental effect. In view of the significant difference between the experimental
and control groups observed at the end of the experiment, the suggestion of the
experimental effect of problem-based learning is a plausible one. It would be
reasonable to deduce that as a result of practicing problem-solving during problem-
based learning, the experimental group has gained experience in making mature
judgments. Consequently, they have developed an appreciation for judiciousness in
decision making.
When compared again six months after the experiment, both groups still showed positive disposition toward cognitive maturity, although the experimental group was demonstrating a higher mean score (47.2) than that of the control group (41.6). Statistically, the difference between the two groups at this point is significant, suggesting that problem-based learning may have a holding effect on cognitive maturity subsequent to the experiment.

The finding in this study that the student nurse educators are ambivalent toward truth-seeking is not unique. The meta-study by Facione and Facione (1979) also reports that ambivalence accounts for more than half of the truth-seeking scores (N = 7926). In the same study, a positive tendency is noted for the six remaining dispositions. In a way, the student nurse educators in this study differ from the respondents in Facione and Facione’s study in that they were ambivalent toward analyticity, systematicity, critical thinking self-confidence and cognitive maturity before the experiment. However, by the end of the experiment, the student nurse educators in the experimental as well as the control groups were more like Facione and Facione’s subjects, with positive inclination toward all the dispositions except truth-seeking. Further, longitudinal studies were also reported in Facione and Facione’s study involving 171 cases. Significant pretest to posttest gains were observed in three of the dispositions, namely, truth-seeking, analyticity and critical thinking self-confidence. In this study, however, significant pretest to posttest gains were reported in analyticity, systematicity, critical thinking self-confidence and cognitive maturity. As Facione and Facione’s samples include freshmen students through to master’s degree students, they are not comparable with the student nurse educators of this
study. Differences in the results are therefore not unexpected.

As there has been no report of critical thinking dispositions assessment involving the Chinese, a comparison of this study's results with equivalent studies is not possible. Similarly, there has been no empirical study into the effect of problem-based learning on students' critical thinking, hence, it is impossible to know if the effects observed in this study are acceptable. It is hoped that the findings of this study has provided a baseline against which subsequent assessments of the critical thinking dispositions of the Chinese or problem-based students may be compared.

1.2 Approaches to Learning

In terms of the surface approach to learning, at the pretest the mean score of the experimental group is 41.2 and the control group 43.5. Interpretation of the scores is based on the table of norms (Biggs, 1992) as described in chapter 3. The scores of 41.2 and 43.0 fall on the 6 and 7 decile scores respectively, indicating that both groups are within the average range in terms of surface approach to learning. This is a useful point to note at the beginning of the experiment, as prior to this course, the students could have been used to a surface approach due to earlier educational experiences. Further, the result indicates that there is no significant difference between the experimental and control groups at the pretest.

At the end of the experiment, the mean score of the experimental group had dropped slightly to 40.0 and that of the control group to 42.5. The decile scores for both
groups, however, remained unchanged at the average level. Again, statistically there is no significant difference between the groups. Although the reduction of scores at the first posttest is small for both the experimental and control groups, it is at least encouraging to note that the present educational experience has not encouraged them to adopt a more surface approach in their learning. Bearing in mind that these are part-time students who have to find a balance among commitments to their work, study and family, the temptation of adopting a surface approach to learning should not be under-estimated. As there is no significant difference between the experimental and control groups at the end of the experiment, there is insufficient evidence to suggest that problem-based learning has reduced the surface approach in the experimental group.

Six months after the experiment, there is still no significant difference between the experimental and control groups with respect to surface approach to learning. With mean scores of 41.0 for the experimental group and 42.6 for the control group, they were maintaining an average result with no change to the decile scores.

As a surface approach to learning encourages students to rote learn rather than to study for understanding, it is not something that should be encouraged. With this in mind, it is at least reassuring to note that both groups are average rather than high on the surface approach subscale. However, it is also disappointing that problem-based learning has made little impact in minimizing the surface approach in the experimental group.
In the case of the deep approach to learning, the mean score of the experimental group improved between pretest and first posttest (pretest mean score = 49.2, first posttest mean score = 51.3). The decile score also changed from 7 to 8, from average to above average. The change in the decile score, however, could be misleading, as a closer examination of the pretest and first posttest mean scores reveals a minor gain of only 2.1. Similarly, the gain between the first posttest (mean score = 51.3) and the second posttest (mean score = 51.6) is also negligible. The decile score of the experimental group remained unchanged at 8 (above average) at the second posttest.

As problem-based learning is supposed to promote deep learning as students become involved with the learning task, it is perhaps not surprising that the experimental group should demonstrate an above average result in the deep approach by the end of the experiment. The result at the second posttest indicates that the above average score in the deep approach has continued six months after the experiment. If problem-based learning is indeed responsible for the small improvement demonstrated by the experimental group at the first posttest, it is quite possible that the experimental effect has continued after the experiment.

With regard to the control group, there is a reduction in score between pretest and first posttest (pretest mean = 50.6, first posttest mean = 49.5). There is a corresponding change in the decile score from 8 (above average) to 7 (average). The suggestion that the control group has adopted a less deep approach to learning between the pretest and first posttest, however, should be interpreted with caution as the mean score difference is very small. Between the first and second posttests, the
control group made a small gain in the mean scores, moving from the first posttest mean of 49.5 to 51.8 at the second posttest. The decile scores also changed from 7 (average) to 8 (above average). Again, despite the apparent difference in the decile scores, the gain of 2.3 in the mean score is really too small to suggest any significant improvement.

The small reduction in the deep approach mean score as observed in the control group at the first posttest may be due to the effect of the lecture method adopted for this group. This didactic method does not encourage students to search for meaning, instead the tendency is to rely on the teacher for a supply of information. This could have made the control group less inclined to study for understanding or to use a deep approach in learning. Further, the small gain in the deep approach at the second posttest is interesting. It could be that after the control group has completed the lectures, they try to apply the theory of clinical education to practice. During this process, they discover that what they have learned is inadequate to deal with the real situation. This may have made them search for information and develop a deeper understanding of the subject, hence the small improvement in the deep approach at the second posttest.

When the experimental and control groups are compared at the pretest, the difference of 1.4 (experimental mean score = 49.2, control mean score = 50.6) is too small to suggest any real difference between the groups. Interestingly, despite the marginal difference in the mean scores, the decile score for the two groups are different with the experimental group showing an average decile score of 7 and the control group
indicating an above average decile score of 8. Again, this highlights the importance of interpreting the difference in decile scores in terms of mean score changes.

When the two groups are compared at the first posttest, the pattern observed at the pretest has reversed. At the end of the experiment, the experimental group has achieved a decile score of 8 (above average) while the control group has dropped to 7. On the surface, this reverse pattern may suggest an experimental effect of problem-based learning. However, statistically there is no difference between the experimental and control groups as indicated in hypothesis 4.2. Again, at the second posttest, the mean score difference between the groups is very small ($E = 51.6$, $C = 51.8$), and t-test results suggest that there is no significant difference between the experimental and control groups.

The absence of significant difference between the experimental and control groups at the first and second posttests is disappointing. The expectation that problem-based learning would enhance deep approach to learning has not been supported statistically in this study.

With reference to the achieving approach, the pretest mean score for the experimental group is 45.3, which is equal to a decile score of 8, an above average score. There is a slight reduction of the mean score at the first posttest (mean score = 44). The decile has also dropped to 7, which denotes an average score. By the second posttest, the mean score has gone up to 45.4 and the decile score changed to 8.
It is somewhat disappointing to note that the experimental group has reduced mean and decile scores at the end of the experiment. One would hope that the experimental effect should influence these students to value deep understanding and select an achieving learning strategy to maximize their chances of getting high marks. On the other hand, it should be noted that the change in the mean scores between the pretest and first posttest is actually very small (a reduction of 1.4), thus, the change in the decile score could be misleading. Similarly, although it is encouraging to see a gain of mean scores from the first posttest to second posttest, the change is very small indeed.

The mean score for the control group is 43.3 at the pretest, which indicates an average decile score of 7. There is a small reduction at the first posttest (mean score = 40.4), but the decile score has remained unchanged. A marginal gain is noted at the second posttest (mean score = 41.1), with no change to the decile score. In view that the lecture method does not actively encourage students to develop an achieving approach to learning, it is perhaps not surprising that the control group has made little improvement in this approach.

In terms of difference between the groups, although the experimental group has a higher mean score at the pretest \((E = 45.3, C = 43.3)\), the group difference is very small. Also, statistically there is no difference between the groups' pretest mean scores. At the first posttest, the experimental group has a mean score of 44.0 and the control group 40.4. On the surface of it, the mean score difference between the groups is greater than that observed at the pretest. However, t-test has failed to
support any significant difference between the experimental and control groups. The
gap between the experimental mean score (45.4) and the control mean score (41.1)
has widened even further at the second posttest, with the experimental group showing
an above average decile score and the control group an average one. Statistically,
however, there is no difference between the groups at the second posttest despite the
mean score differences.

As these are postgraduate students who have self-selected themselves for further
study, perhaps one should not be too surprised to find that both groups are not averse
to the achieving approach to learning. Similar to the deep approach, it is
disappointing to note that there is no significant difference between the experimental
and control groups at the first and second posttests. If problem-based learning were
effective in enhancing an achieving approach, then this study has failed to
demonstrate that.

To summarize, problem-based learning was found to have had no significant impact
on the students’ approaches to learning in this study. While the findings are
disappointing in so far as problem-based learning is concerned, several aspects of the
results are worth noting.

Similar to the Chinese students in the earlier studies by Lai, Tiwari and Tse (1997),
Tang (1993), Kember & Gow (1991), Watkins, Regmi and Astilla (1991), and Biggs
(1989), the student nurse educators in both the experimental and control groups were
shown to rely less on rote learning, more likely to study for understanding, and
oriented toward academic achievement. Thus, the stereotypical image that Chinese students prefer to rote learn is not observed in this study. Further, the active role taken by these nurse educators in their learning has reinforced the findings of Biggs (1996), Kember and Gow (1991).

Despite their previous learning experience as passive learners, the student nurse educators have shown that they are quite capable of changing to a student-centred learning environment if given the opportunity to do so. This finding supports Biggs' (1992) view that students adopt a learning approach appropriate for the learning context. Thus, if the context promotes student-centred learning, then the students would take an active and self-directed approach in their learning. This is precisely what happened in this study. In response to problem-based learning, the student nurse educators in the experimental group managed their learning in an active and self-directed manner. Similarly, those in the control group adopted an active role in the learning task in response to the portfolio assignment. In light of this, the suggestion that the learning context influences students' approach to learning has found support in this study.

1.3 Problem-based Learning

In relation to the effectiveness of problem-based learning, the findings of this study support the results of earlier studies in three areas, namely, retention of knowledge, self-directedness in learning, and motivation for learning.
Better retention of knowledge as a result of working with the problem situations in problem-based learning was identified by the experimental group as one of the benefits. This supports earlier findings that problem-based learning helps students to retain knowledge much longer than the conventional method (Rand & Baglioni, 1997; Creedy & Hand, 1995; Eisenstaedt, Bassy & Glanz, 1990; Schmidt et al. 1989). Similarly, the enhancing effect of problem-based learning on self-directed learning is confirmed by the self-reports of the student nurse educators in the experimental group. Like the problem-based students in the studies by Norman & Schmidt (1992), and Blumberg, Michael and Zeitz (1990), the student nurse educators in the experimental group were more active and self-directed in their learning than those in the control group. In the same vein, the increased motivation for learning that was detected in the problem-based students in Hessami (1995), Conrick (1995), DeVolder et al. (1986), and Schmidt (1983) was also found in the experimental group in this study. Thus, in terms of retention of knowledge, self-directedness in learning, and motivation for learning, the problem-based students in this study gave positive responses that were similar to those documented in earlier studies.

Although conflicting views exist in the literature about the effect of problem-based learning on student's problem solving ability, the findings of this study support the view that such ability could be improved through problem-based learning. Similar to the problem-based students in Hmelo, Gotterer and Bransford's (1997) study, the student nurse educators in the experimental group showed greater coherence in reasoning when solving problems than those in the control group. Also, in contrast to the doubts expressed about the influence of problem-based learning on student's
problem-solving (Margetson, 1994; Norman & Schmidt, 1992; Norman, 1988), the experimental group in this study attributed their improved problem solving ability to problem-based learning. Further, the suggestion that problem-based learning encourages students to apply their newly acquired knowledge to novel problem situations when it is needed (Lai, Tiwari & Tze, 1997; Williams, 1993; Needham & Begg, 1991) was confirmed by the self-reports of the student nurse educators in the experimental group.

In addition to the above observations, this study has offered new insight into the problem solving process of the problem-based students. In their self-reports, the student nurse educators in the experimental group described how they solved problems. Typically they approached problems in a focused and organized manner, recognizing the need to be analytical and systematic in the process. They appeared to accept the fact that some problem situations were inevitably ill-structured, and acknowledged the importance of being prudent when making decisions. They also seemed to be confident about their own problem solving ability. In light of this observation, this study may have provided a new perspective in assessing the effect of problem-based learning on problem solving, a perspective that was not noted in previous studies.

In two areas, however, the findings of this study do not support those of the earlier studies. One is the integration of basic science knowledge into the solution of clinical problems, and the other is the concern about the knowledge base of problem-based students.
In the case of integration of basic science knowledge in solving clinical problems, previous studies have suggested that problem-based students are more able than non problem-based students to integrate basic science and clinical knowledge (Patel, Groen & Norman, 1991; Boshuizen, Schmidt & Wassamer 1990). Such was not observed in this study. Although the experimental group claimed that they applied the knowledge acquired during problem-based learning to similar real-life situations, there was no indication of their integrating basic science in the problem solving process. As problem-based learning was used as a learning strategy for only one of the modules in this study, whereas in the studies cited earlier it was implemented as a problem-based curriculum, this may explain the lack of integration in this case. In a problem-based curriculum, integration of basic science is a feature of the learning process. On the other hand, when problem-based learning is used as a learning strategy for only part of the curriculum, integration of basic science is not the norm. This is an interesting finding as it raises the question that whether problem-based learning should be used for part of the curriculum only, a question that has been debated for sometime.

Although concerns have been expressed previously about the knowledge base of problem-based students (Margertson, 1994; Albanese & Mitchell, 1993), the experimental group in this study has not expressed such a concern. Indeed these student nurse educators were pleased that the knowledge they acquired during the problem-based learning process was helpful to them in real-life problem situations. Thus, from the students’ point of view, whether the knowledge acquired is effectively used or not may be a more important consideration than whether they have acquired a
sufficient body of knowledge. In this respect, this study may have thrown a new light in how students perceive the value of knowledge in their learning.

The discussion so far has highlighted some of the similarities between the findings of this study and those of earlier ones. In addition, some noticeable differences have also been observed, together with the new insight into the effectiveness of problem-based learning.

2. **Conclusions**

The traditional model of training nurses is considered to be inappropriate for preparing professional nurses for a complex and rapidly changing world. A new educational philosophy has been called for to nurture the skills and dispositions required for competent professional nursing practice. Problem-based learning has been advocated as a promising educational strategy, and claims are made about its effectiveness in enhancing students’ thinking and learning processes. It is thought that during the process of problem-based learning, students learn to adopt a critical approach toward problem-solving. They also develop a deeper understanding of the learning task. Thus, problem-based learning encourages students to think critically and adopt a deep approach to learning. As critical thinking is advocated as the key to competent clinical judgment and deep approach to learning is considered as vital for professional education, there is every reason to believe that problem-based learning is an appropriate strategy for educating nurses. Indeed, problem-based learning has been adopted by nurse educators worldwide and the trend is increasing.
Yet, despite its growing popularity, the link between problem-based learning and critical thinking has not been tested empirically. Further, even though problem-based learning is related to the deep approach to learning in general education, there remains a need to validate this relationship in nursing education.

The desire to find out about the effectiveness of problem-based learning in promoting students' critical thinking and deep approach to learning led to the present study. The question at the heart of the study was - to what extent is problem-based learning responsible for enhancing students' critical thinking and promoting the adoption of a deep approach to learning by the students. The main aim of this study was to test problem-based learning on two outcome measures.

A quasi-experiment was designed in which problem-based learning was used as a learning strategy for fourteen student nurse educators in an experimental group. Thirteen of their peers, in a control group, received the traditional lecture method.

For the evaluation of the problem-based learning method, the ‘Untreated Control Group Design with Pretest and Posttest’ as described by Cook & Campbell (1979) was chosen as the most appropriate for the purpose of this study. The original design was modified with the addition of a post-experimental follow-up study six months after the experiment. The modification was deemed necessary so as to assess the retention of the problem-based learning effect. The two outcome measures were the dispositions toward critical thinking and approaches to learning.
Prior to the design, implementation and evaluation of the experiment, a literature review was carried out. The literature review examined the theory and practice of problem-based learning, both in professional and nursing education. As the effectiveness of problem-based learning had to be made in terms of the outcome measures, the next stage of the literature review explored critical thinking and approaches to learning in general and specifically in relation to problem-based learning. The third and final stage of the literature review focused on the Chinese culture and how it may influence critical thinking.

Prior to the implementation of the experiment, three problem situations were developed as a focus for learning in problem-based learning. The problem cases were validated by a panel of experts.

The findings of this study are summarized as follows.

As there are no significant differences in all outcome measures between the experimental and control groups at the pretest, it is reasonable to assume that both groups are equivalent in relation to the outcome measures prior to the experiment.

The findings show that problem-based learning could be an effective intervention to promote the dispositions toward analyticity, systematicity, critical thinking self-confidence and cognitive maturity. Moreover, as the experimental group remained positive toward to these four dispositions six months after the experiment, the intervention of problem-based learning may have a ‘holding’ effect. However, it
was also noted that problem-based learning made no significant impact on the dispositions to truth-seeking, open-mindedness and inquisitiveness. In the case of truth-seeking, the experimental group showed an ambivalent tendency before, at the end of, and six months after the experiment. While the dispositions to open-mindedness and inquisitiveness of the experimental group remained positive at the pretest, first posttest and second posttest, there was no significant difference between the experimental and control groups in all three occasions. Therefore, there was no evidence to indicate that problem-based learning had a significant effect on the dispositions toward open-mindedness and inquisitiveness.

In relation to approaches to learning, problem-based learning was found to have had no significant effect on all three approaches. While the findings are disappointing, it is worth noting that at the end of the experiment, the experimental group was showing an average score in the surface approach, and above average scores in the deep and achieving approaches. While it may be true that problem-based learning has not demonstrated desirable effects on the approaches to learning, it has not caused any apparent ill effects such as an increase in the surface approach or deterioration in the deep or achieving approach.

Analysis of the qualitative data revealed some interesting findings. It appears that the ambivalence toward truth-seeking could be due to cultural influence. As the maintenance of social harmony is of utmost importance in the Chinese culture, Chinese people are reluctant to engage in activities that would threaten this harmony. Within this context, the apparent ambivalence toward truth-seeking as demonstrated
by the student nurse educators in this study can be better understood. It may be that they are prepared to adopt an uncritical acceptance of the ‘truth’ if it means that social harmony can be maintained.

The possibility that an ambivalent tendency to truth-seeking may contradict the positive disposition toward inquisitiveness is not supported by the qualitative data. Although the pursuit of knowledge is common to both truth-seeking and inquisitiveness, the purpose that it serves is different for each of these dispositions. In the context of truth-seeking, one seeks the best knowledge to make objective and sound judgment. On the other hand, in inquisitiveness, one is motivated to learn in order to acquire knowledge. Indeed a high level of motivation in learning was expressed by the respondents from both groups. While problem-based learning may be responsible for promoting the motivation of the experimental group, the commitment to learning as seen in the control group suggests that other factors may also be responsible. Such factors may include the Confucian value toward learning, the highly competitive educational system in Hong Kong, and parental expectation of academic achievement.

Similar patterns of development and group differences observed in four of the dispositions (analyticity, systematicity, critical thinking self-confidence and cognitive maturity) are confirmed by the interview data. It appears that problem-solving is the common factor for the four dispositions. In the interview, respondents from the experimental group attributed their enhanced problem-solving ability to the problem-based learning experience. It is quite conceivable that as a result of the improvement
in their problem-solving skills, the experimental group appreciated more the need for an analytical and systematic approach to problem-solving and the importance of judiciousness in making judgment. Consequently, they developed more confidence about their own ability to think critically. The control group, on the other hand, failed to demonstrate firm evidence of positive tendency to these four dispositions in the interviews. Further, they attributed their improved problem-solving skills to the experience gained from solving problems in the clinical situations.

While some members of the experimental group expressed their concerns about problem-based learning, they were generally positive about this learning experience. Their accounts of how they participated in problem-based learning suggest that they are willing and able to adopt an active role in learning. This does not support the stereotypical image of passivity of the Hong Kong learners as suggested by some writers.

The findings of this study have implications for nurse educators and critical thinking theorists. In the first place, nurse educators should not assume that students who have been used to a passive mode of learning are not able to take responsibility for their own learning. As indicated in this study, the students are quite capable of changing to a student-centred learning environment despite their previous experience of the didactic method. For the critical thinking theorists, this study has reaffirmed the influence of culture on the development and manifestation of an individual’s critical thinking. The possibility that Chinese people may abandon the pursuit of truth for the sake of social harmony could be just the tip of an iceberg. Much more awaits to be
discovered in terms of how the Chinese culture may have influenced the way Chinese people think.
3. **Recommendations**

A major limitation of this study is the small sample size. Because of the small sample size, there may not be enough evidence to reject the null hypothesis. The use of only two outcome measures to evaluate the effectiveness of problem-based learning is another limitation. While the measures of critical thinking dispositions and approaches to learning offer an important insight into the effectiveness of problem-based learning, they reveal little about the process of this learning experience. In programme evaluation, both outcome and process are important indices. Further, the time span of fourteen weeks may not be long enough for significant changes to take place as one's attitude toward thinking and learning takes time to develop. Similarly, it takes time to change attitude that is ingrained. In addition, problem-based learning was implemented in the "untidy" reality of the educational system where human and physical factors could have interfered with the learning process. Consequently, this may have an effect on the outcome measures. Finally, a disposition is not a skill. One may be inclined to do something well but not know how to do it. Hence, it remains to be determined whether a positive disposition toward critical thinking predicts greater critical thinking skills.

Having reflected on the above limitations, the following recommendations are suggested:

(1) That problem-based learning be incorporated into the whole curriculum rather than individual subjects, and its overall effects on students' thinking and
learning monitored throughout.

(2) That longitudinal study be undertaken to monitor the effectiveness of problem-based learning over a longer time frame and with a larger sample.

(3) That the evaluation of problem-based learning should include both outcome and process measures.

(4) That longitudinal study be conducted to follow the development of nurse educators’ approaches to learning throughout the time span of their teaching career.

(5) That future study be undertaken into the barriers that inhibit the development of critical thinking and the adoption of a deep approach to learning in nursing education.

(6) That future study be directed at exploring the relationship between the skill at critical thinking and disposition toward critical thinking.

(7) That cross-sectional and longitudinal research be initiated to examine the critical thinking dispositions of the Chinese students.

This study is about nursing education. Specifically, it is about the effect of problem-based learning on the dispositions toward critical thinking and approaches to learning. Hopefully, this study has contributed to a better understanding of how critical thinking and approaches to learning can be enhanced. In addition, it is hoped that this study will provide the foundation upon which the effect of culture on critical thinking can be explored in future.
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APPENDIX A

CLINICAL EDUCATION TECHNIQUES:

AIM & OBJECTIVES
Aim: The aim of this module is to encourage students to develop the knowledge and skills in clinical education. In this module, the concept of clinical education will be introduced and teaching strategies that will enhance learning in the clinical setting will be explored.

Objectives: At the end of the module, students will be able to:

1. formulate their own philosophy of clinical education.
2. plan, execute, and evaluate clinical education programmes.
3. identify and critically analyze teaching and learning resources that facilitate student learning in clinical settings.
4. utilize and evaluate teaching methods that are appropriate for promoting student learning in specific clinical settings.
5. apply appropriate assessment strategies in the context of clinical education.
6. collaborate with clinical and educational staff to maximize student learning opportunities in the clinical settings.
7. appreciate the dynamics of the clinical settings in relation to student learning.
APPENDIX B

CLINICAL EDUCATION TECHNIQUES:

PROBLEM SITUATIONS
Problem Situation (1)

Teaching and learning in the clinical setting

As a clinical educator, one of the objectives in your Staff Development Review (SDR) is that you would improve student learning in your ward during the next twelve months.

Your ward is of an acute, medical nature with a rapid turnover of patients and covers a broad range of medical conditions. Although it provides a rich learning environment for students and junior staff, there is little opportunity to conduct formal teaching due to the busy nature of the ward.

You have identified the following as the targets for achieving your objective:

1. To evaluate the teaching/learning strategies currently in use on your ward.
2. To build on the strengths of the existing strategies.
3. To propose, with justifications, new teaching/learning strategies that would enhance student learning in your ward.

You are required to provide an interim report to the nurse manager three months after setting your objective.
As a clinical educator, one of your responsibilities is to guide and support student nurses during their placement on your ward.

Cynthia is a second-year student nurse who started her placement five weeks ago. You have not had much opportunity to work with her, but from the brief observations you made on a few occasions, she appeared to be coping well. There has not been any complaint about her performance from other members of staff.

Cynthia and you were on an early shift together yesterday. It so happen that Mrs. Lee, a rather un-cooperative patient, had to have her wound redressed. You decided that it would be a good opportunity to observe Cynthia’s performance and give her feedback.

It was a complicate dressing, made worse by Mrs. Lee’s unwillingness to cooperate. You were surprised by Cynthia’s performance - she was slow and poorly co-ordinated. At one point, you had to intervene as her practice was unsafe. You were called away by the doctor twice during the dressing procedure, leaving Cynthia to work on her own.

During the feedback, you discussed with Cynthia the mistakes that she made and explained the possible consequences. You did, however, acknowledge that it was a difficult task performed under difficult circumstances. Arrangements were made for Cynthia to have further practice under supervision. Cynthia appeared to have accepted your comments and suggestions.

When you arrived on duty this morning, you were told that Cynthia had reported in sick and that she was very upset after the feedback. Apparently she went to see her tutor and complained that your comments were unfair.
Problem Situation (3)

Planning a Clinical Education Programme

You have just accepted the responsibility of providing clinical education to student nurses and newly qualified nurses working in the Accident and Emergency Department.

The department is busy with a ‘chronic’ shortage of nursing and medical staff. The staff turnover rate is high and it is hoped that your clinical education programme would help to support the staff and boast morale.

The department has never had a formal clinical education programme but as a requirement of the accreditation, the Nursing Board has demanded evidence of clinical education for the student nurses and junior nursing staff in the department.

You are required to formulate a comprehensive clinical education programme, which should include assessment strategies appropriate for the department, and to submit this to the School Principal in a week’s time.
APPENDIX C

THE CALIFORNIA CRITICAL THINKING

DISPOSITION INVENTORY (CCTDI)
DIRECTIONS:

1. Carefully separate the last page (ANSWER SHEET) from this test booklet.
2. Put your student number on the answer sheet and on the test booklet.
3. Indicate how much you agree or disagree with each numbered statement by filling in the appropriate place on the answer sheet. Read the two examples first.

EXAMPLE A: The best things in life are free.

EXAMPLE B: I'm always doing more than my share of the work.

The answer sheet shows the responses of someone who STRONGLY DISAGREES with EXAMPLE A and LESS STRONGLY AGREES with EXAMPLE B.

Begin with statement number 1 and continue through number 75. Mark your response on the answer sheet in the place with the corresponding number. If you erase a response, be sure the erasure is clean.

4. After you have responded to the 75 statements, fill in the information items printed at the bottom of page 5.

1. Considering all the alternatives is a luxury I can’t afford.
2. Studying new things all my life would be wonderful.
3. The best argument for an idea is how you feel about it at the moment.
4. My trouble is that I’m easily distracted.
5. It’s never easy to decide between competing points of view.
6. It bothers me when people rely on weak arguments to defend good ideas.
7. The truth always depends on your point of view.
8. It concerns me that I might have biases of which I’m not aware.
9. I always focus the question before I attempt to answer it.
10. I’m proud that I can think with great precision.
11. We can never really learn the truth about most things.
12. If there are four reasons in favor and one against, I'd go with the four.
13. Men and women are equally logical.
14. Advice is worth exactly what you pay for it.
15. Most college courses are uninteresting and not worth taking.
16. Tests that require thinking, not just memorization, are better for me.
17. I can talk about my problems for hours and hours without solving anything.
18. Others admire my intellectual curiosity and inquisitiveness.
19. Even if the evidence is against me, I'll hold firm to my beliefs.
20. You are not entitled to your opinion if you are obviously mistaken.
21. I pretend to be logical, but I'm not.
22. It's easy for me to organize my thoughts.
23. Everyone always argues from their own self interest, including me.
24. Open-mindedness has limits when it comes to right and wrong.
25. It's important to me to keep careful records of my personal finances.
26. When faced with a big decision, I first seek all the information I can.
27. My peers call on me to make judgments because I decide things fairly.
28. Being open-minded means you don't know what's true and what's not.
29. Banks should make checking accounts a lot easier to understand.
30. It's important to me to understand what other people think about things.
31. I must have grounds for all my beliefs.
32. Reading is something I avoid, if possible.
33. People say I rush into decisions too quickly.
34. Compulsory subjects in university waste time.
35. When I have to deal with something really complex, it's panic time.
36. People from another country should study our culture instead of us always trying to understand theirs.

37. People think I procrastinate about making decisions.

38. People need reasons if they are going to disagree with another’s opinion.

39. Being impartial is impossible when I’m discussing my own opinions.

40. I pride myself on coming up with creative alternatives.

41. Frankly, I am trying to be less judgmental.

42. Frequently I find myself evaluating other people’s arguments.

43. I believe what I want to believe.

44. It’s just not that important to keep trying to solve difficult problems.

45. I shouldn’t be forced to defend my own opinions.

46. Others look to me to establish reasonable standards to apply to decisions.

47. I look forward to learning challenging things.

48. It makes a lot of sense to study what people from another country think.

49. Being inquisitive is one of my strong points.

50. I look for facts that support my views, not facts that disagree.

51. Complex problems are fun to try to figure out.

52. I take pride in my ability to understand the opinions of others.

53. Analogies are about as useful as a sailboat on a freeway.

54. You could describe me as logical.

55. I really enjoy trying to figure out how things work.

56. Others look to me to keep working on a problem when the going gets tough.

57. Getting a clear idea about the problem at hand is the first priority.

58. My opinion about controversial topics depends a lot on who I talk to last.

59. No matter what the topic, I am eager to know more about it.

60. There is no way to know whether one solution is better than another.
61. The best way to solve problems is to ask someone else for the answers.
62. Many questions are just too frightening to ask.
63. I'm known for approaching complex problems in an orderly way.
64. Being open-minded about different world views is less important than people think.
65. Learn everything you can, you never know when it could come in handy.
66. Life has taught me not to be too logical.
67. Things are as they appear to be.
68. If I have to work on a problem, I can put other things out of my mind.
69. Others look to me to decide when the problem is solved.
70. I know what I think, so why should I pretend to ponder my choices.
71. Powerful people determine the right answer.
72. It's impossible to know what standards to apply to most questions.
73. Others are entitled to their opinions, but I don't need to hear them.
74. I'm good at developing orderly plans to address complex problems.
75. To get people to agree with me I would give any reason that worked.

Please respond to these final items in the places provided on this page.

Student Number

Date of Birth (month/day/year) / / / / 
Circle one: Female Male
Single Married Divorced

Job Title: __________________________
Years in current position: _______ Yrs.

Modified/18.9.1996
The
C.C.T.D.I.

氣質評估表

原著者：Peter A. Facione
Santa Clara University
Noreen C. Facione
University of California, San Francisco

譯者：葉美玲
University of Maryland at Baltimore

請待指示再行作答

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(PAF47-3.1:071392)
說明：

1. 請勿在問卷上作答或留下任何記號

2. 請於答案紙上填入您的姓名與學號

3. 每個題目，請標示您的同意或不同意程度於答案紙上適當的位置。請先參讀以下兩個範例。

範例甲、生活中最美好的是自由自在。

範例乙、我總做超過我份內應做的事情。

答案紙上，所顯示的答案於範例甲是非常不同意，而於範例乙是較少的非常同意。

請自第1題至第75題，按題號作答於答案紙上適當的位置。

如果您需要擦拭答案，請擦拭乾淨。
1. 考慮所有可能的選擇是一種我所不能負擔的奢侈。
2. 研究新鮮事物，我的人生更美好。
3. 對於一個念頭的最好主張，即是當下的感覺。
4. 我的困擾是很容易分心。
5. 於有爭議的見解裏抉擇其一，從未曾是容易的。
6. 令我感到困擾的是人們用薄弱的論證來辯護好的構想。
7. 什麼是事實總是依據我的見解。
8. 我很在意自己的潛意識中是否對人、事、物存有偏見。
9. 在我嘗試回答問題前，我總是先專注於問題上。
10. 我以有明確的思維為榮。
11. 我們不可能知道每件事的來龍去脈。
12. 在選擇決定時，我會附和眾議。
13. 男性和女性俱有相等的邏輯能力。
14. 忠告的確實價值在於你付出什麼樣的代價。
15. 大學裏大部分的課程是索然無味，且不值得去修。
16. 需要思考而非純記憶的考試，對我較好。
17. 我會一再地談論我的難題而沒有解決一點問題。
18. 其他人佩服我有知性的好奇心與追根究底的精神。
19. 即使所有的證據反對我是錯的，我還會堅守我的信念。
20. 當我很明顯地被誤解時，我沒有權力表達我的意見。
21. 我假裝成是個有條理的人，但我不是。
22. 對我而言，纖細我的思絮是很容易的。
23. 每個人總是會從自己的利害關係著想，包括我在內。
24. 當需判斷對與錯時，無偏見是有限度的。
25. 對我而言，詳細地記錄我個人收支是很重要的。
26. 倘面對一個重大的抉擇，我會先盡力尋求所有相關的訊息。
27. 我的同儕會找我下判斷，因爲我處事公正。
28. 做到無偏見思想，我不知道什麼是真實的，什麼是不真實的。
29. 銀行、郵局等要正確把款項做得令人易懂。
30. 對我而言，去理解別人對事情的想法是很重要的。
31. 我的信念都必須有依賴。
32. 可能的話，我儘量避免閱讀。
33. 人們說我過於衝動地做決定。
34. 學校裏的必修課是浪費時間。
35. 當我必須處理很複雜的問題時，那是個令我恐慌的時刻。
36. 外國人應該研究我們的文化，而不是我們試著去理解他們的。
37. 人們認為我做判斷時，猶豫不決。
38. 倘若人們不同意他人的意見，他們得需要先有理由。
39. 當我表達自己的意見時，要做到不偏袒是不可能的。
40. 我以能提出建設性的創見為榮。
41. 坦白地說，我正試著少去武斷地評論是非、真假或對錯。
42. 我常發現自己在衡量其他人的論點。
43. 我相信我所要相信的。
44. 持續試著去解決困難的問題，並不是那麼重要。
45. 我不該被強迫去為自己的意見作辯護。
46. 其他人依賴我建立能供作決策的合理標準。
47. 我期待去學習俱有挑戰性的事物。
48. 研究外國人的思維是有意義的。
49. 追根究底是我的一項優點。
50. 我尋求支持我看法的事實，而非相左的事實。
51. 試著去解決複雜的難題，是有趣的事。
52. 我以我有能力去理解其他人的觀點自豪。
53. 類推的效用在思維上是沒有助益的。
54. 你可以形容我是個有邏輯能力的人。
55.我很樂於嘗試去瞭解事情如何運作。
56.當難題變得棘手時，其他人依賴我繼續處理那難題。
57.針對手邊將處理的難題，首要地是掌握一個清晰的概念。
58.關於有爭議的話題，我的意見大多依賴最後與我談論的人。
59.無論什麼話題，我渴望知道更多相關的內容。
60.知道一個解決之道是否優於另一個，是不可能的。
61.解決難題的最佳方法是從別人那裡得到答案。
62.有許多問題讓人畏於去詢問。
63.我擅長有程序地去處理複雜的難題。
64.能對不同文化所具有的哲學價值觀持有一個沒有偏見的態度，
     並不如一般人想像的那麼重要。
65.儘量學會每件事，說不定何時就能派上用場。
66.人生已教導我不必太條理分明。
67.事物看來是約定俗成的。...
68.倘若我必須去解決一個難題時，我能將其他事擱置一旁。
69.其他人依賴我去決定問題解決到何種程度算是被解決了。
70.我知道我在想什麼，我何必假裝沈思我的選擇。
71.權勢者決定的答案都是正確的。
72.要知道什麼樣的準則可適用於絕大部分的問題是不可能的。
73.其他人有權力發表他們的意見，但我不需要去聽他們。
74.我擅長於企劃有程序的計畫以解決複雜的難題。
75.為了要獲得人們對我的贊同，我會用任何行得通的理由。

謝謝你的協助，並祝學安
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APPENDIX D

THE STUDY PROCESS QUESTIONNAIRE (SPQ)
What the SPQ is About

On the following pages are a number of questions about your attitudes towards your studies and your usual ways of studying.

There is no right way of studying. It all depends on what suits your own style and the courses you are studying. The following questions have been carefully selected to cover the more important aspects of studying. It is accordingly important that you answer each question as honestly as you can. If you think that your answer to a question would depend on the subject being studied, give the answer that would apply to the subject(s) most important to you.

「研習過程問卷」是什麼？

問卷內的問題是關於你對求學的態度和你慣常的研習方法。

實際上沒有所謂「正確」研習方法，全在乎它是否切合你的個人風格和你所修讀的學科。問卷內的問題是經過細心挑選，務求包括研習的較重要性質。因此，你對每一問題誠實作答是很重要的。如果你認爲某一問題的答案，會因不同的學科而有所不同的話，請把問題應用於你覺得最重要的學科上，然後作答。
How to Answer

For each item there is a row of boxes for a five-point scale on the Answer Sheet:

\[ 1 \quad 2 \quad 3 \quad 4 \quad 5 \]. A response is shown by marking one of the five boxes for an item to underline the desired number.

The numbers stand for the following responses:
1 — this item is never or only rarely true of me
2 — this item is sometimes true of me
3 — this item is true of me about half the time
4 — this item is frequently true of me
5 — this item is always or almost always true of me

Example

I study best with the radio on.

If this was almost always true of you, you would underline 5 thus:

\[ \boxed{1} \quad \boxed{2} \quad 3 \quad 4 \quad 5 \]

If you only sometimes studied well with the radio on, you would underline 2, thus:

\[ \boxed{1} \quad 2 \quad 3 \quad 4 \quad 5 \]

如何回答？

在答案纸上，每条问题都有一行分五级的格子：

\[ 1 \quad 2 \quad 3 \quad 4 \quad 5 \]. 在你所选择的号码下所附空格内画线，以表示你的答案。

每個號碼代表以下的答案：
1 — 這句子對我來說，完全不適用或甚少適用。
2 — 這句子對我來說，有時適用。
3 — 這句子對我來說，大概一半時間適用。
4 — 這句子對我來說，常常適用。
5 — 這句子對我來說，永遠適用或差不多永遠適用。

舉例

「開着收音機時我的學習做得最好。」

如果你認為這句子對你來說是永遠適用，就請在5號下的空格內劃一橫線，如下圖：

\[ \boxed{1} \quad \boxed{2} \quad 3 \quad 4 \quad 5 \]

如果你認為只是有些時候開着收音機對你的學習有幫助的話，就請你在2號下的空格內劃一橫線，如下圖：

\[ \boxed{1} \quad 2 \quad 3 \quad 4 \quad 5 \]
Underline the number on the Answer Sheet that best fits your immediate reaction. Do not spend a long time on each item: your first reaction is probably the best one. Please answer each item.

Do not worry about projecting a good image. Your answers are CONFIDENTIAL.

Thank you for your co-operation.
Study Process Questionnaire

1. I chose my present courses largely with a view to the job situation when I graduate rather than because of how much they interest me.

我选择现在的学科，主要是考虑将来毕业后的就业情况，而不是因为它们吸引我。

2. I find that studying gives me a feeling of deep personal satisfaction.

我发现学习可以带给我很大的满足感。

3. I want top grades in most or all of my courses so that I will be able to select from among the best positions available when I graduate.

在多科或全部的学科中我都想得到高分，因为我毕业的时候就将能选择一份最好的工作。

4. I think browsing around is a waste of time, so I only study seriously what's given out in class or in the course outlines.

我认为博读闲书是一种浪费时间，因此我只认真地研读那些在课堂上派发或已在课程大纲上列明要读的。

5. While I am studying, I think of real life situations to which the material that I am learning would be useful.

当我在书时，我会思考现在所学的在现实生活中有多大用处。

6. I summarize suggested readings and include these as part of my notes on a topic.

我会将建议的阅读资料做摘要，并将它们放在同一课题的笔记中。

7. I am discouraged by a poor mark on a test and worry about how I will do on the next test.

我因测验分数低而感到灰心，又担心下次测验的成绩会如何。

8. While I realize that truth is forever changing as knowledge is increasing, I need to discover what is truth for me right now.

虽然我意识到真理是会改变的，随着知识的增加，我需要发现对我而言现在的真理。

- 年
9 I have a strong desire to excel in all my studies.
我有強烈的慾望要在所有的學科上比別人優勝。

10 I learn some things by rote, going over and over them until I know them by heart.
我是靠死記的方式來學習，一次又一次的背誦，直到我能牢記為止。

11 In reading new material I find that I'm continually reminded of material I already know and see the latter in a new light.
當閱讀新的資料時，我不斷想起已經學過的東西，並對這些東西有新的了解。

12 I try to work consistently throughout the term and review regularly when the exams are close.
我努力在整個學期中不斷溫習。當考試臨近時，更定期復習。

13 Whether I like it or not, I can see that further education is for me a good way to get a well-paid or secure job.
不論我喜歡讀書與否，我明白到高等教育能助我他日獲得一份高薪或穩定的工作。

14 I feel that most topics can be highly interesting once I become involved in them.
我覺得只要我肯投入，大部份課題都能變得很有趣。

15 I would see myself basically as an ambitious person and want to get to the top, whatever I do.
基本上，我覺得自己是個有野心的人，無論做任何事，我都要成爲最出色的一個。

16 I tend to choose subjects with a lot of factual content rather than theoretical kinds of subjects.
我選課那些內容包括較多事實的學科，而不大選擇那些着重理論性的學科。

17 I find that I have to do enough work on a topic so that I can form my own point of view before I am satisfied.
我發現我要在一個課題上很用功，以致我能建立自己的觀點，才會感到滿足。

18 I try to do all of my assignments as soon as possible after they are given out.
我接到作業後，便儘快把它們做完。
19 Even when I have studied hard for a test, I worry that I may not be able to do well in it.
就算我在測驗前已好好地溫習，但仍會擔心自己可能考得不好。

20 I find that studying academic topics can be as exciting as a good novel or movie.
我發現研究學術性課題，如一本好小說或一齣好電影那樣能令人感到興奮。

21 If it came to the point, I would be prepared to sacrifice immediate popularity with my fellow students for success in my studies and subsequent career.
如果在同學中受歡迎會和在學業及未來事業上的成功有衝突時，我會放棄前者。

22 I restrict my study to what is specifically set as I think it is unnecessary to do anything extra.
我只閱讀那些特別指定的資料，因爲我認為沒有需要做額外的。

23 I try to relate what I have learned in one subject to that in another.
我嘗試把在某一學科中學到的知識與另一學科的聯繫起來。

24 After a class/lecture or lab I reread my notes to make sure they are legible and that I understand them.
下課後或實驗課後，我會把筆記重溫一遍，以確保它們清楚易讀及我能明白它們的意思。

25 Teachers/lecturers shouldn't expect students to spend significant amounts of time studying material everyone knows won't be examined.
老師是不該期望學生花太多時間去溫習一些人人都知道不會考的東西。

26 I become increasingly absorbed in my work the more I do.
我做事是越做越專心的。

27 One of the most important considerations in choosing a course is whether or not I will be able to get top marks in it.
當選科時，其中一個最主要的考慮因素是我能否在該學科中取得優異成績。

28 I learn best from teachers/lecturers who work from carefully prepared notes and outline major points neatly on the blackboard.
我學習時，若老師把講義和把重點整齊地寫在黑板上，我會學習得最好。
29. I find most new topics interesting and spend extra time trying to obtain more information about them.

我发现大部分新课题都是有趣的，而且会花额外的时间去加深我对它们的认识。

30. I test myself on important topics until I understand them completely.

我在重要的课题上测试自己，直至完全明白为止。

31. I almost resent having to spend a further three or four years studying after leaving school, but feel that the end results will make it all worthwhile.

我几乎为了中学毕业後还要花三、四年时间去读书而很不高兴，但想到最终的结果，便觉得这是值得的了。

32. I believe strongly that my main aim in life is to discover my own philosophy and belief system and to act strictly in accordance with it.

我坚信我人生的主要目标是寻找一套自己的人生哲学及信念，然後紧照着它而行事。

33. I see getting high grades as a kind of competitive game, and I play it to win.

我把取得高分视为一项競賽。我参与其中，並且要获胜。

34. I find it best to accept the statements and ideas of my teachers/lecturers and question them only under special circumstances.

我发觉最好接纳老师的意见和想法，並只在特別的情況下才向他們發問。

35. I spend a lot of my free time finding out more about interesting topics which have been discussed in different classes.

在不同課堂上討論过的课题，只要是有趣的，我都會花很多空餘時間去增加我对他們的认识。

36. I make a point of looking at most of the suggested readings that go with the lectures/class presentation.

大部份與課堂或研究報告有關的閱讀資料我都會認真去讀。

37. I am at polytechnic/university mainly because I feel that I will be able to obtain a better job if I have a tertiary qualification.

我入理工或大學讀書，主要因为我觉得大学畢業的資格能使我找到一份较好的工作。
38 My tertiary experience has changed my views about such things as politics, my religion, and my philosophy of life.
我的大專生涯改變了我對政治、自己的宗教及人生哲學的看法。

39 I believe that society is based on competition and schools, polytechnics and universities should reflect this.
我相信社會是建基於競爭之上，因此學校，理工及大學應反映這個情況。

40 I am very aware that teachers/lecturers know a lot more than I do and so I concentrate on what they say is important rather than rely on my own judgment.
我深信老師們比我識得更多，所以我較專注於他們認為重要的事上，多過依賴自己的判斷。

41 I try to relate new material, as I am reading it, to what I already know on that topic.
我嘗試把現在閱讀的新資料與那些在同一課題上已知道的聯繫起來。

42 I keep neat, well-organized notes for most subjects.
我大部份學科的筆記都是整齊而有系統的。
### ANSWER GRID FOR SPQ QUESTIONNAIRE

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### THANK YOU FOR COMPLETING THE QUESTIONNAIRE

1 - this item is **never** or only **rarely** true of me
2 - this item is sometimes true of me
3 - this item is true of me about **half the time**
4 - this item is frequently true of me
5 - this item is **always** or almost **always** true of me
APPENDIX E

CONSENT FORM
A Study into the Effects of Problem-based Learning on Students' Thinking and Learning

CONSENT FORM

Purpose

The purpose of this study is to examine the effects of problem-based learning on students' thinking and learning. The insight gained from this study will contribute to the theory and practice of this particular teaching/learning method.

Procedures

Both questionnaires and interviews will be used in this study. You are invited to complete the questionnaires at the beginning of, immediately and six months after the completion of the Clinical Education Techniques module. Some of you will be asked to participate in the follow-up interviews. The interviews will be held at a time and place convenient to you, and will be tape-recorded with your permission.

To maintain confidentiality, student identification numbers will be used in the study and all the records will be kept in a locked cabinet. Upon completion of this study, the results will be submitted in the form of a thesis. Every care will be taken to ensure that the identity of individual is not revealed.

The rights of the participants

Participation in this study is entirely voluntary. There are no known risks to the participants. Whether you consent or not, this research study will not affect the assessment of your assignments. You may ask questions about this study and may withdraw from the study at any time without having to give an explanation.

If you agree to participate in this study, please complete the Informed Consent section below.

Informed consent

The purpose, procedures, rights of the participants, and intended use of the findings of this study have been explained to me. I understand that my participation in the study is entirely voluntary and that I may withdraw from the study at any time.

I wish to give my consent to participate in this study.

Signed ___________________________ Date ___________________________
APPENDIX F

APPROVAL OF THE UNIVERSITY ETHICS COMMITTEE
Faculty of Health and Social Studies
Review of Project for Human Subjects Ethical Issues

July 30, 1996

Memo to: Agnes Tiwari,

Your proposal

Developing student's critical thinking through problem based learning (#79)

has been reviewed for ethical issues and has been:

Approved.

Please report any untoward incidents or problems associated with the project to the Human Ethics ad hoc Committee.

If there are any major changes to the protocol, they should also be referred to the Committee for re-evaluation.

Yours sincerely,

Brian Brown PhD
Chairman
Ethics ad hoc Committee
APPENDIX G

EXPERIMENTAL GROUP:

THE PRETEST SCORES OF THE CCTDI SCALES

AND SPQ SUBSCALES
Appendix G

Experimental Group: The Pretest Scores of the CCTDI Scales and the SPQ Subscales

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T = Truth-seeking   O = Open-mindedness   A = Analyticity   S = Systematicity   M = Cognitive Maturity
C = Critical Thinking Self-confidence   I = Inquisitiveness   D = Deep Approach   A = Achieving Approach
S = Surface Approach
APPENDIX H

CONTROL GROUP:

THE PRETEST SCORES OF THE CCTDI SCALES
AND SPQ SUBSCALES
Appendix II

Control Group: The Pretest Scores of the CCTDI Scales and the SPQ Subscales

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                        S = Surface Approach    D = Deep Approach
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APPENDIX I

EXPERIMENTAL GROUP:

THE FIRST POSTTEST SCORES OF THE CCTDI SCALES

AND SPQ SUBSCALES
### Appendix I

**Experimental Group: The First Posttest Scores of the CCTDI Scales and the SPQ Subscales**

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APPENDIX J

CONTROL GROUP:

THE FIRST POSTTEST SCORES OF THE CCTDI SCALES
AND SPQ SUBSCALES
### Appendix J

**Control Group: The First Posttest Scores of the CCTDI Scales and the SPQ Subscales**

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- **D** = Deep Approach
- **A** = Achieving Approach
- **S** = Surface Approach
APPENDIX K

EXPERIMENTAL GROUP:

THE SECOND POSTTEST SCORES OF THE CCTDI SCALES
AND SPQ SUBSCALES
## Appendix K

### Experimental Group: The Second Posttest Scores of the CCTDI Scales and the SPQ Subscales

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APPENDIX L

CONTROL GROUP:

THE SECOND POSTTEST SCORES OF THE CCTDI SCALES
AND SPQ SUBSCALES
## Appendix L

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APPENDIX M

SEMI-STRUCTURED INTERVIEW QUESTIONS
Semi-structured Interview Questions

First Interview

1. Thinking back over the past six months, can you describe an incident in which your colleague's behaviour struck you as very professional (or very unprofessional)?
   Could you please elaborate?

2. Could you tell me about your views of the official report on the 'Carley Fire'?
   Could you please expand on that?

3. Now that you have completed the Clinical Education Techniques module, how do you feel about your learning experience?
   Would you explain what you mean by that?

4. Could you describe what you would do when you are faced with a problem?
   Would you explain that in more detail?

Second Interview

1. In your view, what do you think a good nurse should be?
   Would you like to elaborate on that?

2. At this stage of your programme, could you comment on your learning experience so far?
   Could you explain what you mean by that?

3. Could you describe what you would do when you are faced with a problem?
   Would you explain that in more detail?